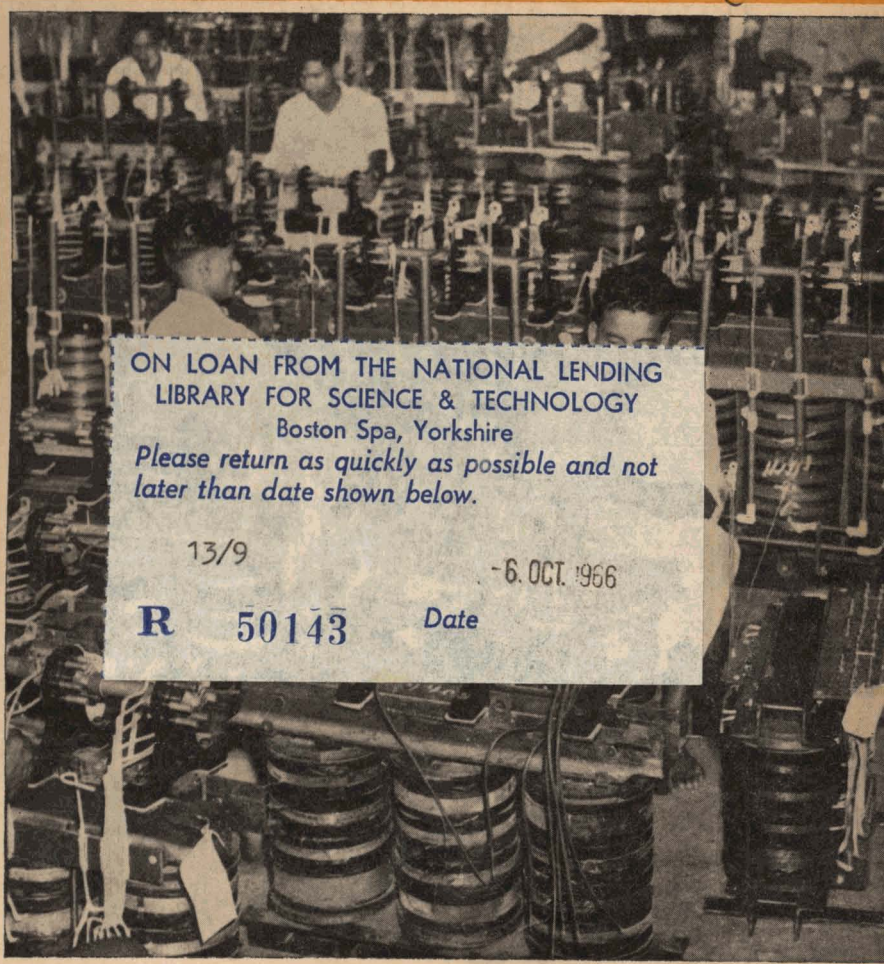
Journal of Scientific & Industrial Research

A — General



THE COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH, NEW DELHI

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Journal of
Scientific & Industrial Research

Vol. 17A, No. 1, JANUARY 1958

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COVER PICTURE

A view of the winding and insulating units of the Transformer Section of the Government Electric Factory, Bangalore. The factory is expanding its annual capacity for transformer production from 50,000 kVA. to 92,000 kVA. during the Second Plan period; the ultimate capacity of the factory proposed is 200,000 kVA. This is a public sector scheme for which a provision of Rs. 1·2 crores has been made in the Plan.

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SECTION C

Announcing

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with effect from

JANUARY 1958

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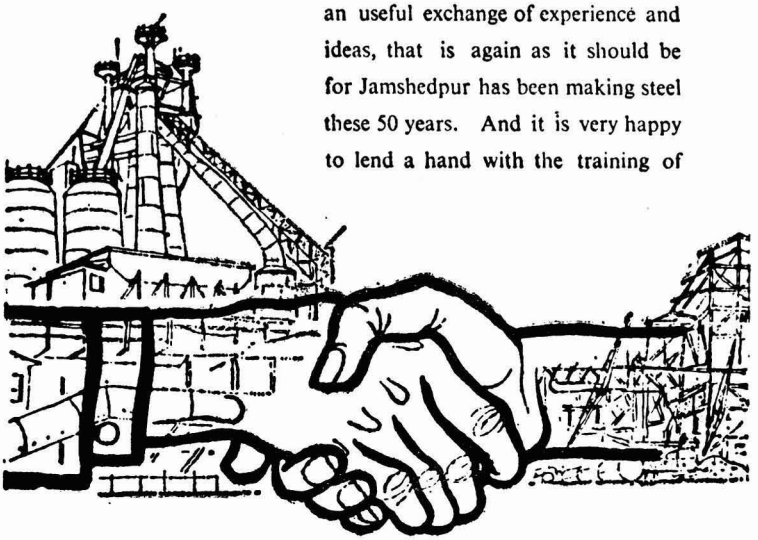
From a Neighbour

If there is a lot of comings and goings between Jamshedpur and Rourkela, that is only as it should be. Of all the steel plants, the one coming up at Rourkela is closest to Jamshedpur, India's first steel city.

If these comings and goings lead to an useful exchange of experience and ideas, that is again as it should be for Jamshedpur has been making steel these 50 years. And it is very happy to lend a hand with the training of



engineers and technicians for Rourkela. There are nearly 150 of them at Jamshedpur — from key personnel to artisans.

Good Wishes to Rourkela

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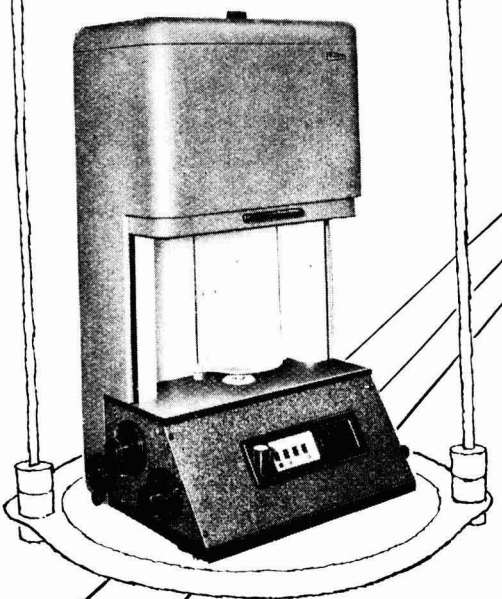

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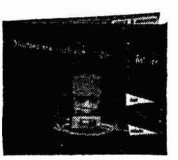

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INDEX TO ADVERTISERS

Science & Society*

THE convention, that the President of the Indian Science Congress should address the annual gathering of scientists, enjoins me to stand before you this afternoon, but while conventionally, the President elects to speak on a specialized field of science or technology, with which he is intimately associated, I propose to make a departure and address you on a subject which is not connected with my expertise, but which concerns us all and, at the same time, is in conformity with the main objective of the Association, namely " to advance and promote the cause of science in India ". I felt, and I felt strongly, that an opportunity such as this should be utilized for sharing with you my thoughts and musings, my dreams and hopes, on the basic requirements for the advancement of science as a whole. I am convinced that without addressing ourselves to what I may call the ' grammar ' of scientific development, our progress can at best be halting and our achievements, of a routine character.

It would be trite to say, today, in plan-conscious India, when the nation's endeavours are canalized to raise productivity and through it, the standard of living of the people, that the advancement of science and technology is a dire necessity. I am not a believer in slogans, but I cannot help giving expression to my conviction that without an abundance of science and technology and without establishing them on a self-perpetuating and exponentially expanding basis, I see little hope of progress. This may sound strong, but the writing on the wall is clear, thanks to the stupendous and far-reaching developments in nuclear fission and fusion and artificial earth satellites. We can ignore science and technology only at our peril.

What are our responsibilities, then, as scientists in the promotion and advancement of the cause of science in India ? We have been endeavouring, particularly since Independence, to expand facilities for teaching and research in science and technology, and while we have achieved during one decade much more than in many previous decades, I may be pardoned if I feel impatient and say that we have not done enough. The problems before us are many and the need for solving them is urgent. In the context of the developments which are taking place in other countries, our attempts appear to be feeble. If we have to make progress, the ' climate ' for science and technology must be made much more propitious, much more responsive, much more encouraging, and in this matter all of us have a responsibility.

From the vantage point of mid-twentieth century, we may take a peep into history to learn the nature of the causes which operated inexorably through the various epochs to give science and technology the dominant position they have come to occupy today. History teaches us that science and society inevitably act and react on each other with consequences to both. While the impact of science has always been to revolutionize the conditions and conventions of society, the latter tends to resist the changes. Science has progressed in those periods of history, and in those geographical areas, where society has not only acquiesced in, but has actually encouraged science and its applications. While there is a prodigious amount of literature, including fiction, on the impact of science on society, comparatively little appears to have been written on the role of society in the evolution of

*Presidential address of Prof. M. S. Thacker, Forty-fifth Session of the Indian Science Congress, Madras, 6 January 1958.

science. Most historians of science take science as the main theme for exposition and everything else as secondary consequences flowing from discoveries, but such treatment does not permit the examination of the social background which made possible the great developments which have made the present, the Age of Science and Technology.

Science came into existence at a comparatively late stage in man's history, long after religion, long after man had adapted himself to community living, and only after he had outgrown the anti-scientific tendencies and inherently false approaches of primitive cultures. It developed independently of the useful arts, but only after the social organization had created a class of thinkers with sufficient leisure and intellectual curiosity to inquire into and understand the world of Nature. The great founders of science sought intellectual satisfaction and no more, only theoretical, contemplative *Weltanschauung*. Practical applications of knowledge were not their concern. This disinterested desire " to know, to understand " has continued to be the main impulse actuating scientists in their discoveries from the ancient period down to the present day. It is stated that one of the rare occasions when Newton laughed was when a friend, to whom he had lent a copy of Euclid's *Elements*, asked him of what use or benefit in life the study of the book would be !

The possibilities of applying the method of scientific deduction for practical ends were recognized and demonstrated even in the heyday of Greek civilization, as for instance, by Archimedes, although they were not extolled or made much of by the scientists themselves. We know, on the authority of Virgil, that the seed of technology was sown at a comparatively early period in history. Due to the paucity of records in the preprinting age, a proper appraisal of the developments in the earlier periods has not been possible. The social environment from the time of the Italian Renaissance onwards became favourable for technological adventures in Europe, and great writers of the period acclaimed the importance of discoveries and inventions. It was during the Renaissance period that people in Europe threw off the yoke of Middle Ages and the restraining bonds of theology. The French Revolution found use for physicists and chemists and the New Republic ' hired ' them for systematizing weights and measures. In the age of the Industrial Revolution, the rule of aristocracy bowed down before the rise of the middle class. The practical applications of science gained emphasis over the disinterested pursuit of knowledge and social support for science became available. The rise of capitalist industrialism created a demand for inventions and the secular universities which came into existence gave a dominant place to science teaching and scientific research. The potentialities of science for catering to the material comforts of man came to be deliberately explored.

The march of civilization in the West since the nineteenth century has become inevitably bound with progress in technology. The tools and instruments which technology designed and fashioned are employed for probing more penetratingly into the realms of Nature; thus helped, scientific research has been producing results which technology utilizes to advance material civilization. Marching in step, and in resonance, science and technology have ventured into new horizons producing marvels of human ingenuity. The pace of development is so quick, that it has become difficult for any scientist to keep track of advances even in his own limited field. Discoveries of today become the nucleus of a new science of tomorrow. The two World Wars provided proving grounds for technological creations, and the world witnessed with surprise and dismay, the powers which science and technology have unleashed; they demonstrated, at the same time, in a most eloquent way, the possibilities of science for achieving peace and plenty and for making man's life rich and meaningful.

Science has emerged as a carrier of a new socialism, realistic in emphasis and rationalist in aim. In an astonishingly short period it has wrought radical changes in the patterns of industry and in the organization of science itself. The scale of scientific and industrial activity outgrew, long ago, the social institutions which gave rise to the Industrial Revolution. Research has come to be recognized as an industrial asset and invention, as an occupation of professionals. Laboratory research has found new meaning and new purpose.

It is not my intention today to discuss the implications of the achievements of science and technology in Western countries: my

purpose is rather to emphasize that social awareness and social support have determined the progress and direction of science. If history has a lesson, it is this: everything that sustains and progresses comes as an upsurge from within, not as a result of something imported or invited, from without. Nothing sustains unless it is *of* the people and *by* the people.

The present position

We started with the premise, which in the context of the present situation has the status of an axiom, that the rapid advancement of science and technology is a prerequisite for the development of the nation's material resources and economic welfare. We have emphasized the lesson of history that such advancement can come only when the efforts of scientists are backed by social support. On our innate ability to achieve results there can be no doubt; we are endowed with an abundance of natural resources and we have a rich wealth of human talent; we have the tradition for objective inquiry and acquisition of knowledge. Where we have lagged behind is in the application of knowledge to useful arts, and the establishment, through such application, of industrial production on a continuously progressive basis. While nothing is to be gained by deploring past neglect, the awareness it has engendered should spur us to action and promote science and technology boldly and with determination.

The need for improving industrial productivity has always existed; it has now acquired urgency. We have hitherto sought inspiration from outside. We have imported plant and machinery, know-how and expert assistance. Perhaps this has been necessary in the circumstances. The result has been that the larger mechanized industries of India are, by and large, those which have been developed in other countries. Those based on indigenous inventions are few and far between. In the context of the new socialistic trends which permeate western technology, a liberal amount of assistance may be forthcoming. We, no doubt, seek knowledge, wisdom and friendship from whatever source they are to be had, but like the bee gathering nectar from whichever flower it is available, and transforming it into honey which is entirely its own, we should adapt such assistance to our own needs and requirements, and evolve a pattern of industrialization which we can call our very own. This will be possible only if we succeed in developing science and technology. Scientists and technologists have thus a responsibility, challenging but meaningful and with potentialities of a great achievement.

The contemporary scientific scene in India is one of considerable complexity. On the one hand, we are faced with a shortage of personnel with specialized skills and on the other, we are confronted with fragmentation of science and the need for liberalizing the education of the scientist so that he may combine knowledge with wisdom, expertise with vision. We are witnessing the peculiar spectacle of technical men being weaned away to other walks of life; our universities and technological institutions are being depleted of their best teachers who find more gainful employment in Government departments and industrial establishments. Research results of proved value remain unutilized by industry, while the hunger for new processes and techniques continues unabated. All these may be signs of a fast developing techno-economy, but the problems are real and we shall be open to the charge, by posterity, of indecision and pusillanimity if we do not find satisfying solutions for them expeditiously.

The systematic promotion of improvements in production — agricultural, industrial, or otherwise — has created a continuously rising demand for the services of persons trained in a variety of skills and knowledge. While much has been done, and is being done, to train personnel, the real solution can emerge only when a serious effort is made to seek out all those who have the talent to profit by a scientific career. In a country richly endowed with human wealth, there can be no dearth of men and women gifted with curiosity and imbued with a passion for inquiry. The task is to stimulate these human endowments wherever they lie latent. No systematic ' talent search ' appears to have been so far undertaken on a nation-wide scale. No effort has been made to tend and nourish the talents, abilities and aptitudes of the youth and kindle their enthusiasm to the delight of learning, at first hand, something new about Nature. It is time that we thought of enlisting new colleagues among the youth to help explore science in its diverse aspects.

Each one of us should undertake, in a spirit of dedication, the task of mobilizing the untapped resources of the nation and guide the new recruits to the high adventure of discovery and invention.

The demand for personnel has outstripped the facilities available for training and has necessitated a re-evaluation of our training programmes. We need an increasingly large number of teachers and scholars, research scientists and engineers, doctors and public health specialists and persons equipped to manage, lead and venture into new enterprises. The process of equipping large numbers of men and women to undertake tasks with knowledge, competence, initiative and enterprise is a matter of vital concern. The levels of accomplishment called for must be achieved with the resources we have. Our academic institutions and research organizations must be husbanded with insight and imagination. We should initiate a system of interchange of scientists and specialists between universities and research laboratories on the one hand, and between these and industry on the other. I have, on many an occasion, emphasized the need for building up a system of exchange of personnel between organizations engaged in training and those concerned with utilizing personnel, not only for vitalizing individual institutions, but in the overall interest of inducting a sense of urgency into our programmes and achieving the targets demanded by the realities of the situation.

The tempo of the recruitment of scientific and technical personnel must be accelerated. This problem is urgent in the context of the dire need for the services of the all-too-scarce specialists — be they scientists, engineers or technologists — in national reconstruction tasks, for which the demand is large and the supply limited. We must determine the pattern of their deployment which would yield results from the point of view of both immediate and future requirements. Several Indian students with brilliant academic records have received or are receiving advanced training in laboratories and institutions in India. A large number of our young men and women are at present undergoing specialized training in various countries abroad. The placement of such personnel is engaging our attention. But our administrative procedures must be considerably simplified so that such personnel is absorbed in appropriate places as soon as their training is over.

We are also concerned with shortages which exist at the level of high intellectual talent. There cannot be enough talent at this level at any time, and shortages will always exist. A small percentage at this level would be in the genius category, and all that we can and ought to do is to create the ' climate ' under which geniuses uncover themselves.

I have often asked myself the question whether the conditions in which some of our able scientists are functioning are such as to get the best out of them. Too often we load the scientists with routine and other non-productive work. Our administrative machinery has not been designed to encourage just that ' out-of-the-wayness ' or ' idiosyncrasy ' of the scientist, which distinguishes him from the ordinary man, and guided by procedures and precedents, it tends to bring scientists and others into a common rigid steel frame. It is well to remember that scientists are not just the ordinary run of people. They are not normal, in the sense that they seek to do things which are out-of-the-ordinary and it is precisely such adventures that are rewarding. Administrative procedures, which perhaps are necessary elsewhere, may prove too cumbersome to the creative genius of the scientists.

Administration should recognize and respect the interests of scientists and permit them to explore the areas in which their talents lie. As Dr. Conant, President of Harvard, observed sometime ago, there is only one proved method of getting results in scientific research: picking men of ability, backing them heavily, and giving them freedom to pursue whatever path appears to them most promising. Science is a delicate plant, exacting in its demands and can thrive only in the warmth of encouragement and deference. Wise administration can go a long way, a very long way, in providing conditions which would enable scientists to give of their best to the nation.

Scientists should also recognize that besides contributing to the enrichment of different fields of research, they have also certain extra-mural responsibilities, as for example, in the training of personnel in its manifold aspects and in the creation of public understanding of science, which they should accept in a spirit of enlightened self-interest.

Too often we hear of lack of buildings, lack of equipment, lack of funds, and so on; what we really lack is the determination *to do*. Buildings and equipment do not make for scientific progress. I have often observed that quite remarkable work is turned out in plain simple laboratories, some of them even improvised and many not lavishly equipped or housed. A good many items of equipment can be designed and fabricated with available facilities without having to wait for import licences or provision of foreign exchange. We have to woo science with greater ardour, greater devotion and greater faith than hitherto, if our approaches are to be favoured and rewarded.

From whatever angle we survey the contemporary scene — personnel requirements, training of scientists, liberalizing education, or any other — we are impressed by the urgency for a deeper comprehension of the fundamental needs and for relating knowledge with action. Science, technology and invention are the most important elements for improving the material welfare of the people and their development is conditioned by social purposes and social support. Without such support, science and technology cannot find the means or the inspiration for development. Without a well-defined social purpose, the search for technological facts will degenerate into dilettantism; and all measures which we may formulate to promote science and technology in isolation, will prove inconsequential. The clear requirement, then, is to exert and spread the understanding of science among the people so that, assured of public support, we may move with freedom and explore the beneficent results which science and its applications make possible.

Social understanding of science

Penetrating minds have held the view that the consequential value of the scientific way of thinking transcends the material benefits which science has conferred on mankind. It is to the propagation of this sustaining value of science that scientists must address themselves. It is a big responsibility which can be discharged only when the scientists revise their 'ivory tower' attitude and recognize that their responsibility to society is no less important than their loyalty to science and that there is no conflict between the two.

Science is not merely thematics, that is, the study of certain subjects. It is study by a certain method which emphasizes observation and experiment, reasoning and deduction, a method based on facts, their sequence and relative significance. The scientific method enjoins one to be critical of all things and accept only facts which are amenable to verification and test. It has a place as much in the education of the scientist and technologist as of the craftsman and citizen, whether he be employed in a skilled or unskilled job, in agriculture or administration.

Everyone longs, in a vague sort of way, for an understanding of science, and this has to be satisfied, not by providing bits of information, but by making him aware of the basis on which science rests, the method by which rational knowledge is gleaned. The real danger to education is to mistake the provision of information for the imparting of knowledge. It is easy to acquire strands of information from diverse sources, but that does not help in understanding science. The greatest common factor of all sciences is the method; and the mind that has been trained in the scientific method and habituated to form judgements on the basis of facts, their relative sequence and significance, converts all that passes through it into science. It is such a mind that is best equipped to meet the challenge of change in a dynamic and forward-looking society.

The educational task involved in promoting the understanding of science is a gigantic one, but all the attention that is devoted to it and all the effort expended on it will prove most rewarding. A primary requirement is to dispel the popular conception that science is some sort of a superdiscipline practised by specially trained people using very complicated precision instruments. This incorrect, if exalted, view of science has tended to separate the scientist as a class from the people. Science is a very human enterprise and is basically a methodological approach to understanding. The best way to obtain an insight into the method and to acquire the habit of dispassionate thinking is to take a live interest in some small area of natural phenomena. The material for science is co-extensive with the whole physical universe and there are many problems which are amenable to investigation by tools and techniques which are

ordinarily available to the layman. I may mention, as instances, observations relating to weather phenomena, variable stars, bird migrations, distribution of plants and animal species and minerals. The opportunities for study are limitless and the whole book of Nature is open to those who possess an inquiring mind and are acquainted with the alphabet of science. Science has room for everyone for all time, and it stands to gain by mass-participation in its work. Mendel, Darwin and many other names that adorn the book of discovery were amateur scientists.

I have referred to amateur science as one of the means of spreading an appreciation of the scientific method. There are, no doubt, other means open, which can be worked out by scientists and educationists working in concert. The important thing is to stimulate interest in enquiry among the people as a whole, particularly among the children, and no effort should be spared to attract the youth to the vast field of science; it is to the youth we look for promoting the resurgence we are striving for.

The ' climate ' for this great educational task has become particularly favourable since Independence. The nation is, as it were, in a ferment and unprecedented enthusiasm for economic reconstruction permeates all sections of society. Craft-centred instruction has become the pattern for primary education throughout the country and a bias for practical and social values is being inculcated, along with the teaching of the Three R's, from the earliest stages. The Five-Year Plans are bringing goals and targets into the picture, and working to a time schedule to attain predetermined objectives has become the economic philosophy of the nation. The introduction of the national calendar, the decimal coinage, and the metric weights and measures has brought in new systems and standards in social transactions. A new order geared to progressive ideals and ideas is coming into existence. The ground has been prepared for the spread of the understanding of science and through it, the spirit of inquiry, the critical habit of mind, and rationalist approach to practical affairs.

The duty of scientists in promoting the public understanding of science assumes importance in the context of the newer Promethean creations of technology, which are being released in breathless succession. Francis Bacon stated that " God has placed no limits to the exercise of the intellect He has given us on this side of the grave ". Bacon envisaged the exercise of the intellect only for the emancipation of man. The newer developments, from the point of view of knowledge gained, have extended the glory of man, but they have inculcated, at the same time, a fear of knowledge which has potentialities for more harm than good. In this situation of uncertainty and doubt, safety lies in the collective social wisdom, for it alone can determine the direction of technological applications and can hinder or nullify injurious experimental ventures.

The task before us

If our faith in science and technology as a promoter of public good is sincere, then our clear duty is to create those conditions which will permit us to pursue science and promote its applications. The lesson of history and the requirements for scientific progress all point to the need for promoting the public understanding of science, and it is to the creation of this understanding that we should dedicate ourselves. Our success will be determined by our sincerity and zeal, and in tackling a problem of this magnitude, we should act collectively as disciplined armies, not individually as ' guerilla ' fighters. Scientists, engineers and technologists must willingly and gladly shoulder this responsibility. Let us get together without loss of time, formulate programmes of action, and strive forward with all the zest and zeal at our command, to achieve the desideratum for progress.

The finances required for the overall progress in science will no doubt be large, but no impassioned plea is called for, to convince the people of this great country that development is possible only through science. Our resources are perennial, and if we reckon even at one rupee *per capita* which is less than half of one per cent of the national income, we should be able to find funds within our own means and resources to make a headway.

Scientists and technologists in India occupy a position of trust, and the country as a whole avidly awaits the benefits that stem from their work. Our Prime Minister, Shri Jawaharlal Nehru, has, time and again, stressed the important role which scientists and engineers have to play in the reconstruc-

tion of India and has made appreciative references to their work. We should not allow this sense of importance to lull us into complacency. Let us remember that we are on the threshold of an era of great and revolutionary changes in our land. It is not every generation that has the challenging opportunity to serve the motherland.

Most of this onerous responsibility will devolve on the shoulders of the younger generation and it is to this generation we look for leaders and the rank and file of builders of resurgent India. I take this opportunity to appeal to the youth of this country to rise to the occasion and equip themselves for the tasks of tomorrow. It has been a great blessing to us that, in our Prime Minister, we have a stalwart champion of the cause of science, and all of us can set about our tasks with the firm conviction that we enjoy his invaluable support in our endeavours.

Abstracts of Research Papers

THE NEED FOR A BIBLIOGRAPHICAL SERVICE covering papers published by research workers in India has been emphasized by the readers of the *Journal* from time to time. In response to this, a beginning was made in April 1952 by publishing, under the *Notes and News* section of the *Journal*, a list of titles of research papers appearing in Indian periodicals. This service was welcomed, but it was pointed out that the list should include papers published in foreign periodicals also, and that the scope of the service should be enlarged to include informative abstracts. This is obviously a task beyond the purview of the *Journal*. At the same time, it is clear, that something more than a mere listing of titles or papers is called for.

A detailed consideration of the question has led to the conclusion that the *Journal* could appropriately and usefully undertake the publication of abstracts of papers emanating from national laboratories and sponsored research projects of the Council of Scientific & Industrial Research. This would not only help in maintaining a record of the research output of the Council, but also bring to the notice of research workers the results of investigations carried out under the Council's auspices and published in various periodicals within and outside the country. Accordingly, it is proposed to issue, commencing from January 1958, quarterly supplements to the *Journal* containing abstracts of papers, classified under broad subheads.

The first number of the supplement appearing in this issue carries abstracts of papers published during July-September 1957. The next supplement will appear in April 1958, and will include abstracts of papers appearing during October-December 1957. The supplements will carry continuous page numbers and an annual index will be issued along with the index of the *Journal*. It is hoped that the publication of the abstracts in the present form will meet the requirements more adequately than the bibliographical list which was being published hitherto.

Indian Calamus: Its Scope in Modern Therapeutics

I. C. CHOPRA, K. L. HANDA & B. K. ABROL
Drug Research Laboratory, Jammu

ACORUS [*Acorus calamus* Linn. (Sweet flag); Sans.–*Vacha*; Arab.–*Vaj*; Pers.–*Agar*; Hindi and Bengali–*Bach*; Mar. and Guj.–*Vekhand*; Tel.–*Vasa*; Tam.–*Vasambu*; Kan.–*Bajegida*; Mal.–*Vavambu*] is a small genus of herbs, comprising two species found in the north temperate regions and south-east Asia. *A. gramineus*, a Japanese species, is occasionally met with in Sikkim up to an altitude of 6000 ft. and in the Khasia Hills (4000-5000 ft.). It is used for the same medicinal purposes as *A. calamus*.

A. calamus is a semi-aquatic perennial herb with creeping and much branched aromatic rhizome, cylindrical in shape, light brown or pinkish brown in colour and white and spongy within. The plant is found growing wild throughout India and Ceylon, ascending to 6000 ft. in the Himalayas; it is also frequently cultivated. It thrives best in marshy places and moist areas such as edges of lakes and banks of streams. It is plentiful in the marshy tracts of Kashmir and Sirmoor, in Manipur and the Naga Hills.

The infusion of the dried rhizomes is used as an aromatic bitter tonic and carminative. It possesses emetic and anti-spasmodic properties, and produces beneficial results in cases of dyspepsia and chronic diarrhoea. In doses of 35-40 gr. it produces a violent and persistent emesis. It has an expectorant action due to the presence of the essential oil and is commonly used as a remedy for asthma. It is also used as a remedy for chronic diarrhoea and forms an important ingredient of a number of paragoric mixtures used in the Ayurvedic system of medicine. The rhizome is pungent, bitter, appetite stimulating and also useful in the treatment of epilepsy, delirium, hysteria and loss of memory. Evers[1] tried it in chronic dysentery with good results. In the indigenous system of medicine it is used in the treatment of infectious diseases of the chest and urinary tract, and for leucoderma. Because of the pleasant aromatic smell, the rhizomes are extensively used as aromatic agent in *agarbatties, dhups* and *havan samagaries*. It is also largely used to protect clothes from insect attacks and also to destroy houseflies, bed bugs and lice.

In the *Tibbi* or *Unani* literature the rhizome has been described to have a very bitter taste, and to be useful as a brain tonic and in general debility. It is reported to be beneficial in bronchial catarrh, hysteria, neuralgia and certain types of dyspepsia[2].

Lately the powdered rhizomes have been employed in combination with *Rauvolfia serpentina* and other drugs in the treatment of neuroses, insomnia, melancholia and hysteria. The essential oil obtained from the roots is used as an ingredient of flavouring agents, particularly for liquors. It is also used in perfumery.

Cultivation — The drug is cultivated in almost the same way as rice and may be grown in any part of the country where suitable irrigation facilities exist. It is generally grown in clayey loams and light alluvial soils of river banks. The planting material consists of live ends or tops of the previous crop of sweet flag. At harvest, the mature portion of the rhizome is cut off which forms the marketable crop and the tender portion formed by the growing end is used for replanting and propagation. The propagating material can be planted at once or stored for about a week by covering it with dry leaves or straw. If required to be stored longer this can be done in damp open pits. The best planting season is the spring (March-April), but the crop may be planted almost at any time of the year taking into consideration the fact that plenty of sun is available at harvest time. The fields are laid out exactly as for rice, irrigated sufficiently and after ploughing twice are watered heavily, again ploughed in puddle, left for a few days, and ploughed in puddle again. The fields are then levelled with the levelling board. According to Iyer[3] the field should be manured

with the leaves of *Pongamia glabra* Vent.; farmyard manure also is used for this purpose. The tops are trimmed by shortening the leaves at the end and pressed about 2 in. into the mud. These are planted in rows 1 ft. apart so that the plants in the second row come in between the plants of the first row and not opposite to them. The field is kept regularly irrigated and about 2 in. of water is left standing in the field in the beginning which is later increased to 4 in. as the plants grow. The field is carefully and regularly weeded. In all, eight weedings are given and at each weeding the growing plants are somewhat pressed down into the soil. After about a year the crop is ready for harvesting. The fields are allowed to dry partially so that sufficient moisture is retained to make the necessary deep digging easy. The rhizomes are cut into short lengths of 2-3 in. and all the fibrous roots are removed; the pieces are then washed thoroughly and dried in the sun. The dried material is put into rough gunny bags and rubbed to free them of leafy scales. The yield of rhizomes is about one and a half tons/acre and if the fields are carefully attended, almost double the yield is possible.

Experimental cultivation of the plant has been recently carried out in Bengal. Trials carried out in the Drug Research Laboratory, Jammu, by the authors gave promising results. The plants came up very well and the fresh rhizomes yielded 1·2 per cent of essential oil and the dry rhizomes 3·0 per cent.

Chemical composition — The rhizomes of the plants investigated by earlier workers were found to contain essential oil to the extent of 1·5 per cent, a bitter glucoside acorin and an alkaloid named calamin which was later found to be a mixture of methylamine and trimethylamine. Besides these the rhizomes contain high percentage of starch and tannins[4]. The fresh aerial parts yield 0·123 per cent oil; unpeeled roots give a higher yield (1·5-3·5 per cent). The fresh roots yield 0·4 per cent oil in spring and 1·82 per cent in autumn.

The yield and physico-chemical constants and consequently the composition of calamus oil depend upon the source from which the rhizomes are obtained. The rhizomes should not be peeled prior to drying because peeling results in considerable loss of the essential oil by evaporation and resinification. Highest yields of oil are obtained from dried unpeeled rhizomes that have been granulated immediately before they are charged into the still. Unpeeled dried European calamus roots are reported to yield 1·5-4·8 per cent oil whereas the Japanese material yields up to 5·0 per cent oil[5]. The roots of American origin yielded 3·4 per cent of essential oil, the Indian roots growing in the plains and foot-hills 3·1 per cent, and those growing in Kashmir valley not more than 1·4 per cent.

The characteristics of the oil obtained in different countries are given in Table 1.

The European and American oils are similar in composition, consisting of 5-10 per cent of asarone, terpenes, camphor, eugenol, calamene, calamenol and hydrocarbons. Indian oil, on the other hand, contains up to 80 per cent asarone, calamenol, calamene, eugenol and very small quantity of terpenes. The characteristic odour of the oil is ascribed to an unidentified constituent (b.p. 125°-35°/11 mm.)[7].

TABLE 1 — CHARACTERISTICS OF CALAMUS OIL FROM DIFFERENT SOURCES[6]

	Source of oil					
	Europe	Japan	America	India		
				Average	Kashmir	Jammu
Sp. gr.$^{15°}$	0·959-0·972	0·973-1·023	0·95-0·974	1·076	0·971	1·0561
Optical rotation	+0·09° to +31°	+7°23′ to 26°30′ (in a few cases −5°36′ to −11°25′)	+13°48′ to +15°	−1°30′	+14°	+2°
$(n)_D^{20°}$	1·5028-1·5098	1·511-1·528	1·5013-1·5069	1·5461 at 30°	1·5036	1·5540
Acid number	Up to 3·7	Up to 2	—	2·4	2·24	0·14
Sap. val.	4-18	2-8	8·4-10·7	4·1	12·7	14
Sap. val. after acetylation	32-50	15-34	—	15·7	58	18·2
Solubility	Clearly miscible with 90% alcohol almost in any proportion	Sol. in 1 vol. of 90% alcohol and 1-10 vol. of 80% alcohol	Sol. in 0·5-5 vol. of 90% alcohol	—	Miscible with 90% alcohol	Same
Methoxy content	—	—	—	—	2·28%	40·55%

The oil from rhizomes from Jammu area resembles generally the oil from other sources of India and consists of palmitic and butyric esters, eugenol, isoeugenol, asarone, a hydrocarbon, calamol and azulene. The oil obtained from the rhizomes growing in the temperate climate of Kashmir valley approached the oil of European origin in composition, consisting mainly of palmitic acid and its ester, heptylic acid, eugenol, butyric ester, L-pinene, camphor, calamene, hydrocarbon, calameone, azulene and asarone[8].

Pharmacological action — Pharmacological studies on calamus oil showed that the oil and its fractions possess carminative properties. In moderate doses the oil produces an anti-spasmodic action on the involuntary muscle tissue, inhibiting the excessive peristaltic movements of the intestines. The effect of the oil on the cardio-vascular system is not marked. It has a stimulant action on the central nervous system and mild clonic convulsions are observed in guinea-pigs. Toxicity studies showed the LD 50 of the oil to be 0·0275 ml. per 100 g. body weight for guinea-pigs. When given in sub-lethal doses to guinea-pigs for 6 weeks the oil did not produce any obvious toxic symptoms[9].

The essential oil-free alcoholic extract of the rhizomes was found to possess sedative and analgesic properties and caused a moderate depression of blood pressure and respiration[10]. The extract showed no significant anti-epileptic activity. In the case of albino rats slightly higher doses than those mentioned by Agarwal *et al.*[10] were required to produce marked sedative effects. These potent sedative and analgesic effects appear to justify its historical use in the Ayurvedic system of medicine for various mental diseases of an excitable nature. The water-soluble fraction of the de-alcoholized extract relaxed the intestines and caused negative inotropic action on frog's heart.

Antibacterial properties — The oil from roots collected from Jammu showed marked anti-tubercular action on *Mycobacterium tuberculosis* var. *hominis* in *in vitro* studies, inhibiting the growth in a concentration of 10 μg./ml. It inhibited the growth of *Sh. dysenteriae* Shigae in a concentration of 0·4 mg./ml., of *Vibrio cholerae* Inaba, *H. pertussis* and *D. pneumoniae* in a concentration of 0·6 mg./ml. The oil did not show any activity against *M. pyogenes* var. *aureus* and *Strept. pyogenes* in a concentration of 1·0 mg./ml. *Paramecium caudatum* is killed by the oil at a concentration of 1 mg./ml. in a few seconds and in about 5 min. at a concentration of 100 μg./ml.[11]. The oil obtained from rhizomes collected from Kashmir valley was not as effective as the oil from Jammu area. A concentration of 400 μg./ml. was required to inhibit the growth of *M. tuberculosis* var. *hominis* and the growth of other Gram-negative and Gram-positive organisms was not effected by even as high a concentration as 1·0 mg./ml. This indicates that the oil obtained from Jammu calamus plants is about 30-40 times as potent in this respect as that obtained from the Kashmir variety.

Insecticidal properties — Subramanyan[12] studied the insecticidal properties of the oil and found it quite effective against bed bugs, moths, lice, etc. Dixit *et al.*[13] found the solvent extracts and steam-distilled volatile oil to be toxic to flies and mosquitoes. In the same concentrations and dosages the petroleum ether extract was more effective against mosquitoes than houseflies and was more toxic than the kerosene extract. Like pyrethrum, the essential oil also possessed immediate knock-down activity and exhibited synergistic activity when compared with other insecticides. The toxicity of a mixture of DDT and *A. calamus* extract against houseflies was higher than the sum of the toxicities of these two individual insecticides. The petroleum ether extract was found to provide satisfactory protection to woollen fabrics against attacks by furniture carpet beetle, *Anthrenus vorax*. The effectiveness is, however, considerably lost when the fabric is washed, dry cleaned or stored for one month. The addition of methyl salicylate to the extract masks its odour without affecting its toxicity.

Insecticidal studies of the alcoholic and petroleum ether extracts of the rhizomes and various fractions of the essential oil were also carried out by the present authors. The efficiency of the extracts and the fractions was evaluated by means of a modified method described by Parkin and Green[14]. The test solution was atomized with the help of De-Vilbis aerograph spray gun into a wooden glass-fronted spray chamber of size $2 \times 2 \times 2$ ft. containing houseflies (*Musca nebulo*). After exposure the insects were returned to the holding cages for observation of the percentage kill in 24 hr.; a minimum of 3 replications

were tried. The alcoholic extract was altogether inert towards flies because even in 20 per cent concentration, it did not produce any mortality. The petroleum ether extract was, however, active, 1 ml. of a 10 per cent solution in deodorized kerosene oil causing an immediate knock-down and 24 hr. mortality of 28 and 38 per cent respectively towards houseflies. Double the dose of the same concentration gave an immediate knock-down effect of 50 per cent and 58 per cent mortality after 24 hr.

The oils obtained from rhizomes collected from Kashmir valley and Jammu province were studied separately, and marked difference was observed between the two. The oil from roots from Jammu area was almost twice as effective as that from Kashmir; 0·2 ml. of Jammu oil gave a quick knock-down effect and cent per cent mortality within 10-15 min. while the same dose of the Kashmir oil killed only 40-45 per cent of the houseflies after 35 min. exposure. There was little change in the mortality rate after 24 hr. in the two cases. In the same dosage, 0·1 per cent of total pyrethrins was equal in its effect to Jammu oil.

Attempts were also made to determine the fraction of the oil responsible for the effect. Fractions containing pinene, calamene and asarone were isolated and tested separately against houseflies, but none of these fractions was found to be as active as the whole oil itself.

The oil from Jammu contained a higher percentage of asarone than the oil from Kashmir. Asarone, therefore, appears to be responsible for the greater activity of the former. A 10 per cent solution of asarone in alcohol did not approach the whole oil in its toxicity. Two ml. of the solution knocked down 40 per cent of the insects within 30 min. The mortality after 24 hr. was only 35 per cent. Hence, of the 3 fractions asarone is the most effective though it has no comparison with the whole oil. Work on other fractions is in progress.

Conclusion

The Indian drug rhizomes differ considerably in chemical composition from the European drug. They yield nearly 3 per cent oil containing nearly 90 per cent of asarone (trimethoxy-hydroxyhydroquinone). Pharmacologically the oil is a good nerve stimulant and the essential oil-free alcoholic extract shows marked sedative and analgesic properties which justify its use in Ayurveda for various mental diseases. Antibacterial studies on the oil *in vitro* showed it to possess definite activity against *M. tuberculosis* and a number of pathogenic Gram-negative organisms. The oil, the alcoholic and kerosene extracts show marked insecticidal and insect-repellent properties against houseflies, mosquitoes and carpet beetle. The oil possesses immediate knock-down properties similar to those of pyrethrum and also exhibits synergistic activity. The oil is nearly twice as potent as the European oil and this substantiates the historical use of the drug in India for insecticidal purposes.

Acknowledgement

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REVIEWS

PHYSICS FOR SCIENCE & ENGINEERING by R. L. Weber, M. W. White & K. V. Manning (McGraw-Hill Book Co. Inc., New York), 1957. Pp. vii + 618. Price $ 6.75

This is a substantial volume of over 600 pages covering the basic ideas of Physics including Mechanics, Heat, Sound, Electricity and Magnetism, Light, and Modern Physics. A large page — double column — is adopted throughout, no doubt to facilitate, among other things, the insertion of certain illustrations. Discussion questions and problems are given in good measure at the end of each chapter, and care has been taken to adhere throughout to the proper use of significant figures in the numerical work and data.

As a guide for the teachers of First Year University Physics and as a source of interesting questions, the book is reasonably satisfactory, but the price and format — why does a double-column page always lose dignity? — will militate strongly against its adoption by students. Moreover, for the engineering or technical student the approach is not attractive, the emphasis being on the ' methodology ' of physics. In one or two places, indeed, the practical issues are overlooked. Thus, the orifice is shown as an illustration of Bernouilli's theorem for fluid flow, but the use and operation of the orifice for metering is not mentioned. In other places there is a tendency to give simply, or mainly, the mathematical derivations of formulae and expressions without adequate elucidation of the practical significance or physical meaning of the problems or results. Definitions, defining equations, units, laws and principles are, it is true, emphasized; and the number of systems of units to be considered by the student has been minimized. Nevertheless, one cannot but feel that the book has been written largely, if not entirely, for examination purposes. This objective is not likely to create a love of physics (or any other subject) yet this is surely what one ought to try to develop in a student. In a word, although the food is there in plenty, it is not attractively served up but with a good and experienced cook much may be achieved. The book is accordingly commended to teachers and lecturers: the discussion questions and problems are valuable.

J.W.W.

APPLIED METALLURGY FOR ENGINEERS by Malcolm S. Burton (McGraw-Hill Book Co. Inc., London, New York), 1956. Pp. 407 + ix. Price $ 7.50

This publication is one in the well-known series for metallurgical engineers by McGraw-Hill which contains such well-known textbooks as Barret's *Structure of Metals* and Kehl's *Principles of Metallographic Laboratory Practice*. As its title indicates, this book is intended to convey in an elementary fashion the basic principles and applications of metallurgy to students of other branches of engineering and broadly speaking, it can be stated that the book achieves its object in quite a good measure. Nevertheless, because of the very extensive ground which the book covers, the treatment has to be inevitably superficial and bound to be unsatisfactory, in part, to metallurgists.

The initial chapters are concerned with an elementary exposition of the structure of metals and alloys and their solidification, metallographic, X-ray and thermal methods of examination of structure, mechanical testing, equilibrium diagrams and related topics. Only one chapter is devoted to the production metallurgy of ferrous and non-ferrous materials. However, the processes of the shaping of metals and their joining are extensively covered and these chapters appear to be the best in the entire book.

While the treatment is on the whole critical and very clear, one could pick out a few instances of rather peculiar logic. As an instance, the discussion on the initiation of solidification during the freezing of a metal may be mentioned. Solid metals are essentially crystalline and a crystalline material can be distinguished from any random group of atoms only by the existence of a complete unit cell; the first formed ' solid ' has, therefore, to be at least a unit cell; otherwise the

name solid would be inappropriate. It is, therefore, difficult to understand how the initial solid can be anything other than a unit cell as argued by the author.

The numerous photographs are well chosen and enhance the value of this publication. The schematic drawings showing changes of grain size on hot rolling and the heating and mechanical working of steel on pages 240 and 242 are very clear and explanatory. Each chapter ends with a list of questions based upon the material discussed in the chapter. Some of the questions are excellent and would be helpful to any paper setter.

The book can be recommended for an elementary introduction to the study of metals and of their methods of application. It may not be useful to students of metallurgy, although the collection of pictures would be of great interest. Its value in India could perhaps be to the group of engineering graduates now drafted to Government metallurgical plants, for an exposition of the principles of metallurgical fabrication, although they may also find the publication costly.

E. G. RAMACHANDRAN

JETS, WAKES AND CAVITIES by Garrett Birkhoff & E. H. Zarantonello (Academic Press Inc., New York), 1957. Pp. xii + 353. Price $ 10.00

The need for bringing out comprehensive books on various topics in applied mathematics and mechanics has been felt by those interested in the advancement of engineering science. Such books not only lead to rapid advancement of technology but also, as a reaction, produce a great impact on research in basic sciences. It is, therefore, a matter of great satisfaction that two mathematicians have brought out a source book on jets, wakes and cavities, which is the second volume in the series of monographs being prepared under the auspices of the Applied Physics Laboratory of Johns Hopkins University.

Physically, the problems of jets, wakes and cavities have intrigued all experimenters. The applications in science and technology are too numerous to be mentioned. We come across them everyday in fountains, faucets and jets. Mathematically, it is a free boundary problem, in which the direction of velocity is known on the fixed boundaries and its value on the free stream lines, which are unknown curves. These prove sufficient to specify the flow completely. But from both points of view we cannot say that a unique and meaningful solution can be obtained. In some cases the problem admits of more than one solution.

Chapter I gives a résumé and definition of a number of physical quantities. In representing the velocity vector as a positive gradient of the velocity potential the well-established convention has not been followed. It is shown how the application of Bernoulli's equation and laws of conservation gives a number of important results. For a Borda tube C_c, the contraction coefficient is readily obtained as $\frac{1}{2}$.

The major part of the book (Chapters II-XI) is devoted to the discussion of flows with free boundaries by the oldest and most successful tool of the hodograph method. In Chapter II cavities behind plates and wedges, and jets from funnels and against plates are treated. The calculated values are found to be in good agreement with experimental ones. Chapter III deals with flows past wedges, re-entrant jets and the classification of flows. Chapters IV and VI contain discussion of general theorems including Schwarz reflection principle and those of existence and uniqueness. Chapter IX gives effective methods of computation used by the authors. Mark I calculator at Harvard, Mark II computing machine at Dahlgren, Virginia, IBM machine at Naval Ordnance Laboratory have all been used.

Axially symmetric flows, of which swirling flow is an important example, are given in Chapter X, while Chapter XI gives examples of unsteady flows. The effect of viscosity is taken into consideration in Chapter XII in which boundary layer separation and wakes are discussed. Chapters XIII and XIV deal with periodic and turbulent wakes and jets. In the last chapter experimental facts are given which the present methods are unable to explain. It should be of great help to workers in this field. The book ends with a bibliography of 91 items and eleven plates.

No account is given of formation of cavities in non-Newtonian fluids. In a recent paper (*Proc. First Congr. Theo. & appl. Mech.*, 1955, *India*, pp. 205-12), Jain has obtained the interesting result that if a cavity is produced in such a liquid it cannot be destroyed. Detailed account of other methods like that

of Shiffman, who uses Schwarz reflection principles, is also not given.

The authors have produced an excellent source book for applied mathematicians, physicists and engineers. It contains a number of their own important contributions to the subject. All engineers may not like its rather concise and rapid mathematical treatment, but even they will profit by knowing the advances that have been made in the theoretical treatment of the subject.

B. R. SETH

SERIES ON ELECTRONIC TUBES — BOOKS XI, XII AND XIII AND TUBE SELECTION GUIDE, 1956-57 [Philips' Technical Library, N. V. Philips Gloeilampenfabrieken, Eindhoven, Netherland; *Distributors in India*: Philips Electrical Co. (India) Private Ltd., Bombay]

Philips' Technical Library series continues to be enriched with periodical additions of useful and practical publications on items of interest and current use in the electronic field. It may be said, they generally describe the Philips products but these publications go much farther than a mere description of products.

The general notes and introduction which precede the specifications are very clear and concise, and generally describe the fundamentals of the design and operation of the product followed by worked out examples and circuits where necessary. All these aid the user in utilizing the product intelligently and also tell him the 'whys' and 'wherefores' of their use.

Book XI in the series on Electronic Tubes titled *U.H.F. Tubes for Communication and Measuring Equipment* (pp. ix + 62, price Rs. 5) describes five types of tubes for operation from 300 Mc/s. to the decimetre and centimetre ranges. The description and specifications are accompanied by typical practical circuit designs and illustrations.

In this particular book one notices that there has been a slip in the thoroughness with which almost all publications of this series are produced. On page 11, where a circuit diagram of the H.F. section of a receiver for 300-400 Mc/s. is given, there are a number of mistakes in the description below the diagrams (a) and (b). For example, the description states that R_2 and R_7 are of 100 ohms in the cathode circuit. The cathode resistors are R_1 and R_3. Actually R_2 is in the anode and there is no R_7 at all. There is a reference to R_5 and R_{11} as anode resistors. R_2 is shown as the anode resistor and there is no R_{11}.

At the end of the book three standard noise sources are described. The introduction gives in brief the fundamentals and definitions of noise, noise factor, etc. Here again unfortunately there are quite a few typographical errors in the formulae which could have been easily avoided.

Book XII, Tubes for Computers (pp. ix + 53, price Rs. 5) describes tubes for high and low speed computers. The general notes on computer circuits are clear and concise and are very handy for reference on binary systems, cascade circuits, decade and free running multivibrators and gate circuits.

The paragraphs on special requirements for these class of tubes are particularly valuable to the circuit designer.

Characteristics of four special tubes E90CC, E92CC, E88CC and E91H with a minimum guaranteed life of 10,000 hr. for reliable operation have been given. Typical circuits of their use in decade counters up to a counting rate of a million including parts list, photographs and other constructional details are also described. For compactness and neatness printed circuitry has been adopted in the experimental counters. A directly readable decade tube, the E1T, which is similar in principle to a cathode-ray tube in its operation, is described. Two cold cathode tubes for low speed counters, the Z50T and Z70U, are described, and the circuit of an experimental decade counter for counting up to 3000 pulses has been given. Since the circuits for counter stages are very similar to each other they lend themselves easily to the construction of plug in units. These can be conveniently manufactured in large numbers.

Industrial Rectifying Tubes (pp. x + 116, price Rs. 8.75) is the thirteenth in the Philips, Technical Library series prepared by the members of the Philips Electron Tube Division. It runs to type. Out of 116 pages 62 are devoted to a very clear and succinct description of the principles of operation of rectifiers, their life, efficiency and proper method of installation followed by ratings. The next section deals with battery chargers and their design considerations which include the choice and design of components such as transformers. It is very thoughtful

of them to have included the essential components as well, since the efficient working of chargers depends on the proper design of the transformer. Illustrative examples have been worked out in detail to assist the reader in designing chargers for practical operation. The third section is on Industrial Rectifiers dealing with conversion of a.c. to d.c. of the high current low voltage type. Here too, typical examples of design have been given. Cinema and welding rectifiers are dealt with in the next two sections in a similar manner. Then follow technical data on 18 rectifier types made by Philips. At the end there is a tube selection chart as a convenient guide to the proper selection of tubes for any specific use.

Tube Selection Guide (1956-57) (pp. 124, price Rs. 5)—This guide lists the comprehensive range of receiving, transmitting, cathode-ray, industrial and microwave tubes manufactured by Philips by type numbers in seven sections. It does not attempt to give the characteristics in detail but only catalogues the various types. There is an interchangeability list wherein the type numbers of tubes made by American, United Kingdom and Continental manufacturers and their equivalents in the Philips range are given. This information is useful when any tube other than Philips has to be replaced by the Philips type. From this list it appears Philips makes tubes which are an exact or *near* equivalents to almost all the tubes manufactured by other valve manufacturers in the rest of the world. Then follows a list of preferred valve types, arranged according to the function of the tubes in tabular form which helps in quick selection for the type of application we have in mind, namely battery, a.c. or a.c./d.c. Some of the salient characteristics such as low μ or high μ, amplification factor, etc., are listed. Illustrations of tube bases come next. Tables giving details of construction of the different types of Philips tube sockets and shields are followed at the end by useful information explaining the designation systems followed in Europe and by RETMA.

Sections 3 to 7 follow a similar pattern for cathode-ray, transmitting, microwave and industrial tubes.

This little book will be very handy to the serviceman or engineer dealing in Philips products.

T. V. RAMAMURTI

CHROMATOGRAPHY — A REVIEW OF PRINCIPLES AND APPLICATIONS by Lederer & Lederer (Elsevier Publishing Co., Amsterdam, London, New York, Princeton; *Distributors*: Cleaver-Hume Press Ltd., London), 1957. Pp. xx + 171. Price 72*s*.

In this excellent production Lederer and Lederer have given a factual survey of the ever-expanding field of chromatography. This second edition retains the pattern of its forerunner in covering the whole range of techniques, equipment, basic principles and applications and results in 44 chapters under five main divisions, namely Adsorption Chromatography, Ion Exchange Chromatography, Partition Chromatography, and Chromatography of Organic and Inorganic Substances. For those familiar with the utility and usefulness of the first edition, the book needs no introduction and for those who want to get acquainted with the principles and practice of chromatography, this can be commended as an excellent guide. The versatility and richness of chromatography as an analytical tool which can be wielded with advantage and assurance, with precision and facility by the research worker are further testified to by the 3704 references included here, representing a 100 per cent increase from 1953. The present edition claims to include the literature up to September 1956. Thorough and painstaking as the attempt has been, omissions by oversight in a tremendous task of this magnitude are inevitable and pardonable. We can just point out to one such omission, relating to the work of Subramanian and Rao [*J. sci. industr. Res.*, **14C** (1955), 56-58], which contains a photograph illustrating the separation, perhaps the best achieved so far, of amino acids by bi-dimensional buffered paper chromatography using solvent systems developed by them.

Gas-liquid chromatography, an important development in recent years, is entitled to a separate treatment in its own rights. The authors have recognized this fact and have rightly excluded the subject from the present treatise except by way of drawing attention to a few relevant references.

To bring under one cover the widely scattered, voluminous and ever-growing literature in a dynamic field of science is no small task and is a positive help to those engaged in research in the allied field. This is especially true of chromatography which, with its wide

ramifications, is fast becoming, in a manner of speaking, a discipline in itself. Lederer and Lederer's task is a noble one truly done and places all those interested in the pursuit of chromatography under a real debt of gratitude.

M. SRINIVASAN

PAINT TRADE MANUAL OF RAW MATERIALS AND PLANT. Compiled by H. W. Chatfield (Elsevier Publishing Co., Amsterdam, London, New York, Princeton), 1956. Pp. xxxv + 282

This particular manual fills a specific want and is sure to be found an invaluable desk companion by all paint technologists and executives in the field. The information on raw materials, semi-processed and processed materials, equipment and plant is arranged in an alphabetical order and facilitates easy reference. No such compilation, other than the *Chemical Engineering Catalogue*, is known to have been made so far. The paint and the allied industries should find it an excellent guide for the purchase of raw materials, plant and equipment. It is always difficult for a paint technologist to obtain information on many raw materials such as an antioxidant, an antisettling agent, an antistatic agent or an antiwetting agent and this directory provides complete information on these including the types of products available, the names of suppliers, etc. Another important feature in this publication is the listing of all British and Indian specifications for paints and raw materials, besides the specifications of paints of the Royal Dutch Shell Group.

Of course, the publication is not without some glaring errors. For instance, on page 176, the following resins are listed as products of *Chemische Werke Albert* of Germany: Synresate 16Z N, Synresin Z41 N, Synresin 241 N, Synresin 308 V, Synresin 331 W, while these are the products of *Chemische Industries Synres N.V.*, Holland. Again, on page 177, Albertol 503 V is described as an *ICI* product, whereas this is a product of *Chemische Werke Albert* of Germany. Similar errors are observed on page 179 also.

These errors are, of course, not such as to minimize the eventual importance of the directory which will certainly be an excellent vade-mecum for all those connected with the paint and allied industries.

R. V. RAGHAVAN

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NOTES & NEWS

Solar-powered rockets

EXPERIMENTS AT THE AIR FORCE Research Centre, Cambridge, Mass., undertaken to assess the practicability of a ' solar rocket ', powered by the chemical energy of matter in the atmosphere, above a height of 60-70 miles from the surface, have shown the feasibility of such a rocket.

In the ionosphere the energy (radiation) from the sun continuously breaks down molecular oxygen (O_2) into atomic oxygen and maintains it in that form. The driving power for the rocket would come from heat released by the recombination of atomic oxygen. The recombined molecular oxygen expelled from the rear will be again continuously broken down by the solar energy and the heat release can be made to occur in a kind of chain reaction. A catalyst is needed to effect the recombination efficiently. The test rocket which would be mostly hollow, can scoop in all the highly rarefied air encountered by it in its path. Atomic oxygen in the air would hit baffles coated with a catalyst releasing heat which would be converted to power by a heat exchanger. The air would be expelled from the rocket's rear. This system may give velocities as high as 18,000 m.p.h. Some promising catalysts have been found out. It is suggested that the rocket may be sent up in collapsed condition within an Aerobee-Hi rocket, and then expanded after its booster has reached a height of 65 miles when the latter would drop off.

The feasibility of harnessing the above principle for powering rockets was demonstrated for the first time in experiments (started in 1956) in which 18 lb. of nitric oxide dumped by a rocket into the high atmosphere produced, under the above process, a shiny burst of light equal to 1 million candle power in the sky. If such a rocket were successful, it could lead to an economic way of maintaining a low-altitude earth satellite from which observations on the upper atmospheric conditions can be made for prolonged periods [*Sci. Newslett., Wash.*, **72** (1957), 20].

Atomic lamps

THE UNITED STATES RADIUM CORPORATION, New Jersey, have developed a new line of ' atomic lamps ' called ' Isolites ' which provide power-free, uninterrupted illumination up to 10 years. Production models of these lamps have been recently exhibited at the Trade Fair of the Atomic Industry in New York's Coliseum.

The lamps, now available in a variety of design configurations and colour emissions, are designed to meet a diversity of signal and marking applications and utilize radioactive krypton^{85} gas. Light sources are made up of specially processed phosphor crystals, enclosed in a hermetically sealed transparent capsule and excited to luminescence by the gas [*News Release from United States Radium Corpn.*, 28 October 1957].

Nobelium

THE NEW SYNTHETIC ELEMENT 102, nobelium, has been made in the laboratory by bombarding rare isotope curium 244 with highly accelerated carbon ions. About 50 atoms, identified by their chemical behaviour in a ' standardized zeocarb resin column ', have been obtained. The element is reported to have an atomic number of 253. It is very unstable, having a half-life of about 10 min. When nobelium decays, one way by which it was identified, it emits alpha particles [*Sci. Newslett. Wash.*, **72** (1957), 35].

Crystal elasticity

RECENT INVESTIGATIONS BY Laval, Le Corre, Raman and his associates and by Wooster indicate that the classical theory of elastic properties of crystals which assumes that the stress tensor is symmetric is not applicable to crystals of all classes of symmetry and a new theory based on a non-symmetric stress tensor is required to explain the behaviour of some types of crystals.

On the classical theory, the equilibrium of a cube within a body at rest, which is subjected to any given set of mechanical stresses, is maintained solely by the forces acting normally or tangentially to its surfaces. If one edge of the cube is supposed vertical, then, the tangential forces act on the vertical face and, in equilibrium, the couples due to the tangential shear stresses acting on these faces just balance. The new theory denies the adequacy of this statement and asserts that ' volume-couples ' can exist which must be balanced by the difference between the couples which were assumed to be equal and opposite in the old theory. Regarding the deformation experienced by the cube, the old theory assumes that all net rotations of the whole body, so far as its elastic deformation is concerned, may be regarded as irrelevant, while the new theory denies this and emphasizes that the deformation can only be adequately described by taking into account any net rotation which may be caused by the stresses. The number of elastic constants on the new theory is increased, e.g. in the triclinic system from 21 on the classical theory to 45 on the new theory.

A mechanical model which demonstrates how volume-couples of the kind envisaged in the new theory can arise has been constructed successfully. In this model, without being inconsistent with symmetry considerations or the arrangement of atoms, the movement of selenium atoms is arranged to be in the nature of a spiral.

If the spiral nature of the atomic distribution is ascribable to the breakdown of the classical assumptions, then it will be clear that in centro-symmetric classes and in those classes having planes of symmetry except where the rotatory effects are not mutually destructive, the old theory can apply. But in the eleven enantiomorphous classes and in the *m*, *mm*, $\bar{4}$ and $\bar{4}2\,m$ classes of crystals where the symmetry elements produce not more than two non-parallel groups of spirals of opposite hands, the new theory only can apply. Ammonium dihydrogen phosphate, $[(NH_4)H_2PO_4]$, is an example of a crystal of class $\bar{4}2\,m$.

Experimental support of the validity of the new theory for the class of crystals mentioned above was also obtained from observations on the Bergmann-Schaefer diffraction patterns using ultrasonically vibrated crystals of ammonium dihydrogen phosphate

and quartz. The results showed that the mechanical transverse wave having a vibration direction lying in the *bc*-plane has a different velocity according to whether it vibrates along *b* or along *c*, the difference of 17 per cent far exceeding the experimental error. These velocities should be the same according to the classical theory. The piezoelectric properties of quartz afford further support for the validity of the new theory for this class of crystals. While the old theory and the classical experiments envisage that no charge should be liberated by any application of stress, Le Corre has shown that a charge is developed on the plane perpendicular to the optic axis when a torque is applied along the optic axis [*Nature, Lond.*, **180** (1957), 430].

Specific heat of solids at low temperatures

A RE-EXAMINATION OF THE TEMperature dependence of the specific heat of solids at very low temperatures using theoretical models and certain recent experimental results has been undertaken at the National Research Laboratories, Ottawa. The general conclusions resulting from the theoretical study are: The temperature region over which the continuum approximation ($C_v=aT^3$) is strictly reliable is shorter than has generally been supposed and the series expansion $C_v=aT^3+bT^5+cT^7+...$ is needed for the analysis of accurate experimental results. For insulators θ_o can best be estimated from measured specific heats by plotting C_v/T^3 vs. T^2; the result is a curve whose intercept at $T^2=0$ gives the coefficient of T^3 (and hence θ_o), and whose slope and curvature give additional information about the vibrational spectrum at low frequencies. For metals the usual plot of C_v/T vs. T^2 can be used, but here again, neglect of curvature may lead to errors in the estimates of γ and θ_o.

The study also includes a brief discussion of the individual results in the case of a few specific substances for which suitable data are available like potassium chloride, lithium fluoride, white tin, tungsten, noble metals, and elements of diamond structure [*Canad. J. Phys.*, **35** (1957), 799].

Units of time and length

SOME CONSIDERATIONS WHICH should be kept in view in defining and measuring practice of the units of time and length have been set down by L. Essen of the National Physical Laboratory, Teddington, England [*Nature, Lond.*, **180** (1957), 137]. These considerations arise out of the use of the atomic standard of frequency to define the unit of time.

The concept of an ideal invariable unit of measurement does not seem necessary, though it is occasionally useful. It is, in fact, preferable to restrict the term 'unit' to practical quantities, so chosen that they can be regarded as constant for most purposes, in terms of which the results of measurements are expressed. But if the precision of measuring a quantity in terms of the appropriate unit is equal to or greater than that with which the unit itself can be defined, then the possibility of variations of the unit must be considered. In such a case, the quantity which can be measured with higher precision can be used for defining a more precise unit. For example, though both the atomic and quartz standards established variations of the mean solar second, the latter is unsuitable for defining a more precise unit. The time scale of U.T. 2, employed since 1957, reduces, with suitable corrections, the rates of all the three, viz. pendulum, quartz and atomic clocks in terms of one unit, the U.T. 2 second. Though this unit of second can be considered constant for almost all purposes, careful labelling is necessary for the accurate interpretation of the experimental results of highly precise measurements.

From the laws governing the emission and propagation of electromagnetic radiation, a self-consistent system of units can be obtained only by choosing the unit of time so as to maintain the constancy of both the frequency of the radiation (ν) and the velocity of light (c). The only way of achieving this is to use ν to define the unit of time.

The non-availability of a practical technique for measuring the frequency of a light wave and the insufficient development, to the required degree of accuracy, of measuring the wavelength of radio waves (the frequencies of which can be measured for length measurement) make it inconvenient to adopt this ideal system. Dr. Huntoon and Dr. Fano suggested, in 1950, a system in which a radiation such as that of caesium line is used for defining the unit of time and the radiation of a suitable light source for defining the unit of length. This system is self-consistent so long as the ratio of the frequencies of the two radiations remains constant. The units of length and time are no longer independent in this system, the two independent quantities being ν and c. To define the units of measurement, of the three quantities concerned, any two can be given arbitrary values to preserve the existing values of the units within the accuracy with which they are known.

Two other problems are the difficulty of ensuring that two atomic clocks indicate the time in the same phase (epoch) and of ensuring continuity of operation. For this purpose, quartz clocks and astronomical measurements can be used together. Quartz clocks, directly controlled or monitored by atomic standards, provide a time scale, in steps of 10^{-5} sec., extending over periods of years; this is adequate for most physical measurements. For astronomical measurements and civil time, only time interval is important and epoch is of no significance. Epoch can be conveniently defined in relation to the position of the earth relative to the sun but the precision is limited. Any changes in the phase of the atomically controlled quartz standard which may be necessary to synchronize atomic and astronomical time can be noted and a continuous record of the relationship between the two systems can be preserved; then any interval, however long, can be expressed in terms of the atomic unit. Such a time system in which interval is based on the atomic unit but epoch on astronomical measurements has been in use for the past two years at the National Physical Laboratory, Teddington, England, and is being used for measuring the variations in the period of rotation of the earth.

Liquidus temperature of blast furnace slags

THE CLASSICAL METHOD OF MEAsuring liquidus temperatures is tedious and time-consuming. A simple method described by Welch [*J. sci. Instrum.*, **31** (1954), 458] for the purpose has now been applied for determining the liquidus temperatures of blast furnace slags; the equipment employed in

the work is similar to the one used by Welch. The technique permits direct observation of crystal growth and movement in the molten slag at temperatures up to 1750°C. as well as the nature of the primary phase crystallizing out; it also enables certain conclusions to be drawn regarding the relation of the viscosity to the behaviour of the slag around the liquidus temperature. Measurements carried out with the apparatus on over 150 slags have furnished valuable information which can help in deciding the composition of slags in the iron and steel-making practice while producing low sulphur pig iron from sulphur-rich raw materials.

The apparatus consists of a gas-tight cell in which is placed a 5 per cent Rh-Pt/20 per cent Rh-Pt thermocouple. The slag is held by capillarity at the thermocouple junction. The thermocouple can be connected to either a potentiometer or a power supply by means of a high-speed relay. By this means it is possible to heat the thermocouple (and hence the slag) and read its temperature at virtually the same instant. The cell is fitted on the stage of a simple low-powered microscope (×25-50) through which the slag droplet is viewed. The microscope has an analyser and a cap polarizer so that crystals can be seen in polarized light. The two-cell windows, normally microscope cover slides, and the thermocouple holder are held in place by O-rings.

All measurements on the slags are made in dry, oxygen-free nitrogen. This precludes the oxidation or reduction of the iron or manganese in the slag but does not prevent the loss of most of the sulphur present. The provision for viewing in polarized light enables the distinction between isotropic and anisotropic materials to be observed. The viscosity of the slag above the liquidus is determined by the basicity as measured by the $CaO + MgO/Al_2O_3 + SiO_2$ ratio. The rate of crystal growth is observed by quenching the specimen from the liquidus temperature by switching off the power.

A significant fact emerging from the liquidus measurements of the slags is that the actual liquidus temperature of a slag is close to that predicted on the assumption that the slag is composed wholly of CaO, MgO, Al_2O_3 and SiO_2. This indicates that the triangular diagrams of Osborn, De Vries, Gee and Kraner can be used with confidence in the selection of blast furnace slag composition. Other conclusions drawn from the study are: Though the mean temperature is close to 1500°C. the periodical fluctuations in temperature occurring in practice render it advisable to select slags having a calculated liquidus temperature of 1450°C. unless direct liquidus and viscosity data are available. It is confirmed that the slags are free-flowing above the liquidus temperature. For slags with the composition range used in the blast furnace the higher the basicity the lower is the viscosity at temperatures above the liquidus [*J. Iron Steel Inst.*, **186** (1957), 388].

Uranyl protoporphyrin

THE SYNTHESIS OF URANYL PROtoporphyrin, a new complex of uranyl ion with protoporphyrin 9, the porphyrin ring of haemin, is described. The compound is not nephrotoxic to mice.

The compound is synthesized by the addition of $UO_2Ac_2.2H_2O$ or $UO_2(NO_3)_2.6H_2O$ to aqueous protoporphyrin 9 at *p*H 7; the complex precipitates below *p*H 5 and is more stable in acid than in alkali. Copper in the protoporphyrin ring is neither displaced by UO_2^{++} nor interferes with the complex formation. It is proposed that the uranyl ion is bound to protoporphyrin as a complex with the two propionic acid groups present in the porphyrin ring or it may form a complex with one propionic acid group from two different rings. From a study of the radiations emitted it is shown that an equilibrium mixture of U^{238} and its daughters (Th^{234}) and not U^{238} alone is associated with the porphyrin.

Investigations on mice show that uranyl porphyrin is not nephrotoxic and showed no histological abnormalities. This property of uranyl complex and the property of porphyrins to concentrate in tumours, embryonic and in inflammatory tissues of human beings and animals has opened the way for the treatment of tumours by uranium [*Science*, **126** (1957), 164].

Synthesis of aspartic acid by bacteria

A NEW PHOTOSYNTHETIC PROCESS by which sulphur bacteria are able to synthesize aspartic acid, a basic building block for the synthesis of proteins, has been discovered at the Brookhaven National Laboratory, New York. This process is a shortcut that bypasses the making of sugar and produces protein directly utilizing light energy. The sulphur bacteria not only fix carbon dioxide in the usual manner to form sugars but they also fix carbon dioxide in an alternate way to produce aspartic acid. In this alternate process, the bacteria ' fix ' carbon dioxide into a three-carbon acid phosphoenolpyruvic acid to form a four-carbon acid which is rapidly transformed into the four-carbon amino acid-aspartic acid. This method of CO_2 fixation may also play a role in the photosynthesis of proteins by higher plants because all the enzymes necessary are found in higher plants. However, the equilibrium seems to tend more towards the synthesis of sugar [*Sci. Newslett., Wash.*, **72** (1957), 149].

Thallium poisoning

THE WIDESPREAD USE OF THALlium compounds as rodenticides has caused a considerable number of cases of thallium intoxication, especially in agricultural communities. Many of these cases have been fatal owing to the lack of any specific anti-toxic agents.

Studies have been carried out on the detoxifying effect of diets, supplemented with B group vitamins and 20 per cent of dried yeast and fed to thallium-poisoned rats. It has been observed that the diet supplemented with B-vitamins alone does not significantly prolong the life of poisoned rats, while the diet supplemented with yeast does prolong the life of the rats. The life-prolonging action of yeast is, therefore, attributed to cystine supplied by it. This observation confirms the view that thallium poisoning, characterized by hair loss and widespread damage to the nervous system, is caused by an attack of thallium on metabolic systems of one or more of the sulphur-containing amino acids. The fact that methionine is able to counteract thallium poisoning, by virtue of its labile methyl group or possibly by acting as a lipotropic agent, suggests that thallium also attacks the methyl metabolism of rats.

A number of compounds containing sulphur and labile methyl group have been tested on acutely

and chronically poisoned rats for their detoxifying action. It has been found that choline and sodium formate are ineffective; cystine, homocystine and betaine show significant detoxifying properties; methionine and homocystine-betaine mixtures are very efficient detoxicants. These compounds are non-toxic to human beings and can, therefore, be used for treating cases of thallium poisoning [*J. Sci. Fd. Agric.*, **8** (1957), 516].

Corrosion of titanium

STUDIES ON THE CORROSION OF titanium in the presence of fuming nitric acid show that titanium reacts explosively and has a susceptibility to stress corrosion cracking. The stress corrosion cracking is found to increase with nitrogen dioxide concentration from 0 to 20 per cent and decreases with increasing water concentration from 0 to 1 per cent at 25°-71°C. This corrosion reaction probably occurs through intergranular corrosion of the all-alpha or all-beta material [*Chem. Age*, **78** (1957), 143].

Measurement of deviations in periodic structures

AN INSTRUMENT FOR RAPIDLY measuring and automatically recording very small imperfections in pitch uniformity of repetitive structures has been developed by the Bell Telephone Laboratories. The instrument, presently employed for evaluating travelling-wave tube helices, can also be used for measuring the pitch uniformity of other periodic structures such as precision screws, grids, etc.

The method employs a combination of optical, electronic and mechanical techniques. Essential components of the apparatus include (1) an optical grating which provides a very accurate distance scale, (2) an optical system for ascertaining the position of the part to be measured with respect to the chosen scale, and (3) an electronic means for analysing this information and recording it on a strip chart.

The part to be measured is rigidly mounted on a moving platform on which is also mounted the precision optical grating. This grating moves past a similar fixed grating, so that a beam of light is interrupted when the rulings on the two are superimposed. The light beam falls on a photocell where these interruptions produce electrical pulses representing accurate distance increments of one micron. Another fixed beam of light and photocell combination produces an output pulse when an element of the periodic structure passes a fixed reference point.

The pulses from the measuring scale and those from the part being measured are fed to an electronic computer which evaluates the deviation from the ideal. This information is then recorded by a pen-recorder on a chart to provide a direct reading of the actual deviation of each element.

Longitudinal displacements are indicated to an accuracy of one micron. Complete evaluation of a travelling-wave tube helix can be accomplished in less than 5 min., compared to more than two man-days necessary by previously available techniques [*News from Bell Telephone Laboratories*].

Gassing rate of dry cells

EXPERIMENTS CARRIED OUT AT the National Bureau of Standards with the aid of a ' gasometer ', an equipment constructed at the Bureau for accurately measuring the gassing rate of a dry cell, showed that neither the initial cell capacity nor retention capacity (i.e. after a period of shelf storage) is a function of the gassing rate but that the retention capacity does depend on the total amount of gas evolved.

The normal chemical reaction of the cell produces gas, mostly hydrogen. But when a cell is not in use, the reaction is not the same as that which produces useful current. The gaseous reaction promotes self-discharge with consequent deterioration of the cell. Hence cells with less tendency to evolve gas should have a longer shelf life. To test this assumption, open circuit and discharge (at two different specified rates) runs were conducted. The results revealed that on open circuit, gassing proceeds at a constant rate at any given temperature and the rate is greatly affected by temperature. For each temperature and type of cell there appears to be a critical volume of gas a cell may evolve before there is a substantial loss in its capacity to generate current. Once the critical volume is evolved the cell deteriorates more rapidly. The rate of gassing falls as soon as the discharge test begins but increases later for some time and finally tapers off until the cell is exhausted. Gassing continues long after the cell ceases to have any useful life [*Tech. News Bull., U.S. Nat. Bur. Stand.*, **41** (1957), 126].

Separation of boron 10

THE AMERICAN ATOMIC ENERGY Commission has announced a commercial method for the preparation of B^{10} which is superior to natural boron as a neutron absorber. Natural boron (containing 19·6 per cent of B^{10}) is distilled in a six-tower distillation train in the form of a dimethyl ether (DME)-boron trifluoride (BF_3) complex to separate B^{10} from B^{11}. The DME-BF_3 complex is formed by mixing the two components and condensing at a slight positive pressure. The separation of the isotopes not only depends on the difference in volatility of the two isotopes but also on the equilibrium which slightly favours dissociation in the vapour phase of the complex containing B^{11} and recombination as liquid phase of the complex containing B^{10}. The fractionating towers are worked as a single unit and operated on the countercurrent principle. The pressure at the top of the columns is 6 in. of Hg and temperature 91°C.; both pressure and temperature are kept down to minimize the rate of irreversible decomposition of the boron complex. The bottom pressure in columns 1-5 is 12 in. of Hg and temperature 105°C. Steam consumption is heavy: 2500 lb./hr. are required to produce 2 lb./hr. of enriched complex. The enriched complex is converted, by reaction with potassium fluoride in aqueous ethyl alcohol, into potassium fluoborate. This is electrolysed in a potassium chloride bath at 800°C. employing a monel cathode. About 200 g. of elemental B^{10} are deposited per batch. The product is ground and leached with water and acid to remove potassium salts, iron and other impurities [*Industr. Chem. Mfr.*, **33** (1957), 477].

Determination of Sr^{90} and Ba^{140}

A TECHNIQUE FOR THE DETERmination of Sr^{90} and Ba^{140}, as a result of long-range fall-out from nuclear tests, in many natural materials like bone, cheese, milk, vegetation and soil is described [*Ann. N.Y. Acad. Sci.*, **71** (1957), 257].

The first four sample materials which contain calcium phosphate as a major component of their ash are completely ashed at 600°C., taken up in excess of concentrated hydrochloric acid and the resulting solution filtered to remove insolubles. Ammonium hydroxide is added to the filtrate to bring the *p*H to 1·5, after which excess of ammonium oxalate is added to precipitate out calcium oxalate, which carries with it the Sr and Ba quantitatively, leaving the phosphate ion in solution. Phosphate is completely removed by reprecipitation of the oxalate at *p*H 1·0-1·5.

Soils contain exchangeable calcium as well as non-exchangeable calcium in the silicate lattices and Sr and Ba are carried by Ca only under proper conditions. The exchangeable calcium in the soil sample (1 kg.) is removed by treating it with 1N ammonium acetate solution (4 litres) and allowed to stand for 24 hr. The residue is washed with 500 ml. of 1N ammonium acetate and the combined filtrates evaporated to dryness. The residue is dissolved in 6N hydrochloric acid and the calcium along with Sr^{90} and Ba^{140} is precipitated out as oxalate at *p*H 1·0-1·5. In all cases the oxalate is reprecipitated and then ignited to oxide. The oxide is dissolved in dilute hydrochloric acid to give the mother solution. The radioactivity measurements are made on the daughter isotopes of Sr^{90} and Ba^{140} (Y^{90} and La^{140} respectively) which are extracted from the mother solution.

The separation of the daughter isotopes from the mother solution is accomplished by raising the *p*H of the solution to 5 with ammonium hydroxide after adding about 10 mg. of non-radioactive yttrium carrier. A white gelatinous precipitate of yttrium hydroxide (carrying with it Y^{90}, La^{140} and rare earths) quickly forms and coagulates when heated for a few minutes. A second milking of the filtrate is required to obtain only Y^{90} or La^{140}. The gelatinous precipitate is unsatisfactory for radioactive measurements. Therefore, it is dissolved off the filter paper with 6N HCl, the *p*H adjusted to the point just below precipitation, and excess oxalic acid added. This precipitates yttrium oxalate as a coarse granular precipitate. The precipitate is filtered on a stainless steel funnel and dried. The filter paper with the sample is removed and mounted for counting on a brass disc covered with pliofilm. The radioactive counting of the precipitate is done in a specially designed beta counter which employs anti-coincidence shielding to minimize background effect. The relatively short half-lives of the daughter isotopes make it desirable to count these isotopes rather than the parent isotopes for two reasons: firstly, the decay of the daughter isotope may be followed to detect contamination and, secondly, repeated milkings from the same mother may be made after a few days.

Sorption of DDT by clay surfaces

MALARIA CONTROL BY MEANS OF residual applications of DDT and related insecticides to the interior surfaces of dwellings is an established practice. In areas where mud is the predominant building material, residual treatments frequently lose their insecticidal activity at a rate which may seriously hamper the malaria control programme. When dry mud surfaces are treated with DDT or related insecticides, the adsorption of the insecticide which occurs can result in a loss of most of the biological activity of the deposit in a relatively short time.

All measurements of loss of activity on mud surfaces have so far been based on biological methods supplemented with chemical analyses. Such methods are time-consuming and difficult to evaluate. A rapid method developed and described below is based on the measurement of the loss of radioactivity of mud surfaces dusted with C^{14}-labelled DDT. Because the C^{14}-labelled compound migrates to a depth only slightly beneath the surface, the weak beta rays are shielded; thus it is possible to follow the loss from the surface by measuring the loss in radioactivity. This technique lends itself to the rapid screening of substances for their adsorption capacities.

A homogeneous mixture of radioactive DDT dusting powder (made by mixing 990 mg. of pure *p*, *p'*-DDT with 9·8 mg. of radioactive *p*, *p'*-DDT; specific activity, 0·49 mc./g.) was obtained by dissolving it in CCl^4 and evaporating the solvent. The residue was ground to a fine powder after drying over silica gel and 1 mg. of the powder dusted on to a number of mud cakes obtained from different sources. Radioactivity of the samples was measured immediately and then stored in the humidity-controlled desiccators maintained at definite humidities. The samples were tested at intervals of 1-5 days. Within 24 hr., a measurable decrease in radioactivity was observed in all samples. The average loss of radioactivity in samples in dry atmosphere after 1 day was 15·2 per cent. Samples placed in an atmosphere of 47 per cent relative humidity suffered an average loss of 7·6 per cent during the same period while for those kept in high humidity atmosphere the loss averaged 4·2 per cent [*Science*, **126** (1957), 169].

Polarographic analysis of arsenic

A RAPID, ACCURATE AND SENSITIVE polarographic method has been developed for the estimation of arsenic in such small amounts as those used for decolourizing and fining of glass. Results are reproducible within ±4-5 per cent and time taken for one complete analysis using cathode-ray polarograph is about 6 hr. Although arsenic in the trivalent state is reported to have unfavourable polarographic characteristics, well-developed polarographic waves are obtained due to reduction of As^{3+} to As and As^{3-}, at nearly −0·64 and −1·20 volts against a saturated calomel electrode by the following treatment of the glass sample.

Dried glass sample is fused with sodium carbonate and potassium nitrate in a platinum crucible till a clear melt is obtained. It is acidified with sulphuric acid and diluted and filtered to remove gelatinous siliceous mass. Acidified mass is boiled with KI to reduce As^{5+} to As^{3+}. Excess of free iodine is removed by 3 per cent sulphurous acid, added drop by drop. One drop is added in excess after the solution is completely decolourized, to avoid reoxidation of As^{3+} to As^{5+}. Polarographic measurements on arsenious acid are carried out on solution obtained after reduction of the acid with hydriodic acid using 8 per cent NaCl, 1N H_2SO_4 and 0·5 per cent KI as supporting electrolyte. The first wave is utilized for direct polarographic determination of arsenic in glass [*Cent. Glass Ceram. Res. Bull.*, **4** (1957), 65].

Estimation of 7-oxocholesterol

AN ULTRAVIOLET METHOD FOR the quantitative determination of 7-oxocholesterol in wool waxes has been developed at the Textile Chemistry Laboratory of the Leeds University. The method can be extended to the estimation of 7-oxocholesterol in mixtures of sterols. The method is based on the observations that (1) 7-oxocholesterol forms an insoluble complex with digitonin and (2) it has a chromophore which exhibits maximum absorption in the region of 240 mμ.

For the preparation of the sample, the waxes are dissolved in peroxide-free ether, 5 per cent sodium methoxide in methanol added and the mixture left for 16 hr. The wax alcohols are separated from the soaps by partitioning the mixture between aqueous methanol and ether containing 50 per cent hexane. Weighed amounts of the alcohols (0·15 g.) are dissolved in 96 per cent ethanol (10 ml.) and a 1 per cent solution of digitonin (30 ml.) is added and the mixture left over for 16 hr. The digitonides are filtered on a sintered glass crucible and dried *in vacuo*. Standard solutions of the digitonides (20 mg./50 ml.) are made in absolute ethanol and their ultraviolet spectra determined in the region 230-250 mμ.

The only compound which interferes with the determination is cholestenone which is present in traces in wool wax; it has also a chromophore with maximum absorption at 240 mμ and forms an insoluble digitonide. Separate determinations should, therefore, be carried out to estimate cholestenones after removing 7-oxocholesterol either through acetylation or by the absorption of the polar alcohols on activated alumina. The method is reported to give an accuracy of ±2 per cent [*J. appl. Chem.*, **7** (1957), 491].

Determination of dextran in plasma

A COLORIMETRIC METHOD, USING anthrone-carbohydrate reaction in aqueous medium, has been shown to be accurate for the determination, in plasma, of small amounts of dextran. The method gives accurate results for plasma containing 50-150 mg. of dextran per 100 ml. and requires 3-4 hr. for a determination.

The protein in plasma is removed by precipitation with trichloroacetic acid. Glucose present in plasma extracts interferes in biological assay of the dextran and is, therefore, removed by dialysis employing a cellulose membrane. By dialysing for 90 min. at 40°C., 95·5-99·5 per cent of glucose can be removed. The losses for high molecular weight dextran are not appreciable during dialysis but losses occur when low molecular weight dextran is dialysed. When the concentration of dextran in plasma is low, the dextran in the solution may be further reduced by dialysis for longer periods. Complete recovery of dextran can be achieved by keeping the filtrates at 23°C. for 6 hr. before dialysis.

A known amount of plasma (2 ml.) was mixed with 10 ml. of 5 per cent trichloroacetic acid in a centrifuge tube, allowed to stand for 10 min. and then centrifuged for 20 min. at 2000 r.p.m. The supernatant (10 cc.) dialysed against water at 40°C. for 90 min., and then diluted to a known volume, the final concentration of dextran being adjusted to 2·0-7·0 mg./100 ml. To 2·0 ml. of the diluted dialysate in a large heat-resistant test tube (20×150 mm.) anthrone solution (4 ml.) was added directly and quickly, the contents of the tube mixed by swirling and placed on a water bath (80°C.) for 6 min. The tubes and their contents were cooled (0·5°C.) and their optical densities read in a spectrophotometer against distilled water anthrone blank at 625 mμ [*Canad. J. Biochem. Physiol.*, **35** (1957), 383].

Uranium recovery from phosphate rock

A METHOD FOR THE RECOVERY OF uranium as a byproduct in the manufacture of phosphoric acid from phosphate rock is described [*Industr. Chem. Mfr.*, **33** (1957), 478]. The phosphate rock is digested with sulphuric acid and the resulting phosphoric acid is filtered along with tetra- and hexavalent uranium (measured as U_3O_8) present in a concentration of 0·0165 per cent. Phosphoric acid is pumped through a number of settling tanks and from the last settling tank the acid goes into 'reduction pits' containing scrap iron to reduce all uranium to the tetravalent state. The extraction of uranium from the phosphoric acid is carried out in a two-stage countercurrent contacting process, using the pyrophosphate ester of a mixture of trimethyl heptanol isomers.

The pyrophosphate ester besides complexing with uranium also complexes with other metal ions like calcium, which are present as impurity. Calcium is removed as sulphate by the treatment of the organic complex with 25 per cent sulphuric acid. Uranium is precipitated as tetrafluoride from the complex with sulphuric acid containing an excess of hydrofluoric acid. The precipitated uranium tetrafluoride is centrifuged in solid bowl centrifuge and dried in open pan driers.

Epoxy resins as high vacuum sealing compounds

EPOXY RESINS, CONSISTING OF Araldite CN 502 (Ciba Co.) and 8-10 per cent triethylenetetramine, have been found to be promising sealing compounds in high vacuum systems. At operating temperatures of 25° to 140°C. no separation of the bond between dissimilar materials has been observed. Even after several successive heatings the resin bond showed no signs of brittleness, cracking or separation. The resin partially softens and flows to compensate for expansions of unlike materials. The resin when cured for optimum strength can withstand a tensile force equivalent to 8000 lb./sq. in., 18,000 lb./sq. in. compression pressure at room temperature which is slightly reduced at elevated temperatures. As an adhesive, it can withstand 2000-5000 lb./sq. in. of shear. Vacuum seal could be maintained for 0·5 hr. in liquid nitrogen using these sealing compounds. The excellent dielectric properties, low vapour pressure and bonding qualities of epoxy resins enable the introduction of wires, electrodes, etc., into vacuum systems [*Industr. Engng. Chem.*, **49** (1957), 1106].

Announcements

■ *The Third World Congress of the International Society of Gastroenterology* will be held during 25-29 May 1958 at Washington D.C. Further information can be obtained from Dr. H. M. Pollard, University Hospital, Ann Arbor, Michigan.

■ *The International Congress on Prestressed Concrete* will be held at Berlin during 5-10 May 1958.

Particulars may be obtained from the General Secretary, Federation Internationale de la Precontrainte, Mr. P. Gooding, c/o Cement & Concrete Association, Terminal House, 52 Grosvenor Gardens, London S.W. 1.

■ *Kalinga prize* — The Kalinga prize for the year 1957 has been awarded to Bertrand Russell, the famous British philosopher and writer. The prize, worth £1000, was established in 1951 by Sri M. B. Patnaik, an industrialist of Orissa, and is awarded annually for outstanding achievement in the dissemination and interpretation of science to the public.

Born in 1872, Bertrand Russell was educated at Trinity College, Cambridge. He became a Fellow of the Royal Society at the age of 36. He is the author of over forty books.

■ *Dr. C. V. Raman* is one of the seven recipients of this year's International Lenin Prize awarded by the Committee for International Lenin Prizes for " strengthening peace between the peoples of the world ".

■ *Dr. U. P. Basu*, Director, Bengal Immunity Research Institute, Calcutta, has been invited to act as a correspondent from India to the Industrial Pharmacists Section of the Federation Internationale Pharmaceutique (F.I.P.).

■ *Award of Doctorate Degrees* — The following have been recently awarded the Ph.D. degree of the Delhi University for their theses noted against their names:

Satya Pal Talwar: *Some problems on astrophysics*; Gita Halder: *Differential geometry of real and complex analytic manifolds*; V. Iswaran: *Physico-chemical factors of soil fertility in relation to nitrogen fixation by azotobacter in tropical (Indian) soils*; and T. R. Rajagopalan: *A study of fungal and lichen anthraquinones.*

Sri Madan Mohan Payak has been awarded the Ph.D. degree of the Poona University for his thesis, *Morphological, cytological and taxonomical studies in some rust fungi of Bombay State.*

■ *Broodbank Fellowship* — The Managers of the Broodbank Fund have announced a Fellowship tenable for three years at the University of Cambridge from 1 October 1958. The Fund operates for the furtherance of research in Biochemistry and Biophysics with special reference to the Principles and Practice of Food Preservation. The annual pensionable stipend of a Fellow varies from £750 to 1000 according to the Fellow's experience and qualifications. Ten copies of the application, containing an outline of the candidate's proposed research, should be sent to the Registrary at the University Registry, The Old Schools, Cambridge. They should also be accompanied by not more than two testimonials, a statement of his career, date of birth, reprints of papers published and the names of at least two referees. The applications should reach the Registrary not later than 31 March 1958.

■ *Post-Doctorate Fellowships of Canada* — The National Research Council of Canada will award during 1958-59 eighty post-doctorate Fellowships for research/study in Chemistry, Physics, Biological Sciences, Agriculture, Geophysics, Mining, Mathematics, Engineering, etc., tenable at the National Research Council Laboratories for a period of one year in the initial stage which may be renewed for a second year in special cases. The value of each fellowship is $ 3700 (Rs. 17,619 approx.) for single Fellows and $ 4500 (Rs. 21,429 approx.) for male Fellows who are married. In addition, cost of travel both ways will also be provided. Candidates should not be more than 35 years of age and should possess a Ph.D. degree from a recognized university, or expect to obtain such a degree before taking up the award.

Full particulars regarding the fellowships and the prescribed application forms can be obtained from the Awards Officer, National Research Council, Ottawa 2, or from the Chief Scientific Liaison Officer, National Research Council of Canada, Africa House, Kingsway, London W.C. 2, England.

The applications should be forwarded direct to the National Research Council of Canada, Ottawa, so as to reach the Council by 15 February 1958.

INSTRUMENTS AND APPLIANCES

Dilution Viscometer for Foaming Liquids

An Ostwald type of capillary viscometer with a few modifications has been successfully adapted at the Physical Chemistry Division of the Pulp and Paper Research Institute of Canada, Montreal, Quebec, to overcome the difficulties inherent in viscosity measurement of foaming liquids due to the accumulation of foam in the bulbs. The modified apparatus (Fig. 1) permits (1) control of foam, (2) dilution *in situ*, and (3) measurement at two or more shear rates.

The adverse effect of foaming is avoided by providing a side capillary and a wide vertical tube (controlled with a ground glass stopcock) through which the foaming liquid is routed back to the lower bulb of the usual Ostwald capillary viscometer.

By trial the liquid level is manipulated until it stands at the standard mark I and the liquid allowed to flow back into the lower reservoir. The fall is timed between three marks F, G and H. The marks are located such that

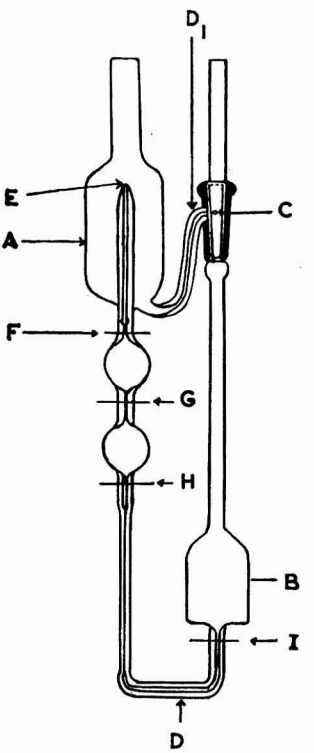

FIG. 1 — DILUTION VISCOMETER [A, B, reservoirs; C, hole drilled in the ground glass joint; D, D_1, connecting capillary tubes (diam. 2 mm.); E, tapered end; and F, G, H, I, reference marks]

viscosities corresponding to different mean rates of shear can be measured in the usual way.

The dimensions of the viscometer are so chosen that while the meniscus falls from E to mark F on the left side, the liquid in the right side rises from the mark I to the flat bottom of B and forms a shallow layer. A large ratio of the diameter of the bulb to that of the connecting tube ensures that the initial head and the volume of the liquid flowing are independent of the total volume of the liquid in the viscometer. After each run the liquid is transferred from the reservoir A to B. To dilute, a known volume of diluent is poured into the upper reservoir A. The liquid is sucked completely to the lower reservoir B where it is mixed with the rest of the solution. The mixture is then sucked to A and the cycle is repeated three to four times until the mixture is homogeneous. The precision with which the viscosity is determined by this instrument is up to 0·2 per cent. The kinetic energy correction for this apparatus also is positive as with the Ostwald type instrument and is about 0·2 per cent for the range studied [*Canad. J. Chem.*, **35** (1957), 742].

Integrometer for Adhesion Measurement

An electronic device, known as the Integrometer, for measuring the force with which samples of protective coatings adhere to aircraft has been developed at the plastics laboratory of the U.S. Bureau of Standards. This instrument at the push of a button automatically averages and records accurately the many variable readings of the stripping force during a run and thus eliminates the disadvantages of manual strain and unreliability inherent in the operation of pendulum and dial gauge adherometers. This is achieved by an elaborate electronic system which converts the variable stripping force into electronic impulses which are then added to give a single average value that can be read directly from a standard recorder. The pendulum in the conventional adherometer is replaced by an aluminium alloy beam with resistance strain gauges attached to both faces. The integrometer could then be used to perform the function of the dial gauge. The recorder draws a straight line the length of which, after a precisely timed interval, is proportional to the average value of the varying voltage impressed on the integrating circuit. The coefficient of variation for replicate stripping is less for the integrometer (2·2 per cent) than for the pendulum and dial gauge method (4·1 per cent). Also the precision of the integrometer is independent of the uniformity of the material's adhesion property. The integrometer provides a more reliable experimental basis for interpretation of adherometer data. The device may also be useful in theoretical studies of adherometer operation and in correlation of the data with other adhesion measurements and service performance of aircraft [*Tech. News Bull., U.S. Bur. Stand.*, **41** (1957), 124].

New Sedimentation Balance

A new sedimentation balance developed by Sartorius Werke A.G., Goettingen, West Germany, automatically records the increase in weight of the sediment deposited in a weighing pan as a function of time and the graph thus recorded permits the particle size distribution curve to be plotted. The design of the balance allows the sedimentation process to obey Stokes' law and the automatic recording saves considerable time. Also, unlike in the Andreasen pipette procedure the liquid and hence the sedimentation process remains undisturbed, when the balance is in operation, permitting an appreciable reduction in the duration of fall. This reduces the time taken for the test. The balance can be located on any firm bench and will operate without attention after a few manipulations. This new development finds application in research and other work in chemicals, plastics, paper, pigments, ceramics, dyestuffs and other industries where mechanical analysis of particle sizes below 60 μ diam. is essential.

The operation of the balance is as follows: As soon as 2 mg. weight of sediment deposits in the pan, the normal position of a beam is altered thereby causing a ray of light to operate a photoelectric system which actuates a ' step by step ' motor through an amplifier and relay. This motor twists a torsion wire through a given angle, the resultant force of elasticity transmitting a torsional moment to a secondary beam fixed to the torsion wire. The torsion in this wire is in turn transmitted to the main beam by a mechanical coupling of the two beams and turns it back to its initial position, thereby automatically compensating the moment due to the load on the pan, simultaneously cutting off the light beam to the photocell. Concurrent with this operation, a recording pen moves a distance of 0·08 cm. over the chart paper at each step of the motor. The paper moves at a constant speed vertically to this direction, resulting in a stepped diagram which represents the weight on the pan as a function of time. The dimensions of the apparatus are, length, 95 cm.; width, 42·5 cm. and height, 72 cm.; the apparatus weighs 61 kg. with accessories and works from 110 or 220 V. mains at a frequency of 42-60 c/s. Power consumption is *c.* 30 W. [*Chem. Prod.*, **20** (1957), 372].

New Radiation Monitor

A new instrument for measuring low levels of radioactivity in rocks, which are not necessarily uraniferous, is described. The instrument which is completely transistorized is highly suitable for prospecting work. The arrangement is simpler and cheaper than a scintillation counter and consists of a pulse integrating system using a high speed electromechanical counter. One transistor generates the corona-stabilized H.T. for the G.M. tube and three are used in the counting circuit. Dry batteries provide the power. This counter has been used extensively in Devon and Cornwall to survey old mining areas to gain information on the radioactivity levels in various types of rocks and on waste dumps at old mining sites. The counter is left for a short time while field notes are made, after which an average count per minute is determined. When marked radioactivity is met, further information is found by normal ratemeter and chemical methods. This monitor has revealed the existence of lumps of uranium minerals undetected in preliminary searches with the ordinary probe type monitor [*Atomics & nucl. Energy*, **8** (1957), 356].

Progress Reports

BENGAL IMMUNITY RESEARCH INSTITUTE

THE FIVE-YEAR REPORT (1951-55) OF THE BENGAL Immunity Research Institute, Calcutta, records many useful contributions made by the Institute in the fields of chemistry (analytical, synthetical and pharmaceutical), biochemistry (nutritive value of foodstuffs, vitamins, glandular products and enzymes) and biology (bacteriology, pharmacology, pharmacognosy and physiology). The following account deals briefly with some of the important investigations carried out by the Institute.

Chemistry — Improved analytical methods for the determination of B-vitamins, alkaloids and minor metallic constituents in pharmaceutical preparations have been reported. Special mention may be made of the ultraviolet spectrophotometric method developed for the estimation of strychnine in the presence of brucine and quinine. Methods for the determination of copper and manganese in colloidal solutions have also been reported.

New chemotherapeutic agents have been synthesized with possible applications as antimalarials, antibacterials, antituberculars and antispasmodics. 8-Aminoquinoline derivatives have been synthesized as possible antimalarials by lengthening or branching the side chain and altering the state of terminal nitrogen or the size of the terminal alkyl group. Some of them have been found effective in controlling *vivax* malaria infection. Various groupings which are known to induce antibacterial activity in other series of drugs have been introduced into the sulphone molecule to see how the antibacterial spectrum is altered with special reference to pulmonary tuberculosis.

A method for the preparation of chloriodized arachis oil, which can be used as a contrast medium in branchographic and other examinations and as a radiopaque, has been standardized. Activated charcoal, with improved acid and base adsorption capacity and suitable for medicinal purposes, has been made from groundnut hulls, coconut shells and bamboo. Groundnut oil with zero peroxide value for use in pharmaceutical industry has been produced by chromatographing the oil over activated alumina. The separation and estimation of tocopherol in groundnut oil has been accomplished by a chromatographic method.

Biochemistry — A method for preparing protein hydrolysates possessing requisite nutritive value has been developed. From studies on the evaluation of the anti-anaemia factors present in liver processed under various conditions, it has been found that proteolysed liver solution contains, in addition to vitamin B_{12}, some vitamin B_{12b} and some alkali-stable growth factors. A microbiological method has been developed for the separation and assay of vitamin B_{12} in liver extracts. Crude liver preparations derived from liver after proteolysis have been found to contain greater quantity of amino acid and growth factors than proteolysed liver. Ultraviolet irradiation of pituitary proteins under varying physico-chemical conditions has been found to bring about the inactivation of oxytocic activity of the proteins as a result of oxidation. During studies on the action of different antimalarials on the enzymes of the tricarboxylic acid cycle, it was found that quinine inhibits oxygen uptake of the enzyme preparation except when succinate is used as substrate. The site of inhibition appears to be between α-ketoglutarate to succinate step indicating that quinine inactivates the thiol group of the enzyme.

Biology — Work on the isolation of both 'Inaba' and 'Ogawa' types of cholera *vibrios* from the same patients on repeated culture show that the change in sub-types occurs *in vivo* and such changes explain how both sub-types are met with during the same period and at the same place. Detailed researches on antidysenteric sulpha compounds and their mode of action have established that for becoming effective in bacillary dysentery, poor absorbability of the drug is not the only criterion, absorbable drugs such as sulphathiazole, sulphanilylbenzamide, sulphadiazine possessing the characteristic property of re-excretion through the gut, can exert more powerful therapeutic activity. In fact, selective re-excretion through the caecum and large intestines has been shown to be an important factor in imparting therapeutic effectiveness to an antidysenteric sulpha drug. The formaldehyde derivatives of some sulpha drugs such as sulphacetamide and sulphanilylbenzamide exhibit significant activity against streptococcal infection. The absence of potency against the pneumococci suggests that their mode of activity against systemic infections is probably similar to that of sulphanilamide. Chemotherapeutic studies of some amidino-arsenoxides with reference to trypanocidal and bacteriostatic properties have shown *p*-amidinophenyl arsenious acid to possess powerful anti-trypanosonal action against both *T. equiperdum* and *T. evansi*. When, however, the amidino group is substituted, the compounds exhibit high *in vitro* bacteriostatic effect with no appreciable trypanocidal activity and are highly toxic.

A number of compounds of pyrazolone and quinoline series and containing strong basic groups have been synthesized and tried for antispasmodic property. Of these, piperidinomethyl pyrazolone derivative has been found to be a suitable antispasmodic, showing musculotropic and neurotropic action and low toxicity. Certain plain-muscle stimulating factors have been detected in protein hydrolysates of meat and casein. Though simulating histamine, these factors have been shown to be non-histaminic in biological behaviour. The meat hydrolysate has been found to possess strong antidiuretic activity.

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

THE ANNUAL REPORT OF THE EUROPEAN ORGANIZATION for Nuclear Research (CERN) for the year 1956 reports considerable progress in many direc-

tions, the construction of the synchro-cyclotron being a notable achievement of the year. Another significant result is the experimental proof obtained for the existence of the τ neutral meson. A huge double-cloud chamber has been designed and constructed for investigations on K-mesons.

A symposium on ' High Energy Accelerators and *pion* Physics ' was organized by CERN at Geneva during June 1956 and was attended by over 300 eminent scientists from 22 countries. The proceedings have been published in two volumes.

Research on the theoretical aspects of hyperon and heavy meson physics, meson-nucleon collisions and experiments on cosmic rays in connection with the life-time of K-mesons, in particular, have been conducted at Geneva. At the Jungfraujoch laboratory, during cosmic ray experiments, an interesting cloud-chamber photograph has been obtained which showed a four-pronged event; two of the prongs are due to a pair of positive and negative electrons and the other two resemble a normal neutral V-event. The event has been interpreted as the decay of a neutral τ°-meson into two charged π-mesons and a neutral π°-meson. The neutral π°-meson subsequently decays into an electron pair and a γ-ray. This event may provide the best experimental evidence for the existence of the neutral τ°-meson. A comparison of the observations on K-mesons in cosmic rays from different laboratories with those obtained at Jungfraujoch showed that the relative frequencies of the different modes of decay of K-mesons could be the same in all the cases considered and that the same proportions could hold forth for both positive and negative K-meson decays.

An automatic tuning system for the accelerating units of the proton synchrotron has been designed and constructed on the basis of a large number of measurements carried out on the tuning magnet and the cavity. A refined model of the Hall computer, which works successfully with closed servo loops, has been constructed to study questions of static and dynamic behaviour of the system as well as of accuracy and reproducibility. A new type of an extremely stable Bloch-head has been developed for electron spin resonance measurements. A pulsed r.f. ion source and a prototype 500 kV. accelerating column have also been tested.

Some of the characteristics of the beams obtainable from the synchro-cyclotron constructed by CERN have been described. In this instrument the proton beam with an average current of 0·2 μa. can attain an energy of *c.* 600 MeV. Internally produced neutron beams in 7 steps of 70 MeV. each, rising from 110 MeV. up to 600 MeV., will be available in an array of parallel channels cut through the shielding wall. Internally produced negative pions with a continuous energy spectrum in the range 100-400 MeV. can be obtained in a two-channel array.

Two experimental liquid hydrogen bubble chambers (10 cm. diam. $\times$ 10 cm. depth and 30 cm. diam. $\times$ 15 cm. depth) are being constructed for experiments with the synchro-cyclotron.

Work on Cerenkov effect and the use of fast pulse electronic devices has been carried out to develop apparatus and techniques required for the detection of various particles.

Conversion of a Non-coking Coal into Coking Type by Partial Hydrogenation

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(*Manuscript received* 17 *June* 1957)

Hydrogenation of a low rank Jambad Bowlah coal has been studied at different pressures and temperatures, with or without a catalyst. The coal changes into coking variety on hydrogenation at 200 atm. pressure and 375°C. without the use of a catalyst. The same result is obtained by hydrogenating at 30 atm. after impregnating the coal with an iron oxide-chromic acid-ammonium molybdate catalyst. Gray-King assay of the product shows that the coke is similar in quality to that obtained from a high rank coal, but the yield is lower. The yield of tar, however, is higher than that obtained from a high rank coal. There is a corresponding change in the heat of wetting of the hydrogenated residue as a result of the elimination of oxygen groups from coal.

MUCH work has been done on the improvement of the coking quality of coal by hydrogenation. Most of the early investigators employed pressures of the order of 100 atm.[1-6]. However, by the use of catalysts, the same result could be achieved at lower pressures. Since most of the work is covered by patents, the exact conditions of operation, details of catalyst preparation, etc., are not available. The present work was undertaken with the object of investigating the conditions under which a non-coking coal could be converted into a coal of coking variety.

Experimental procedure

Jambad Bowlah coal from Raniganj coalfield was used. The coal was crushed to pass a 240 B.S. sieve. For hydrogenation, dry coal (*c.* 100 g.) was charged into a rocking type externally heated steel bomb of 2-litre capacity, which was then flushed with hydrogen to expel all air and the pressure raised to the desired level. The bomb was heated at the rate of 3°-4°C./min. The temperature of the coal was read by means of a thermocouple extending into the coal mass. As the temperature rose, the pressure of the gas inside the bomb also rose and was maintained constant by bleeding a part of the gas. After the required temperature was attained, heating was continued for 4 hr.

The coal was hydrogenated both alone and in the presence of iron-based catalysts. Since the catalyst was retained by the coke it was necessary to choose such materials as could be tolerated in the final coke.

The coal was soaked in ferric nitrate solution of the desired strength and ferric hydroxide precipitated by ammonia. When incorporation of a promoter was necessary, a solution of chromic acid, molybdic acid (in the form of ammonium molybdate) or tungstic acid (in the form of ammonium tungstate), as the case may be, was stirred into the mass and the latter evaporated to dryness.

Results and discussion

The proximate and ultimate analyses, caking index and heat of wetting of the original and hydrogenated coals are given in Table 1.

On heating the coal alone at 375°C. in a stream of nitrogen or hydrogen, there was an increase in carbon content and a corresponding decrease in hydrogen and oxygen contents. There was also a reduction in the moisture content and heat of wetting. There was, however, no change in the caking index.

The sample was next hydrogenated at different pressures, viz. 30, 70 and 200 atm., keeping the temperature and contact time constant. There was an enrichment of the mass with hydrogen, but the improvement in the coking property became conspicuous only at 200 atm. (Table 1). The caking index was 17. The heat of wetting, however, reached a value of about 4 cal./g. d.a.f. (which is the characteristic value for coking coals) even before the coal became coking.

The volatile matter showed a fall on heating the coal in nitrogen or hydrogen at

atmospheric pressure. It, however, increased in the samples heated at higher pressures.

Influence of catalysts — Horton *et al.*[1] observed that 2·5 per cent by weight of ferric oxide serves as a moderately good catalyst for hydrogenation at 100 kg./sq. cm. pressure. The coal was accordingly impregnated with ferric oxide (2·5 per cent by weight) and hydrogenated at 30 atm. The caking index showed only a small increase (Table 2).

Chromium oxide, which has been reported to be a good promoter for hydrogenation catalysts[7], was incorporated into the coal (0·25 per cent by weight) impregnated with ferric oxide and the experiment repeated. The caking index of the treated sample showed a further increase.

Molybdic acid and ammonium molybdate have been reported[8] to be good catalysts for the hydrogenation of coal. Incorporation of 0·25 per cent by weight of molybdic acid into the coal impregnated with iron oxide raised the caking index from 4 to 12. Tungstic acid, however, was found to have no beneficial effect on the coking property of coal impregnated with iron oxide; on the other hand, it brought down the caking index to the value for the original coal.

A mixture of chromic acid and molybdic acid gave the highest value of caking index (16) upon hydrogenation.

Effect of temperature — On hydrogenation at 300°C. and at 30 atm. pressure, there was practically no change in the caking index of coal impregnated with iron oxide-chromic acid-ammonium molybdate mixture (Table 3). Raising the temperature to 400°C. increased the caking index to 20; it was 16 at 375°C. From these results it is clear that the coal has to be raised to its decomposition point before hydrogenation could be effected. This is in agreement with the findings of Storch *et al.*[8] and Crawford *et al.*[5]. Further increase in temperature to 425°C., however, decreased the caking property.

Effect of moisture — In order to determine the effect of initial moisture content of coal on hydrogenation, samples of coal impregnated with the iron oxide-chromic acid-ammonium molybdate catalyst were dried to different extent and treated with hydrogen at 375°C. and 30 atm. pressure for 4 hr. The coals with initial moisture contents of

TABLE 1 — HYDROGENATION AT VARYING PRESSURES AND IN DIFFERENT ATMOSPHERES

(Jambad Bowlah coal used in all the experiments)

Treatment of coal	Proximate analysis (as received)				Ultimate analysis (d.a.f.)					Caking index	Heat of wetting (d.a.f.) cal./g.
	Moisture %	Ash %	Volatile matter %	Fixed carbon %	Carbon %	Hydrogen %	Sulphur (org.) %	Nitrogen %	Oxygen (by diff.) %		
Original coal	8·4	16·7	34·0	40·9	78·93	5·27	0·36	1·84	13·60	<2	17·5
Heated at 375°C. for 4 hr. in an atmosphere of nitrogen at atmospheric pressure	2·6	18·5	21·0	57·9	82·81	4·39	0·48	2·04	10·28	<3	13·1
Heated at 375°C. for 4 hr. in an atmosphere of hydrogen at atmospheric pressure	1·4	20·9	—	—	85·17	3·78	0·42	2·16	8·47	<3	12·1
Hydrogenated at 375°C. for 4 hr. at 30 atm.	2·9	17·0	30·3	49·8	83·70	5·16	0·52	2·01	8·61	<3	4·2
Hydrogenated at 375°C. for 4 hr. at 70 atm.	2·0	17·5	—	—	83·64	5·29	0·56	2·16	8·35	<3	4·1
Hydrogenated at 375°C. for 4 hr. at 200 atm.	2·8	18·1	35·0	44·1	86·46	5·78	0·56	2·14	5·05	17	3·5

TABLE 2 — HYDROGENATION USING CATALYSTS

(Temp., 375°C.; pressure, 30 atm.)

Catalyst	Proximate analysis (as received)				Ultimate analysis (d.a.f.)					Caking index	Heat of wetting (d.a.f.) cal./g.
	Moisture %	Ash %	Volatile matter %	Fixed carbon %	Carbon %	Hydrogen %	Sulphur %	Nitrogen %	Oxygen (by diff.) %		
Fe_2O_3 (2·5%)	2·7	20·3	29·6	47·4	86·40	5·49	0·56	2·36	5·19	4	2·8
Fe_2O_3 (2·5%) + CrO_3 (0·25%)	2·2	20·2	32·4	45·2	84·39	5·66	0·52	2·32	7·11	5	3·6
Fe_2O_3 (2·5%) + MoO_3 (0·25%)	2·1	20·5	32·3	45·1	85·48	5·72	0·65	2·61	5·54	12	3·1
Fe_2O_3 (2·5%) + WO_3 (0·25%)	2·1	20·6	30·7	46·6	83·10	5·53	0·47	2·46	8·44	<2	5·5
Fe_2O_3 (2·5%) + MoO_3 (0·25%) + CrO_3 (0·25%)	2·2	20·8	34·6	42·4	83·95	5·61	0·99	1·99	7·58	16	—

TABLE 3 — HYDROGENATION AT DIFFERENT TEMPERATURES USING CATALYST

(*Catalyst composition*, Fe_2O_3, 2·5; MoO_3, 0·25; CrO_3, 0·25%; *pressure*, 30 *atm.*)

Temp. °C.	Proximate analysis (as received)				Ultimate analysis (d.a.f.)					Caking index
	Moisture %	Ash %	Volatile matter %	Fixed carbon %	Carbon %	Hydrogen %	Sulphur (org.) %	Nitrogen %	Oxygen (by diff.) %	
300	2·7	18·9	33·1	45·2	79·49	5·66	0·45	2·08	12·32	<3
375	2·2	20·8	34·6	42·4	83·95	5·61	0·99	1·99	7·58	16
400	2·8	22·1	30·9	44·2	87·60	5·89	0·66	2·44	3·41	20

TABLE 4 — GRAY-KING (L.T.) ASSAY OF ORIGINAL AND HYDROGENATED COALS

Coal	Treatment	Yield per ton (dry basis)							
		Coke *cwt.*	Tar *gal.*	Liquor *gal.*	Gas *cu. ft.* S.T.P.	Ammonia *lb.*	Gas point °C.	Oil point °C.	Type of coke
Jambad Bowlah	Nil (original coal)	14·68	24·86	13·62	3770	—	345	355	A
do	Hydrogenated at 30 atm. and 375°C. using Fe_2O_3 (2·5%) + MoO_3 (0·25%) + CrO_3 (0·25%) catalyst	15·22	21·09	14·16	4192	3·40	370	350	G
do	Hydrogenated as above; temp., 400°C.	15·51	33·45	2·93	3900	4·75	370	320	G_1
Kustore (a high rank Jharia) coal	nil	16·96	13·66	5·60	3395	2·13	375	342	F

13, 6 and 2 per cent gave caking index values of 6, 13 and 16 respectively after hydrogenation. Thus, it is clear that the initial moisture content has a profound effect on the caking property of the coal obtained on hydrogenation, the caking index decreasing with increase in the initial moisture content.

Gray-King assay — The Gray-King (L.T.) assay was carried out on samples obtained using the iron oxide-chromic acid-ammonium molybdate catalyst and showing caking indices of 16 and 20. The results given in Table 4 show that there is remarkable improvement in the yield as well as the quality of the coke obtained from the coal on hydrogenation. In fact, the quality of the coke is similar to that obtained from a high rank coal. The tar yield is also considerably higher (with the coal showing a caking index of 20) than with the original coal[5,6].

Heat of wetting — There is a gradual decrease in heat of wetting with decrease in the oxygen content for the various hydrogenated coals. This is because heat of wetting is primarily a measure of the oxygen groups in coal[9] and since these are eliminated, the heat of wetting also decreases.

It is clear from the results that it is possible by the use of suitable catalysts to convert a completely non-coking coal into a good coking coal by hydrogenation at fairly low pressures. The resultant coal does not, however, resemble a natural coking coal in its ultimate analysis, Gray-King assay or in its heat of wetting.

Acknowledgement

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Corrosion of Steel: Part I—Protective Action of Oxides of Lead & Zinc

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The protective action of oxides of lead and zinc and their mixtures on the underwater corrosion of steel has been investigated. While the aqueous extract of litharge renders water completely non-corrosive, those of red lead and zinc oxide inhibit the corrosion of steel only slightly. The aqueous extract of the dried oil paint containing litharge shows practically no passivating action on steel, whereas the extracts of the paints obtained from zinc oxide and red lead decrease the corrosion of steel. Also, the aqueous extract of red lead paint dried at room temperature has very slight passivating effect, whereas the paint dried at 100°C. inhibits the corrosion of steel completely.

Steel specimens coated with paints containing red lead and litharge (or red lead and zinc oxide) are protected more effectively than those covered with the paints prepared from red lead alone. The beneficial effect of the addition of litharge to red lead appears to be due to its influence on the physical structure of the paint coatings. Zinc oxide, however, seems to increase both the corrosion inhibitive action and mechanical properties of the paints.

ALTHOUGH oil paints have found extensive use in the prevention of corrosion of metals, the mechanism of protective action of the paints is not clear. The view that the protection afforded by paints depends mainly on the mechanical exclusion of the corrosive substances — water, acids or salts — from the metal does not seem to be always correct, since many effective paint coatings are porous. Mayne[1,2] has shown that paint films are so permeable to water and oxygen that they cannot inhibit the corrosion of metals beneath the films unless they contain corrosion inhibitive pigments. Crennel[3] has, however, found that in sea water a painted steel is cathodic to bare steel which is due to the passivating action of alkali produced at the local cathodes behind the paint film.

The specific inhibitive nature of certain pigments used in paints has been demonstrated by certain investigators. Lewis and Evans[4] have shown that the protection afforded to steel by red lead is largely due to its passivating power, while that afforded by iron oxide is essentially mechanical. According to Mayne[5] the passivating power of basic lead (or zinc) pigments in linseed oil is associated with the formation of lead (or zinc) soap which is readily adsorbed on the metallic surface. Wagner[6] has, however, reported that red lead, ferric oxide and zinc chromate produce paint films with small pores and hence help to give mechanical protection to the base metal. In the opinion of Pryor[7] the inhibitive properties of aqueous extracts of pigments are in the same order as their reserve alkalinities and the protective action is due to the formation of a thin film of γ-ferric oxide by the reaction between dissolved oxygen and iron atoms at the surface of steel.

It is clear from the above that the mechanism of protection of metal surfaces with paints has not been clearly elucidated. The paints can protect the underlying metals in two ways: (1) by mechanical exclusion of corrosive substances such as water, oxygen, etc., and (2) by chemical passivation of the metallic surface. The presnt paper describes the results of studies on the protective action of oxides of lead and zinc (single or mixed) against the corrosion of steel. The following series of experiments were conducted: (i) the passivating action of pigment suspended in water (no linseed oil being present), the steel specimen remaining covered by the aqueous extract of the pigment; (ii) the inhibitive action of oil paint on the corrosion of steel placed in water contained in a beaker, the paint being applied on the inner surface of the beaker; and (iii) the protection conferred by oil paint under water, the paint being applied on the steel specimen.

Experimental procedure

Preparation of specimens — Specimens (6 × 2 cm.) were cut from cold-rolled mild steel strip. The steel analysed to: C, 0·12; Si, 0·06; S, 0·044; P, 0·055; and Mn, 0·430 per cent. The surfaces of the pieces were rubbed with cloth to remove oil, abraded with No. 1 emery paper and washed with soap and water. Next, the specimens were pickled in 2 per cent hydrochloric acid for 1 min., washed with water and then with alcohol. The clean steel specimens were then dried with cloth and left in a calcium chloride desiccator for at least 24 hr. to ensure the formation of a uniform oxide film.

Painting procedure — The pigment, consisting of a single oxide or mixed oxides, was finely ground in a mortar and passed through a 200 mesh sieve. The paint prepared by mixing the pigment (10 g.) thoroughly with linseed oil (2·5 ml.) was applied uniformly with a brush on the steel specimen over an area of 4 × 2 cm., leaving a bare area of 2 × 2 cm. at one end. The first coat of the paint was allowed to dry for 1 day; the second coat was then applied and allowed to dry for 4 days.

To control the average thickness of the paint coatings, the beaker containing the paint and the brush was weighed before and after painting; the weight of the paint applied on each specimen varied from 0·7 to 0·9 g.

Corrosion test — The bare steel specimen was partially immersed in the aqueous extract of the pigment or oil paint in a 100 ml. beaker to a depth of 4 cm. of the specimen. The painted steel specimen was similarly covered with 3 per cent sodium chloride solution, the edges being coated with paraffin wax before immersion in the corrosive liquid. The specimen was placed in the beaker in an inclined position and the beaker covered with a watch glass to reduce the loss of water by evaporation. The progress of corrosion was followed by visual examination, by electrode potential measurements and by loss in weight. In these experiments the corrosion products were removed from the steel surface with the help of a 'policeman'[8].

Electrode potential — The electrode potential of the specimen was measured with respect to saturated calomel electrode using a Cambridge valve-potentiometer. An agar-KCl bridge was employed to connect the test solution and the saturated potassium chloride solution in which the standard calomel electrode was immersed. The value measured represents the 'compromise' potential of the whole specimen.

Reaction between steel and aqueous extracts of pigments — The pigment was suspended in distilled water contained in a 100 ml. beaker and kept in contact with water for 20 days. The steel specimen was then partially immersed in the liquid and the electrode potentials (corrosion potentials) measured at regular intervals. The *p*H of the aqueous extract was measured before immersion of the steel specimen and also at the end of the experiment by means of a glass electrode.

Reaction between steel and aqueous extracts of the dried oil paints — The pigment was ground with linseed oil and applied on the inner surface of a beaker and allowed to dry for 4 days at room temperature. Distilled water was poured in the beaker and the paint left under water for 20 days. The steel specimen was then partially immersed in the liquid and the potential/time curves were obtained. The initial and final *p*H values were determined.

The inhibitive behaviour of the paints dried at various temperatures was next studied. Red lead and litharge were separately mixed with linseed oil and the resulting paints applied on the outer surfaces of test tubes. Some of the painted tubes were dried at room temperature for 6 days, while others were dried at higher temperatures for 30 hr. Aqueous extracts were next prepared by shaking each of the coated test tubes in distilled water in a mechanical shaker. The weighed steel specimens were then immersed partially in the aqueous extracts in separate beakers and the extents of corrosion determined by the loss in weight of the specimens after 7 days.

Protection by paint coatings — Steel specimens were coated with the oil paints and partially immersed in 3 per cent sodium chloride solution. The potentials of the painted specimens were then measured to obtain the potential/time data.

Results and discussion

The potential/time curves for steel partially immersed in aqueous extracts of pigments and oil paints are shown in Figs. 1-3 and the *p*H values of the extracts are recorded in Tables 1 and 2. The potential/time correlations for painted steel partially covered

with 3 per cent sodium chloride solution are shown in Figs. 4 and 5.

In the potential/time curves the negative values are associated with corroding action and positive values with protection. The potential values obtained during the first few hours of immersion are less reliable than the values for later periods. In the present investigation, the potentials measured after 24 hr. of immersion are considered in assessing the protection conferred by pigments against the corrosion of steel.

Corrosion inhibitive action of pigment extracts — The results indicate that the aqueous extracts of red lead and zinc oxide inhibit the corrosion of steel only to a slight extent and the steel specimens show signs of rusting within 24 hr. of immersion in these liquids. The litharge extracts, however, give complete protection throughout the duration of experiments. Thus, litharge has better inhibitive power than red lead, zinc oxide or mixed oxides. Litharge extract has the highest *p*H value compared to those of the extracts of the other pigments (Table 1), and the greater passivating power of litharge can be attributed to the higher alkalinity of the liquid. The nature of the potential/time curve and the bright appearance of the steel specimen suggest that the aqueous extract of litharge behaves as an

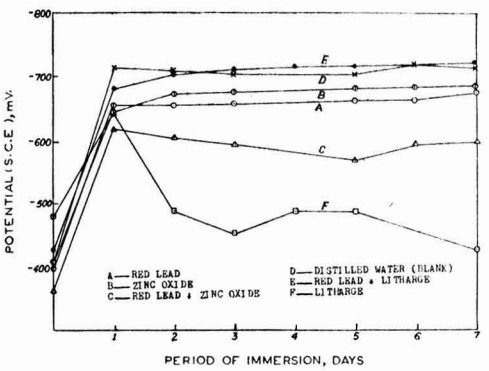

FIG. 1 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF PIGMENTS

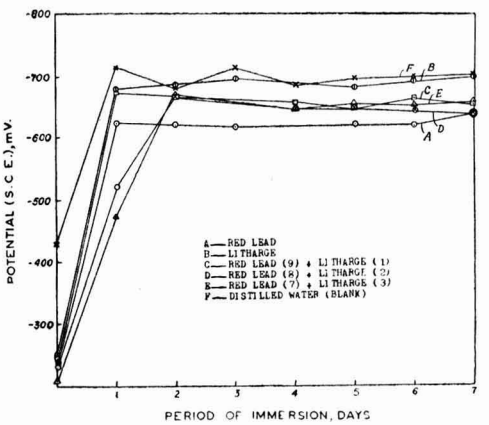

FIG. 2 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF PAINTS

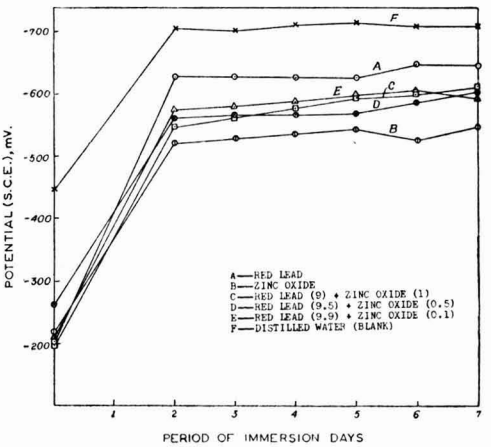

FIG. 3 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF PAINTS

TABLE 1 — *p*H OF AQUEOUS EXTRACTS OF PIGMENTS

PIGMENT	*p*H	
	Initial	Final
Red lead	8·1	8·0
Litharge	9·8	—
Zinc oxide	7·9	6·6
Red lead + litharge	8·9	—
Zinc oxide + red lead	8·1	8·3

TABLE 2 — *p*H OF AQUEOUS EXTRACTS OF PAINTS*

PIGMENT	*p*H	
	Initial	Final
Red lead	6·4	5·3
Litharge	6·8	—
Zinc oxide	6·5	5·6
Red lead + litharge (9:1)	6·5	—
Red lead + litharge (8:2)	6·6	—
Red lead + litharge (7:3)	6·9	—
Red lead + zinc oxide (9·9:0·1)	6·1	5·1
Red lead + zinc oxide (9·5:0·5)	6·0	5·2
Red lead + zinc oxide (9:1)	6·2	5·2

*The paints contain pigment and linseed oil.

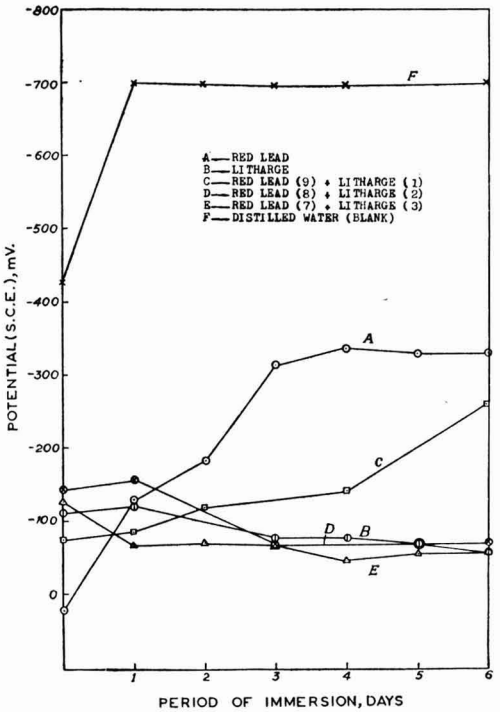

FIG. 4 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS COATED WITH LEAD OXIDE PAINTS (SECOND COAT ALLOWED TO DRY FOR 4 DAYS) AND PARTIALLY IMMERSED IN 3 PER CENT SALT SOLUTION

anodic inhibitor towards the corrosion of steel. This suggestion is in conformity with the conclusions advanced by Mayne[5] and Pryor[7].

A mixture of red lead and litharge (8: 2), however, shows different behaviour; the extract of the mixed pigments confers no protection to the steel (curve E, Fig. 1) although the *p*H value of its aqueous extract is higher than that of red lead extract. The mixture of red lead and zinc oxide (9: 1), however, shows better inhibitive action than either of the pigments alone (curve C, Fig. 1) and here again the result indicates no correlation between alkalinity of the pigment extract and the corrosion inhibitive value of the pigment.

Corrosion inhibitive action of paint extracts— Unlike litharge extract, the aqueous extract of the dried oil paint of litharge shows practically no passivating action on steel (Fig. 2). Initially the extract of the paint prepared from the mixed oxides of red lead and litharge (7: 3) affords greater protection to steel than the extract of the paint containing red lead alone; the latter, however, has better inhibitive action when the experiments are continued for 7 days. The initial improved behaviour is probably due to the higher *p*H value of the aqueous extract of the paint obtained from the mixed pigments (Table 2). The extract of the zinc oxide paint inhibits the corrosion of steel more effectively than red lead paint extract and the addition of zinc oxide to red lead improves the inhibitive value of the lead oxide paint (Fig. 3). None of the paint extracts is, however, capable of rendering water completely non-corrosive.

The partial inhibition brought about by the aqueous extracts of the oil paints cannot be explained in terms of alkalinity of the liquids, since the *p*H values of the extracts generally lie between 6·0 and 6·5, whereas distilled water has *p*H 6·8. It is possible that new compounds formed by the chemical reaction between lead or zinc pigments and linseed oil are responsible for the inhibitive behaviour of oil paints. The pigments, owing to their basic and oxidizing character, may react with the unsaturated fatty acids of the vehicle and produce zinc or lead

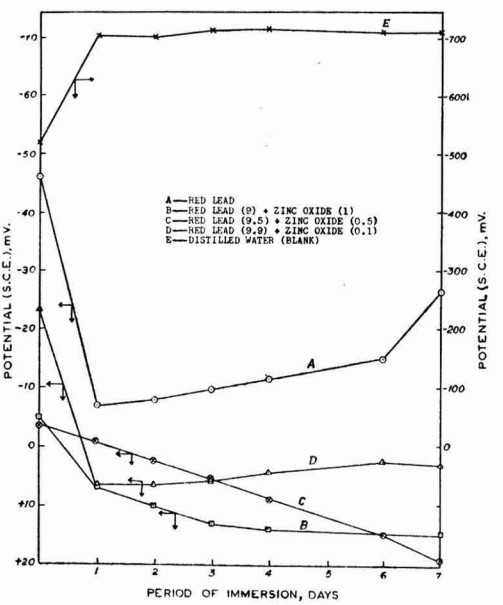

FIG. 5 — POTENTIAL/TIME CURVE FOR STEEL SPECIMENS COATED WITH OXIDE PAINTS OF LEAD AND ZINC (SECOND COAT ALLOWED TO DRY FOR 20 DAYS) AND PARTIALLY IMMERSED IN 3 PER CENT SALT SOLUTION

salts of various simpler organic acids. Mayne and Van Rooyen[9] showed that soaps are formed by the interaction of basic pigments and linoleic acid (the important constituent of linseed oil) and the aqueous extracts of the soaps contain metallic salts of several dibasic acids which can act as corrosion inhibitors. The final *p*H values of the paint extracts are between 5·6 and 5·1 and the lowering of the values with time indicates that more acidic compounds are formed probably owing to the action of the pigments on linseed oil.

The pigments react more easily with linseed oil when the paints are dried at higher temperatures and the reaction products thus formed may suppress the corrosion of steel more effectively. A slight improvement in the inhibitive property of litharge with increase in the drying temperature of the paint is evident from the results given in Table 3. In the case of red lead, however, the effect of temperature during drying of the paint is quite pronounced. The aqueous extract of the red lead paint dried at room temperature has slight passivating effect, whereas the paint dried at 100°C. makes water completely non-corrosive.

Protective action of paint coatings — The steel specimens coated with paints containing litharge or a mixture of red lead and litharge in the proportions of 8 : 2 and 7 : 3 are protected more effectively than those covered with red lead paints (Fig. 4). Litharge paint extract has practically no passivating properties. In the light of this it may be suggested that litharge improves mainly the mechanical properties of the paint coatings. The pigment, probably, helps in the polymerization of linseed oil and gives rise to an impervious film which gives better mechanical protection to the underlying metal.

The addition of zinc oxide to red lead also brings the potentials of the painted specimens to more positive values, indicating a beneficial effect due to the presence of zinc oxide in the paint (Fig. 5). In this case the improved behaviour of the mixed oxide paint may arise from the increase in both the chemical and mechanical properties of the paint caused by the presence of zinc oxide.

TABLE 3 — CORROSION OF STEEL PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF PAINTS

PIGMENT	DRYING TEMP. OF PAINTS °C.	LOSS IN WEIGHT AFTER 7 DAYS g.
Distilled water (blank)	—	0·0123
Litharge	30	0·0112
do	60	0·0081
do	100	0·0096
Red lead	30	0·0060
do	60	0·0004
do	100	nil

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Corrosion of Steel: Part II—Inhibitive Behaviour of Chromates, Molybdates & Tungstates of Zinc & Lead

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The inhibitive behaviour of chromates, molybdates and tungstates of zinc and lead against corrosion of steel has been investigated. The relative protective action of aqueous extracts of the zinc pigments falls in the following descending order: zinc molybdate, zinc chromate, zinc tungstate. Zinc chromate extract, while affording protection against corrosion, produces water-line attack. The corrosion inhibitive property of zinc molybdate can be attributed to two factors: (i) the slight solubility of the pigment in water, and (ii) its mild oxidizing action. Zinc tungstate, which is a weaker oxidizing agent than zinc molybdate, shows lower protective action. Lead compounds, which are almost insoluble in water, do not exhibit any protective action.

Applied in the form of oil paints (pigment+linseed oil), zinc molybdate retains its protective behaviour but zinc chromate completely loses its corrosion inhibitive property. No correlation is observed between the anti-corrosive property of any of the pigments or paints and the alkalinity of its aqueous extract.

SOME oxidizing agents have been shown to behave as corrosion inhibitors for metals[1,2], but the usefulness of such compounds as corrosion inhibitive pigments depends largely on their solubilities in water. A highly soluble pigment like sodium chromate cannot be employed in a paint, since it would be washed away by water. On the other hand, a completely insoluble pigment would completely fail to inhibit corrosion. A pigment with intermediate solubility is likely to produce satisfactory results. Thus strontium chromate, which is only slightly soluble in water, serves as an effective anti-corrosive pigment for magnesium alloys[3]. The inhibitive property of pigments may increase with increase in their oxidizing properties, but it has been observed that the strongly oxidizing compounds like permanganates often fail to protect iron satisfactorily. The role of the vehicle also needs consideration since in a completely waterproof paint coating, the inhibitive pigment cannot pass into solution. The inhibitive pigments like red lead and zinc chromate have been reported[4] to afford better protection in linseed oil than in media such as dehydrated castor and tung oils which have lower water absorption values. Wagner[5] has, however, reported that red lead and zinc chromate produce paint films with small pores and thus afford only mechanical protection to the underlying material.

Although some work has already been done on the protective behaviour of chromate pigments[6,7], no systematic and comparative study has been carried out on the anti-corrosive properties of chromate, molybdate[8] and tungstate pigments. The present investigation was undertaken with a view to study the corrosion inhibitive action of these pigments of zinc and lead, which have varying solubilities and oxidizing properties.

Experimental procedure

The experimental procedures were the same as described in Part I[9]. The chromates, molybdates and tungstates of zinc and lead were prepared in the laboratory by the usual methods[10]. Red lead (chemically pure), which was employed for comparison, was obtained from the market. Zinc chromate was prepared as the basic compound (zinc oxychromate); the other pigments were prepared as normal compounds.

Aqueous extracts of zinc chromate, zinc molybdate, zinc tungstate, red lead, lead chromate, basic lead chromate, lead molybdate and lead tungstate were prepared. The extracts of the zinc pigments were obtained by saturating distilled water with the pigments in glass bottles. Since the solubilities of the lead compounds were very low, the extracts were made by boiling distilled water in contact with the lead pigments for 1 hr. The weighed steel specimens were

then partially immersed in the aqueous extracts and the progress of corrosion was followed by potential/time data. After 7 days the specimens were washed thoroughly with water, cleaned and re-weighed. The loss in weight of steel indicated the amount of corrosion that had occurred in 7 days. The *p*H values of the extracts were determined before immersion of the steel specimens and also at the end of the experiments.

The paints were prepared by mixing the pigments separately with linseed oil so as to form a brushable paste. The paints were applied on the outer surfaces of small test tubes and were allowed to dry for 10 days. The painted test tubes were kept immersed in distilled water contained in glass bottles which were then shaken occasionally for 10 days to obtain aqueous extracts of the paints.

The weighed steel specimens were then partially immersed in the extracts and the corrosion of the specimens was studied by potential and weight-loss measurements.

The experiments with the extracts of pigments and paints were performed in duplicate (sometimes in triplicate) and the average values are given in potential/time and weight-loss data.

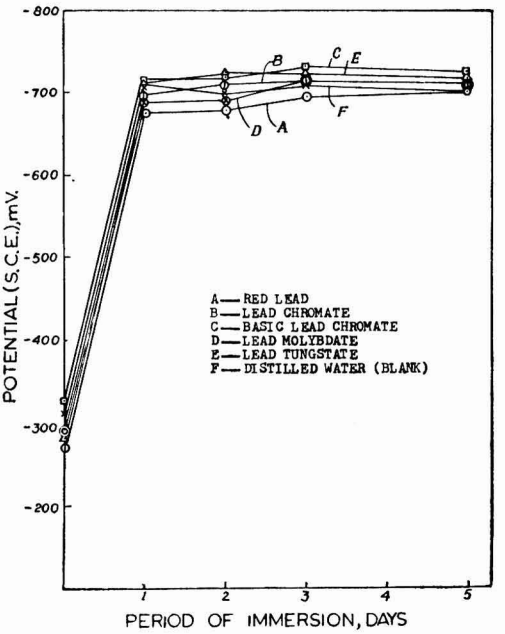

FIG. 2 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF LEAD PAINTS

Results and discussion

The potential/time data for the steel specimens partially immersed in aqueous extracts of paints are recorded in Figs. 1-4.

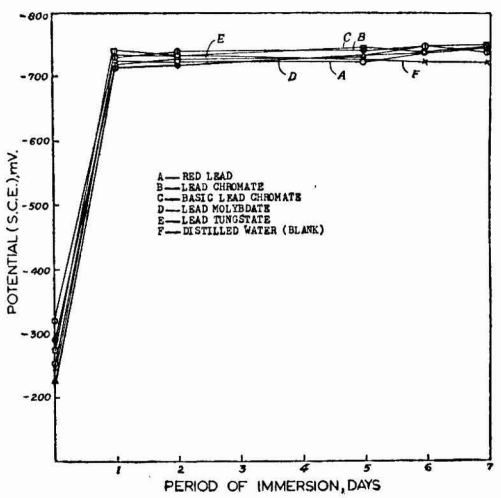

FIG. 1 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF LEAD PIGMENTS

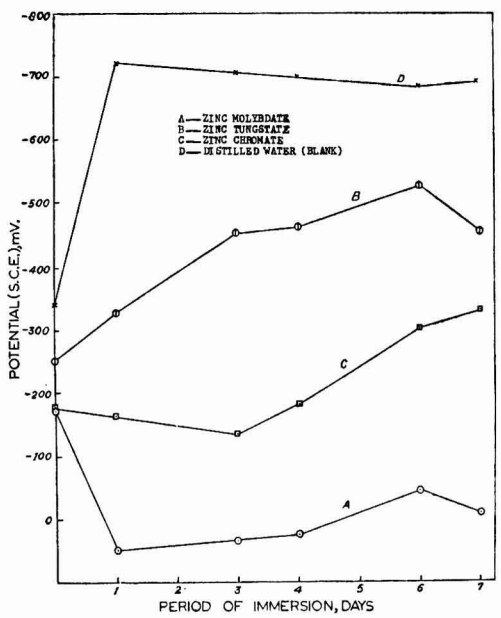

FIG. 3 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF ZINC PIGMENTS

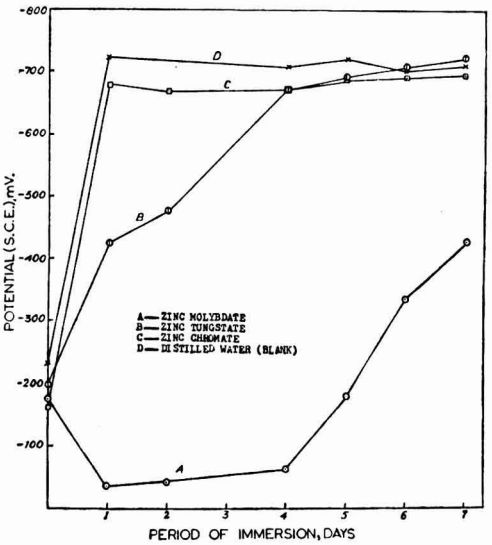

FIG. 4 — POTENTIAL/TIME CURVES FOR STEEL SPECIMENS PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF ZINC PAINTS

TABLE 1 — CORROSION OF STEEL PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF PIGMENTS

(Period of immersion, 7 days; immersed area of specimens, 4 × 2 cm.)

PIGMENT EXTRACT	INITIAL *p*H	FINAL *p*H	LOSS IN WEIGHT g.
Distilled water (blank)	6·8	5·6	0·0250
Zinc chromate	6·7	6·6	0·0162
Zinc molybdate	5·9	5·7	0·0022
Zinc tungstate	7·1	7·4	0·0123
Red lead	6·4	6·3	0·0365
Lead chromate	7·3	6·6	0·0290
Basic lead chromate	8·8	7·0	0·0335
Lead molybdate	7·0	6·6	0·0329
Lead tungstate	6·7	6·2	0·0309

TABLE 2 — CORROSION OF STEEL PARTIALLY IMMERSED IN AQUEOUS EXTRACTS OF PAINTS

(Period of immersion, 7 days; immersed area of specimens, 4 × 2 cm.)

PAINT EXTRACT	INITIAL *p*H	FINAL *p*H	LOSS IN WEIGHT g.
Distilled water (blank)	6·7	5·2	0·0296
Zinc chromate	6·6	5·5	0·0273
Zinc molybdate	5·9	6·0	0·0063
Zinc tungstate	6·5	6·0	0·0225
Red lead	6·9	5·9	0·0234
Lead chromate	7·1	6·1	0·0225
Basic lead chromate	7·2	5·9	0·0220
Lead molybdate	7·2	5·8	0·0216
Lead tungstate	7·1	6·3	0·0228

The *p*H values of the aqueous extracts obtained from the pigments and paints are shown in Tables 1 and 2, which also include the results of the weight-loss measurements.

Inhibitive action of pigments — The specimens covered with the aqueous extracts of zinc molybdate remain bright throughout the duration of the experiments and show no sign of rusting (Table 1). The zinc chromate extract has inhibitive action on the corrosion of steel, but it produces water-line attack. The steel specimens immersed in water saturated with zinc tungstate show rusting in portions only after 7 days of immersion. The extracts prepared from the lead pigments produce general corrosion of the specimens within 24 hr. of immersion; similar corrosion is also observed with the steel specimens immersed in distilled water.

The potential/time data (Fig. 3) indicate that on the basis of inhibitive action the zinc pigments fall in the following sequence: zinc molybdate, zinc chromate, zinc tungstate. In the case of lead pigments, the potential/time curves (Fig. 1) overlap and the compounds have hardly any anti-corrosive action on steel. The results of the weight-loss measurements (Table 1) are in general agreement with the potential values; they, however, reveal that the lead compounds stimulate the corrosion of steel to a small extent. Apparently zinc chromate inhibits the corrosion of steel immersed in it more effectively than zinc tungstate, but the total amount of corrosion is found to be slightly greater in the former case (Fig. 3). This discrepancy is due to the severe water-line attack produced by zinc chromate solution.

No correlation can be observed between the *p*H values of the extracts and the protective action of the liquids; for example, the initial *p*H value of the aqueous extract of zinc molybdate, which is most non-corrosive, is 5·9, whereas that of water 6·8.

The oxidizing character of the extracts falls in the following descending order: zinc chromate, zinc molybdate, zinc tungstate. Thus although zinc molybdate is a milder oxidizing agent than zinc chromate, it has a better anti-corrosive action on steel. Zinc chromate being a strong oxidizing agent may be easily reduced at the steel surface and thereby stimulate the corrosion of steel at the water-line where the replenishment of the inhibitor is slow[11]. The excellent corrosion inhibitive property of zinc molybdate may be attributed to two factors: (i) the slight solubility of the pigment in water, and (ii) its mild oxidizing property. Zinc tungstate has a lower inhibitive value than zinc

molybdate, probably due to its weaker oxidizing property. The lead pigments are insoluble in water and, therefore, show no protective action.

Inhibitive action of paints — The zinc molybdate paint shows good inhibition against the corrosion of steel (Table 2). The steel specimens covered with the aqueous extracts of molybdate paints remain bright in appearance for 5 days and slight amount of rusting is observed after this period. In the extract of zinc tungstate paint, rusting in portions of the steel specimens is seen after 2 days of immersion of the specimens. The extracts of lead paints show general rusting within 24 hr. of immersion of the steel specimens; the extracts, however, seem to reduce the corrosion of steel in the weight-loss experiments.

The results of the potential measurements are in agreement with the visual observations and indicate that zinc molybdate paint has the highest inhibitive property (Fig. 4). Initially, the aqueous extract of zinc tungstate paint affords partial protection of steel, but gradually the potentials move in the negative direction indicating that the extract loses its anti-corrosive property. The paints obtained from red lead and lead molybdate inhibit the corrosion of steel slightly during the first 2 days of immersion (Fig. 2). As in the case of pigments, the *p*H values of the extracts of the zinc and lead paints have no relation with their anti-corrosive properties.

The results of the present study indicate that zinc chromate can decrease the corrosion of steel under immersed conditions, but the pigment, in the presence of linseed oil, has practically no corrosion inhibitive property. The analysis of the aqueous extract of the zinc chromate paint shows the absence of chromate ion in the solution, but the extract of the molybdenum paint contains molybdate ion in a small concentration. This suggests that while zinc chromate remains locked up in the paint coating, zinc molybdate can pass into solution to passivate the steel surface.

Acknowledgement

The authors are much indebted to the Council of Scientific & Industrial Research, New Delhi, for financial assistance.

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Letters to the Editor

ELECTROLYTIC PREPARATION OF CUPROUS OXIDE FROM BRASS

THE ELECTROLYTIC OXIDATION OF BRASS using an alkaline sodium chloride solution has been taken up to produce cuprous oxide along with zinc oxide.

The cell used and the experimental procedure followed were similar to those employed earlier[1,2] in the preparation of cuprous oxide using copper anodes. In the preliminary experiments electrolysis was carried out at 80°C. using sodium chloride solution (10 per cent) containing 0·3 g./litre alkali as the electrolyte; the optimum anodic current density was found to be 5 amp./sq. dm. The product obtained was white in the beginning and was mostly zinc oxide thereby indicating a greater dissolution of zinc initially, but on prolonged electrolysis, it started developing a reddish tinge due to the formation of cuprous oxide. The amount of cuprous oxide formed fluctuated from hour to hour indicating that the dissolution of zinc and copper from brass during electrolysis was not uniform.

Results of experiments using both stationary and rotating anodes and varying the concentration of sodium chloride and alkali are given in Table 1. Using rotating anodes, the effect of varying the current density was also studied by carrying out the electrolysis for such periods as to dissolve the same amount of brass each time; a new anode was used for each experiment. Brass sheet ($\frac{1}{16}$ in. thick) of composition Cu: Zn, 60 : 40 was used in all the experiments. For making a rotating anode the sheet was bent into a cylindrical form. The electrolyte was heated to 80°C. and circulated through the cathode compartment at the rate of 5 litres/hr. The product was simultaneously syphoned out, filtered and the filtrate recycled. The product was washed free of chloride, stabilized and dried. The dried samples were used for studying the leachability of the zinc compounds. Nearly three times the theoretical quantity of alkali was found to be necessary to leach out the zinc completely. By estimating the moisture content of the product the leaching can be done in the wet state by adding the requisite amount of water and alkali.

The cuprous oxide left after leaching with alkali was carefully washed with alkali and water, stabilized and dried. To see whether the purity of the cuprous oxide was affected by the alkaline leaching procedure a sample of known purity was given a treatment similar to the leaching step and its purity

TABLE 1 — ELECTROLYSIS OF BRASS

(Temp., 80°C.; rate of circulation of electrolyte, 5 litres/hr.; current consumed, 2 amp. hr. except in the last 3 experiments where it was 5 amp. hr.)

Sodium chloride conc. %	NaOH and Na_2CO_3 g./litre each	Anodic c.d. amp./sq. dm.	Cell voltage V.	Yield g./amp. hr.	Product composition		
					Cu_2O %	Zinc %	Chlorine %
			Stationary anode				
10	0·3	5·0	2·00	2·12	37·8	35·5	1·38
18	0·3	5·0	1·75	1·78	32·9	44·0	0·52
25	0·3	5·0	1·50	1·97	45·8	35·4	0·16
25	1·0	5·0	1·50	1·95	40·4	32·3	0·45
25	1·5	5·0	1·50	2·06	43·0	36·4	0·46
			Rotating anode				
10	0·3	20·0	2·50	2·24	38·7	29·6	0·14
18	0·3	20·0	2·25	2·21	40·6	31·7	0·29
25	0·3	20·0	1·75	1·95	47·7	36·7	1·75
25	1·0	20·0	2·50	1·66	47·8	34·1	0·97
25	1·5	20·0	2·50 and above	1·95	46·1	33·4	0·35
25	0·3	50·0	2·50	2·00	48·0	32·3	2·45
25	0·3	100·0	3·25	2·03	52·9	33·2	2·34

determined. Except for a visible darkening in the shade of cuprous oxide, no change was observed in the purity.

The results in Table 1 show that increase in sodium chloride concentration in the electrolyte leads to a lowering of cell voltage and hence of energy consumption. Since the duration of electrolysis was kept constant and fresh anode was used every time, it is evident that increase in sodium chloride concentration increases the cuprous oxide content of the product even though the yield of the product/amp. hr. is reduced.

Increase in the alkali content of the electrolyte was not favourable and led to increase in cell voltage in the rotating anode cell. The product also showed a tendency to oxidize during processing.

The chlorine content of the products obtained with stationary and rotating anodes was rather irregular but the chlorine content was so low that the possibility of the presence of oxychlorides of any definite composition in the product did not appear to need closer investigation.

The rotating anode permits the use of current density 4-20 times higher than that used with the stationary anode. Using fresh anodes for each experiment and passing the same quantity of electricity, the cuprous oxide content of the product increases with increase in current density. The quality of the product was also reproducible.

The purity of the cuprous oxide obtained was of the order of 94-96 per cent and it conformed to I.S. specification[3], whenever the brass sheets (60: 40) used were free from other impurities. In the alkali leaching step undue exposure of the product to atmospheric oxidation has to be avoided in case the processing operation is long.

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12 *July* 1957

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Supplement

ABSTRACTS

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

JULY-SEPTEMBER 1957

No. 1, JANUARY 1958

Journal of Scientific & Industrial Research
1958, Vol. 17, No. 1

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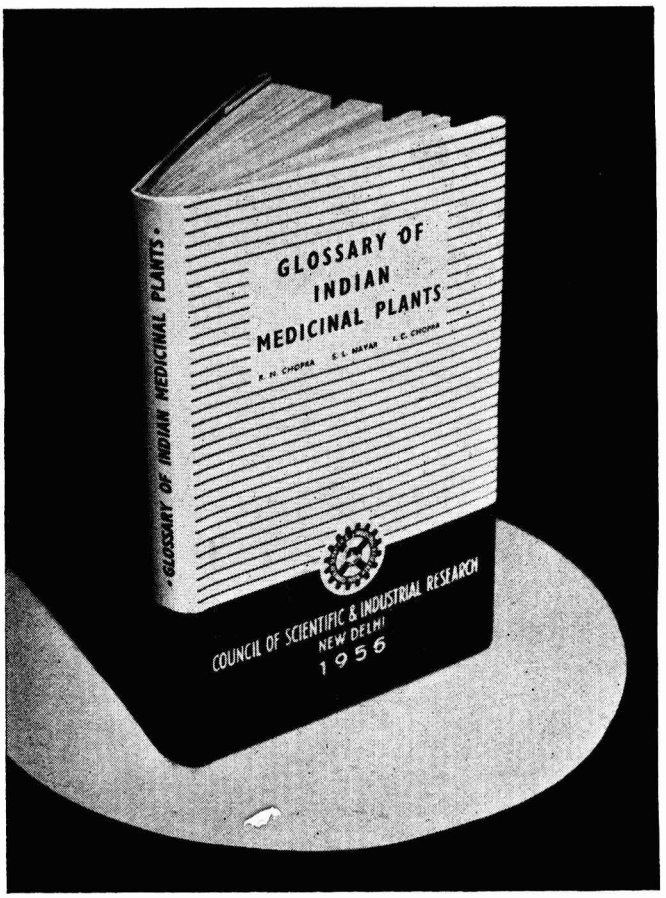
GLOSSARY OF INDIAN MEDICINAL PLANTS



An exhaustive compendium of information on the occurrence, distribution and uses of Indian medicinal plants

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I. C. CHOPRA

PUBLICATIONS DIRECTORATE, C.S.I.R.

OLD MILL ROAD, NEW DELHI 2

ABSTRACTS

C PHYSICS 53

C21 Physics of Solids 539.11

1. AGGARWAL, P. S. & GOSWAMI, A.: A new phase structure of molybdenum, *Proc. phys. Soc., Lond.*, **70** (1957), 708

Polymorphism is often exhibited by metals such as Ni, Co, Ag, Fe and Ca. Molybdenum, however, has so far only been observed in b.c.c. structure. Electron diffraction studies have shown that Mo evaporated in vacuum onto glass or rocksalt substrates in thin layers sometimes has a f.c.c. structure, $a_0=4{\cdot}16$A. This value of a_0 is slightly higher than the one calculated on the basis of the suggestion that the α-γ phase transition of Fe generally occurs in the interface (110), <111>, b.c.c. //(100), <110> f.c.c. A similar, though smaller, increase in lattice parameter has also been observed in the case of thin zirconium and thallium films.

C4 : 14 Conduction 536.2

2. SRIVASTAVA, K. P.: Force constants for like molecules on exp-six model from thermal conductivity, *Indian J. Phys.*, **31** (1957), 404

The Chapman Enskog theory of non-uniform gases has been utilized in determining the force parameters for some simple non-polar molecules on exp-six model from the observed variation of thermal conductivity with temperature. The method used is an adaptation of the Keesom and Lennard Jones procedures and has been applied to neon, argon, krypton and xenon. First the parameter a is fixed up and then translations are carried out to determine the parameters ϵ/k and r_m. To test the adequacy of the model both the equilibrium and non-equilibrium properties of gases have been computed by utilizing these experimentally determined potential parameters and the results compared with the observed values over an extensive range of temperatures. The agreement between theory and experiment is found to be quite satisfactory, showing thereby the adequacy of the exp-six model and the appropriateness of the potential parameters used.

3. SRIVASTAVA, B. N. & SAXENA, S. C.: Formulas for thermal conductivity of ternary gas mixtures, *J. chem. Phys.*, **27** (1957), 583

The thermal conductivities of ternary mixtures of neon, argon and krypton have been compared with those calculated from an extension of the Enskog's expression for the binary thermal conductivity from the Lindsay-Bromley formula. It is found that the latter generalization yields values which are in better agreement with the experiment, provided the two constants of the Lindsay-Bromley formula are determined experimentally from binary conductivity.

C5 : 73 Fluorescence 535.37

4. PANT, D. D. & PANDEY, B. C.: Fluorescence and absorption spectra of uranyl salts, *J. sci. industr. Res.*, **16B** (1957), 280

The intensity reversal in fluorescence and absorption of two bands A and B in the spectra of four uranyl salts has been studied. The various interpretations for the violet companions of the B bands have been discussed. It has been shown that the two bands are due to two close levels.

C56 Infrared Rays 535.61.1

5. DAS GUPTA, SHARDA & SINHA, A. P. B.: Infrared absorption by copper and nickel manganites, *Trans. Faraday Soc.*, **53** (1957), 909

The infrared spectra of nickel and copper manganites formed in solid state are analysed. The optical activation energy and the force constants for the stretching of bonds between the oxygen ions and the octahedral or tetrahedral cations have been calculated. The calculated force constants are used to evaluate the compressibility and the Debye temperature for these substances.

C6 Electricity 537

6. CHAUDHRI, MAN MOHAN: Electromotive forces of the electroplated thermocouple, *J. sci. industr. Res.*, **16B** (1957), 425

Sensitive thermocouples have been prepared for detecting minute changes in temperature. The e.m.f. developed by these thermocouples is given by the relation

$$E=E_{\circ}\frac{R_1}{R_1+\frac{p_{cu}S_{cu}}{m}}$$

where $E_{\circ}$ is the e.m.f. developed for the soldered thermocouple, R_1 is the resistance per cm. of the constantan wire, m, the mass deposited per cm., and p_{cu}, S_{cu}, the density and the specific resistance respectively of the deposited metal.

C6 : 14 Electrical Conduction 537.311

7. KRISHNAJI & SRIVASTAVA, G. P.: A three centimetre microwave bench for studying the pressure and temperature effects on dielectric behaviour of gases, *J. sci. industr. Res.*, **16A** (1957), 289

A sensitive three cm. microwave bench for studying the effects of temperature and pressure on absorption and dispersion of microwaves in gases has been set up. The gas cell is a 7 ft. rectangular waveguide bent in a suitable shape so that it can be put inside temperature controlled chambers. Two chambers have been used to cover the range from 30° to 80°C. Several components of the bench have been designed and made in the laboratory. The insertion loss and S.W.R. of components is very satisfactory. The minimum measurable value of absorption coefficient (α) is $0{\cdot}5\times10^{-6}$ per cm. and that of electric susceptibility (δ), 2×10^{-5}.

C7 Magnetism 538

8. LAKHBIR SINGH,: "Satellite-electron" theory of ferromagnetism, anti-ferromagnetism and related phenomena, *Naturwissenschaften*, **44** (1957), 417

The orbit of the free 3d electron in the transition metal ions undergoes a distortion due to the repulsion from electron clouds of the surrounding ions. This denting reaches a maximum limit in a contracting lattice as the magnetic substance is cooled down to its Curie point. The orbit of the free 3d electron becomes untenable at this stage and further cooling results in the ejection of this electron into two types of satellite orbits formed round the parent cation through the annular space between the surrounding ions. Equatorial satellite orbits of two neighbouring cations couple with each other and cause anti-ferromagnetism. Smaller latitudinal satellite orbits formed round the bond contacts remain uncoupled and cause ferromagnetism.

C9B2 Atomic Physics 539.15

9. MURTY, B. V. R.: Experimental atomic form factor curves for carbon and oxygen of anthraquinone, *J. sci. industr. Res.*, **16B** (1957), 384

An empirical method has been developed for the derivation of scattering factor curves for different kinds of atoms of a substance, when one of its Fourier projections is well resolved. Applying the method to anthraquinone, scattering factor curves for its oxygen, carbon bonded with oxygen and one of the other carbons have been derived.

C9D1 Low Temperature Physics 536.48

10. RAMANATHAN, K. G. & SRINIVASAN, T. M.: Lattice and electronic specific heats of copper and silver, *J. sci. industr. Res.*, **16B** (1957), 277

The variation of atomic heats of copper and silver has been investigated in the liquid

helium range of temperature (4·2°-1·3°K). They can be represented by C_v (copper) = $(1{\cdot}728 \pm 0{\cdot}066)\,10^{-4}T + (0{\cdot}125 \pm 0{\cdot}002)\,10^{-4}T^3$, and C_v (silver) = $(1{\cdot}471 \pm 0{\cdot}023)10^{-4}T + (0{\cdot}439 \pm 0{\cdot}003)10^{-4}T^3$.

D ENGINEERING 62

D1 Civil Engineering 624

11. RAMASWAMY, G. S.: Non-destructive testing of concrete by ultrasonic pulse, *Indian Concr. J.*, **31** (1957), 213

The possibilities of using the ultrasonic technique to determine the dynamic modulus of elasticity, cracks, deterioration, hardening, etc., have been discussed along with the details of the construction of the apparatus.

D65 Electronics 621.38

12. LAL, J. B.: Effect of terrain on vertical polar diagrams, *J. sci. industr. Res.*, **16B** (1957), 330

Vertical polar diagrams of a horizontal folded dipole aerial using different types of terrain have been studied at 1500 Mc/s. Reinforced concrete and cement building materials (which behave as conductors at ultra-high frequencies) do not show the reflecting properties so markedly as a metallic ground, e.g. copper or galvanized iron, at the microwave frequency used. Nordex is almost transparent to these high frequencies and can be conveniently used to form a container for loose test materials.

E CHEMISTRY 54

E : 21 Chemical Mechanics 541.12

13. (Miss) RAZIA OSMANI & DATAR, D. S.: Reactions of sulphates at high temperature: Part II—Thermal decomposition of alkaline earth sulphates and their mixtures in presence of aluminium oxide, *J. Indian chem. Soc., industr. Edn.*, **20**(1) (1957), 1

The effect of alumina on the thermal decomposition of alkaline earth sulphate mixtures has been studied. The decomposition is accelerated in all the cases, on account of the formation of aluminium sulphate or fusible aluminates at the intermediate stage. These intermediate reaction products, which are in liquid phase at the reaction temperature, accelerate the reaction by increasing the mobility of the reactants.

A method is suggested for the economic production of sulphur dioxide from gypsum and sodium sulphate. The reactions pertaining to this process have been studied in detail. The process appears profitable as valuable byproducts like sodium hydroxide and pure alumina may be recovered.

E : 232 Surface Chemistry 541.183

14. GOVINDAN, K. P. & BAFNA, S. L.: Molecular sorption on ion-exchange resins: Part II—Phenol sorption-desorption studies, *J. sci. industr. Res.*, **16B** (1957), 321

In continuation of studies of molecular sorption on ion-exchange resins, column study of phenol sorption-desorption on these resins has been made. The results indicate that equilibrium is attained quite fast for sulphonic acid resin, slowly for carboxylic acid resin and very slowly for phenolic resin; the process of sorption-desorption is reversible; the overall concentration of non-ionic material in the desorption effluent is not significantly different from that in sorption influent; and sorption of non-ionic material can be carried out in the presence of strong acids and salts.

E : 26 Electrochemistry 541.13

15. GOSWAMI, A.: Effect of addition agents on the plating of nickel, *J. sci. industr. Res.*, **16B** (1957), 315

The effect of addition agents and brighteners on cathodic crystal growth in a Watt's type of nickel-plating bath with a *p*H favourable to lateral growth has been studied by electron diffraction. Addition agents producing a high cathode polarization gave rise to outward growth deposits.

16. MURTY, C. R. K.: Relaxation time and nature of the orienting unit, *J. sci. industr. Res.*, **16B** (1957), 334

The relaxation times of phenol, *ortho*- and *para*-chloro-phenol, aniline and benzyl alcohol have been determined in benzene solutions at 9515 Mc/s. and 30°C. The radii

of the molecules have been calculated from the measured relaxation times. An attempt has been made to use the data for ascertaining whether part rotation can take place in these molecules. The conditions under which segment orientation can take place in the molecules have been indicated.

17. RASTOGI, R. P. & RAMA VARMA, K. T.: Lattice energies of molten mixtures of electrolytes, *Trans. Faraday Soc.*, **53** (1957), 1165

Phase equilibria of mixtures of electrolytes have been investigated. The KCl+KF, NaF+KF, and NaF+NaCl systems have been found to be approximately ideal and the KCl+AgCl system symmetrically regular.

The lattice energies of the molten mixture are calculated using an expanded lattice model and Vegard's law for lattice spacings. The values are compared with the corresponding ones calculated by an independent method which is based on a knowledge of the lattice energies of the pure molten electrolytes and the heat of formation of the mixture. The agreement between the two sets of values for ideal systems is satisfactory. The limitations of the model have also been discussed.

E : 288 Polymerization 541.64

18. JOSHI, R. M. & KAPUR, S. L.: The temperature dependence of monomer reactivity ratios in copolymerization, *J. sci. industr. Res.*, **16B** (1957), 379

The effect of temperature on the monomer reactivity ratios in copolymerization has been investigated for two binary systems. A new statistical procedure is described for uniform and precise computation of the reactivity ratios at different temperatures. The temperature dependence thus determined indicates a major influence of the activation energies and insignificant entropy factors in guiding the trend of the competitive propagation steps.

E : 3 Analytical Chemistry 543

19. BAWA, M. S.: A method for determination of carbonate carbon dioxide in coal, *J. Instn Chem.* (*India*), **29** (1957), 201

A single determination of carbonate carbon dioxide in coal takes several hours to complete. In this paper, a simple gravimetric method, which gives results of high accuracy and takes about 20 minutes for one single determination, is described. The method was tested with pure Iceland-spar (99·7 per cent) and with samples of coal containing carbon dioxide in the range 0·1-2·7 per cent.

20. DATTA, SACHINDRA KUMAR: Analytical aspects of some organic compounds: Part VI—2-Hydroxy-3-naphthoic acids in the determination of thorium and zirconium, *J. Indian chem. Soc.*, **34** (1957), 531

2-Hydroxy-3-naphthoic acid and its acetyl, bromo, iodo, nitro and nitroso derivatives have been used for the gravimetric determination of thorium and zirconium. Separations of thorium from the cerite earths and of thorium and zirconium from a number of foreign ions have been carried out with the bromo, iodo, nitro and nitroso compounds. They may also be used for the extraction of thorium from monazite sands. A considerable amount of zirconium may be separated from a smaller quantity of thorium when present in a mixture. Separation of thorium from uranium with the bromo, iodo and nitro compounds has also been described.

21. KAILASH CHANDER & SESHADRI, T. R.: Leucoanthocyanidin in cottonseed, *J. sci. industr. Res.*, **16A** (1957), 319

Cottonseed hulls contain appreciable quantities of leuco-delphinidin. It is not found in the kernels. Damaged seeds sometimes develop a red colour which seems to be due to phlobaphenes derived from the leucoanthocyanidin.

22. KAPUR, N. S., NARAYANAN, K. M., BAINS, G. S. & BHATIA, D. S.: Application of thiobarbituric acid reagent to the colorimetric determination of vanillin, *Chem. & Ind.*, (1957), 1272

A colorimetric method based on the reaction between thiobarbituric acid and vanillin has been developed for the determination of micro quantities of vanillin. The coloured complex shows a single absorption peak at 432-434 mμ at which it obeys Beer's law.

23. MAZUMDAR, S. K. & BANERJEE, N. G.: A volumetric method for the determination of sulphur in coal, *J. Instn Chem.* (*India*), **29** (1957), 213

The usual gravimetric method for the determination of sulphur in coal by Eschka

process is time-consuming. The paper suggests a volumetric method in which the precipitate, $BaSO_4$, is dissolved in an excess of a standard ammoniacal solution of disodium dihydrogen ethylenediamine tetraacetate (versenate) and the excess of versenate is titrated against standard magnesium chloride solution using solochrome black as indicator.

24. VERMA, M. R. & RAMJI DAS: Application of reverse-phase chromatography to the analysis of fat-soluble dyes, *Naturwissenschaften*, **44** (1957), 351

Filter paper (Whatman No. 1) was modified by treatment with (i) liquid paraffin, (ii) oleic acid, (iii) silicone and (iv) acetic anhydride-acetic acid and thus rendered water repellent. Chromatography of a number of fat-soluble dyes was carried out on these papers and R_f values recorded using a number of developing agents.

E5 Organic Chemistry 547

25. ACHARYA, R. V., TILAK, B. D. & VENKITESWARAN, M. R.: Quinone Series: Part X — Benzo-*bis*-naphthofuranquinones, *J. sci. industr. Res.*, **16B** (1957), 400

Brazanquinone vat dyes have been synthesized from 2: 3-dichloro-1: 4-naphthoquinone and naphthols. Condensation of chloranil with naphthols gave benzo-*bis*-naphthofuranquinones. The mechanism of these reactions has been studied.

26. JOSHI, C. G. & KULKARNI, A. B.: Anthoxanthins: Part V — A convenient method for the synthesis of flavan-3:4-diols: Synthesis of flavan-3:4-diols related to melacacidin, *J. sci. industr. Res.*, **16B** (1957), 307

A convenient method is described for the synthesis of flavan-3:4-diols by the reduction of dihydroflavonols with lithium aluminium hydride. Catalytic reduction of dihydroflavonols is stereospecific and gives only one isomer. The reduction of 7, 8, 3′, 4′-tetramethoxy-dihydroflavonol gave the corresponding flavan-3: 4-diols isomeric in position-4. None of the diols obtained was identical with melacacidin ether.

27. JOSHI, C. G. & KULKARNI, A. B.: Anthoxanthins: Part VI—Synthesis of the third racemate of 6-methyl-4′-methoxy-flavan-3: 4-diol, *J. sci. industr. Res.*, **16B** (1957), 355

Two 6-methyl-4′-methoxy-3-bromoflavanones isomeric in position-3 have been synthesized and reduced with lithium aluminium hydride to the corresponding 3-bromo-4-ols. By replacing bromine of one of these bromohydrins the diacetate of the third racemate of flavan-3:4-diol was synthesized. Attempts to convert the other bromohydrin to the fourth racemate were unsuccessful.

28. KAPOOR, R. N. & MEHROTRA, R. C.: Organic compounds of zirconium: Part I—Reaction of zirconyl chloride with mandelic acid, *J. sci. industr. Res.*, **16B** (1957), 300

The precipitation reaction between zirconyl chloride and mandelic acid has been studied under different conditions. Even with excess of mandelic acid (up to 4 moles), the precipitate corresponded to a mono-mandelate. The composition of the precipitate varies on increasing the concentration of the reacting solution or on increasing the acidity of the medium above 0·1N. In the presence of 2·4N hydrochloric acid, the tetra-mandelate begins to precipitate. Preliminary conductometric titration of zirconyl chloride solution with mandelic acid has been carried out.

29. KAPOOR, R. N. & MEHROTRA, R. C.: Organic compounds of zirconium: Part II—Reactions of zirconyl chloride with sodium mandelate, *J. sci. industr. Res.*, **16B** (1957), 304

Reaction between zirconyl chloride and sodium mandelate has been studied using different molar ratios of the reacting solutions. Contrary to earlier observations the precipitate is mainly mono-mandelate. In this respect, the reaction has been shown to be similar to the reaction between zirconyl chloride and mandelic acid in dilute neutral solutions. The two reactions have, however, been shown to differ in that the precipitated mono-mandelate begins to dissolve in sodium mandelate when the ratio of mandelate: zirconium exceeds 2. A preliminary study of the reaction has been carried out by

conductometric and electrometric titration methods.

E5 : 4 Organic Synthesis 547.1

30. CHATTERJEE, ASIMA & CHAUDHURI, NARAYAN ADITYA: A new synthesis of β-hydroxy-β-*p*-methoxyphenyl ethylamine and aegelin, the alkaloid of *Aegle marmelos* Correa, *Sci. & Cult.*, **23** (1957), 155

The constitution of aegelin, an alkaloid of *Aegle marmelos* Correa, has been determined as N-(2-*p*-anisyl-2-hydroxy-ethyl)-cinnamide. A simple and elegant synthesis of this amide and the corresponding amine dl-β-hydroxy-β-*p*-methoxyphenyl ethylamine has been achieved. The key intermediate for the synthesis of the amine is anisaldehyde cyanhydrin which on reduction with lithium aluminium hydride produces dl-β-hydroxy-β-*p*-methoxyphenyl ethylamine and the latter with *trans*-cinnamoyl chloride forms aegelin. Identity of the synthetic and natural products has been established from a comparative study of their properties, ultraviolet and infrared spectra, R_f values and from their mixture melting points.

E95 Pigments 547.97

31. AHLUWALIA, V. K. & SESHADRI, T. R.: Special chemical components of commercial woods and related plant materials: Part VI — *Tectona grandis* (Teak), *J. sci. industr. Res.*, **16B** (1957), 323

The sapwood contains small quantities of tectoquinone (2-methyl-anthraquinone) and glucose. The bark contains *c.* 1 per cent of a triterpenoid compound whose properties and those of its derivatives agreed with those of betulinic acid. This has been confirmed by its conversion into betulin using lithium aluminium hydride.

32. PAVANARAM, S. K. & ROW, L. RAMACHANDRA: Chemical examination of *Tectona grandis* Linn.: Part I — Isolation of 3-hydroxy-2-methyl anthraquinone, *J. sci. industr. Res.*, **16B** (1957), 409

From the heartwood of teak, 3-hydroxy-2-methyl anthraquinone has been isolated, besides 2-methyl anthraquinone (tectoquinone) previously isolated by Kafuku and Sebe from teak wood. A third colourless neutral compound has also been isolated from the petroleum ether and ether extracts.

E9G Biochemistry 577.1

33. BANERJEA, A.: A comparative study of the amino acid composition of certain serotypes of *Escherichia coli*, *Ann. Biochem.*, **17** (1957), 67

Sixteen serotypes of *Escherichia coli* consisting of (i) strains widely accepted as pathogens like 0111 B4, 055 B5, 026 B6 and 086 B7 types, (ii) strains which may or may not be pathogens like 073, 0119, 028, 04, 02, 06 types and (iii) non-pathogenic types like 076, N1, N2, N3, N4 and N5, in the production of infantile diarrhoea, were analysed quantitatively by the paper chromatographic method, for their amino acid contents. It was found that very marked variations occurred in the quantities of amino acids present between individual strains. Tryptophan, histidine, proline, arginine, aspartic acid, glutamic acid, lysine, serine, glycine, threonine, alanine, tyrosine, valine, methionine, leucines, phenylalanine, cystine, cysteine and ergothionetine were found in all the strains. α-Aminobutyric acid and cysteic acid were also present in some of the strains. But when examined groupwise, no significant variations in the amino acid compositions of the groups could be observed.

34. CHAUDHURI, S. N., GHOSH, S. N. & ROY, M. K.: Studies on the nature of renal damage by nephrotoxic serum: Part II — Rate of phosphate release from adenosine triphosphate by nephropathic kidney in guinea-pigs, *Ann. Biochem.*, **17** (1957), 73

It was reported earlier that phenol sulphonphthalein uptake by renal cells of guinea-pigs treated with anti-kidney sera (AKS) was significantly lowered. Such uptake might require adenosine triphosphate (ATP) as immediate source of energy. ATPase activity in kidney homogenate was assayed and its kinetics have been partially delineated. Nephrotoxic serum has been shown to depress ATPase activities in guinea-pigs. Anti-Forssman anaphylaxis seems to have doubtful effect while haemorrhagic shock presents a stimulating effect.

35. GUPTA, P. S., GHOSH, S. N. & CHATTERJEE, JYOTIRMOY: Phosphatase activity in guinea-pig kidney: The effect of *p*H shift — A comparative study of histochemical and chemical methods, *Ann. Biochem.*, **17** (1957), 97

A quantitative method for the determination of alkaline phosphatase activity by histochemical means has been described and a comparative study of biochemical and histochemical assay of enzyme activity of the same guinea-pig kidney tissue has been made.

The readings available with slides incubated at different *p*H ranges as also readings obtained by biochemical means have been plotted against *p*H. A striking similarity between the two graphs has been noted.

36. GHOSH, S. N., ROY, M. K. & CHAUDHURI, S. N., Studies on the value of renal damage by nephrotoxic serum: Part III — Studies of phosphomonoesterases of nephropathic kidney in guinea-pigs, *Ann. Biochem.*, **17** (1957), 79

Dephosphorylation of adenosine triphosphate (ATP) by kidney of guinea-pigs treated with nephrotoxic serum has been shown to be significantly lowered. In order to investigate whether other dephosphorylating processes are also involved in the damage, phosphomonoesterases of guinea-pig kidney have been assayed and some of their properties described. It has been found that nephrotoxic serum has no influence on the dephosphorylating rates of phosphomonoesterases at *p*H 9·4, 6 and 4.

37. KAR, A. B., KARKUN, J. N. & DE, N. N.: The effect of 19-nortestosterone on the adrenal cortex of rat, *Acta endocr.*, **25** (1957), 238

19-Nortestosterone, when injected alone in graded doses (0·5, 1·5 and 3 mg. daily for 10 days), has no effect on the adrenal cortex of rats as judged by both biochemical and histochemical criteria. Nevertheless, simultaneous administration of this compound protects the adrenal cortex from the inimical effects of cortisone. But such adrenal-sparing capacity of 19-nortestosterone seems somewhat limited in the dosage used (1·5 mg.) as some residual effects of cortisone treatment could be seen in the cortex. In animals pretreated with cortisone, this compound does not hasten the recovery of the cortex.

38. MUKHERJEE, S., ACHAYA, K. T., DEUEL, H. J. & ALFIN-SLATER, R. B.: The nature of lipids in rat blood, *J. biol. Chem.*, **226** (1957), 845

Rat blood lipids have been chromatographically separated into various fat components and the fractions examined for component fatty acids by iodimetry and spectrophotometry following alkali-isomerization. Normal rat blood lipids consist of 49 per cent phospholipids, 33 per cent cholesterol esters (with the highest iodine value of the three categories) and 18 per cent triglycerides, excluding about 6 per cent free cholesterol. Saturated acids predominate in all categories (56-77 per cent), oleic acid is completely absent and linoleic acid contributes 10-25 per cent. Tetra- and hexaenoic acids are also definitely present. On fat-deficient diets, there is a marked shift to oleic acid, which now comprises 40-50 per cent, with depression of both saturated and linoleic acid contents, and an overall decrease in iodine value. 200 mg. of the methyl ester of linoleic acid, an essential fatty acid, is sufficient to restore the normal blood picture.

39. ROY, DURLAV K.: Absence of inositol in crystalline fungal alpha-amylase, *Ann. Biochem.*, **17** (1957), 127

Crystalline fungal alpha-amylase was tested for the presence of inositol to find out whether inositol was a co-factor or formed part of any prosthetic group of the active amylase molecule. A portion of the crystalline amylase was hydrolysed with dilute hydrochloric acid and the hydrolysate was tested with the help of microbiological assay technique using *Saccharomyces carlsbergensis* No. 4228. Inositol was found to be absent.

F TECHNOLOGY 66

40. MANI, J. V. S., SRINIVAS, V., SUBBARAO, V. & NARASINGARAO, M.: Atomization by pressure nozzles: II — Characteristics of swirl thread nozzle, *Trans. Indian Inst. chem. Engrs*, **8**(2) (1955-56), 151

The effect of tangential and vertical velocity components on 'atomization' in a swirl thread nozzle using water is examined.

41. SRINIVAS, V., SUBBARAO, V. & NARASINGARAO, M.: Atomization by pressure nozzles: Swirl disk nozzle, *Trans. Indian Inst. chem. Engrs*, **8**(2) (1955-56), 111

In a programme of investigations on 'Atomization of liquids' by nozzles, swirl disk nozzle was chosen as a type for study. The total flow rate, volume rate distribution, drop size distribution, and cone angles were determined. Correlations for the effect of pressure on total flow rate, volume rate distribution, drop size distribution, cone angle and capacity were also attempted.

F191 Metallurgy 669

42. DAS GUPTA, S. B. & NARAYANAN, P. I. A.: Beneficiation of a lateritic iron ore from Rajhara Pahar, Madhya Pradesh, *J. sci. industr. Res.*, **16A** (1957), 373

A lateritic iron ore from Rajhara Pahar, Madhya Pradesh, assaying Fe, 34·14; SiO_2, 19·24; Al_2O_3, 18·02; TiO_2, 1·10 and P, 0·13 per cent, was subjected to washing, tabling, magnetic separation, magnetic separation after magnetizing, reduction roast, and flotation methods of beneficiation were studied. A good grade of concentrate could not be obtained by any of the above processes due to the intimate association of alumina and silica with the ferruginous minerals.

43. DAS GUPTA, S. B. & NARAYANAN, P. I. A.: Recovery of sulphur and gold from the tailings of Nundydroog Mines, Kolar Gold Fields, *J. sci. industr. Res.*, **16A** (1957), 374

A sample of gold tailing from Nundydroog Mines, Kolar Gold Fields, assaying total S, 1·58; sulphate S, 0·47; Fe, 10·69; Al_2O_3, 7·97; SiO_2, 58·93; CaO, 7·13; MgO, 5·47 and As, 0·46 per cent, with traces of Cu and 0·5 dwt. of gold per ton, was studied in order to assess the possibilities of recovering sulphur. Flotation did not produce a suitable grade of sulphur concentrate but recovered 45·1 per cent of gold in a concentrate of grade 4·8 dwt./ton. This concentrate on roasting and cyanidation extracted 95·9 per cent of gold which was equivalent to a recovery of 43·3 per cent gold with respect to the original sample. The low grade of sulphide concentrate with its high arsenic content precluded the possibility of its utilization as a source of sulphur, but there were indications that the gold content in the sample could be recovered.

44. SHARMA, U. C. & NIJHAWAN, B. R.: Moulding characteristics of Jubbulpore pale grey sand, *J. sci. industr. Res.*, **16A** (1957), 424

The moulding characteristics of a sand sample from Jubbulpore have been studied. The sample is suitable for dry sand moulding for steel castings, particularly for medium and heavy jobs.

F55 Fuel Technology 662.6

45. MAJUMDAR, N. C.: Firing of Bull's trench kiln, *Indian Builder*, **5**(9) (1957), 23

Improvement in the firing of the common Bull's trench kiln is suggested through a predetermined schedule of firing, by regulating the feed, avoiding accumulation of partially burnt fuel on the kiln floor and advancing the fire to a fresh line only when good bottom heat is secured. Kiln draught is controlled by using an adjustable damper and correctly positioning the chimneys.

46. SRINIVASAN, S. R. & BASAK, N. G.: Decomposition of lower alcohols over a Fischer-Tropsch iron catalyst, *Fuel, Lond.*, **36**(3) (1957), 277

The decomposition of lower aliphatic alcohols was studied at normal pressure over a Fe: Cu: MgO: K_2O catalyst and at high vapour space velocities with a view to obtaining a clue to the mechanism of the Fischer-Tropsch reaction. The decomposition reaction is a complex one involving many side reactions, such as dehydration, dehydrogenation and condensation. Ethanol and *iso*-propanol decompose almost completely, while about 70 per cent of the *iso*-butanol reacts under the same conditions. Primary alcohols differ from the secondary in the manner of dehydrogenation, condensation and carbon dioxide formation. Hydrocarbons and high boiling condensation products are most easily formed from ethanol, and yields of these products fall as the molecular weight of alcohols increases. That free methylene radicals are formed is evident from the chain lengthening of the various products. Olefines, carbon monoxide and hydrogen formed during decomposition may subsequently condense to give 'oxo' products. Ester yields are high for ethanol. The study of these reaction products suggests that alcohol-like complexes may be formed as intermediates in a Fischer-Tropsch reaction.

F551 Coal Technology 662.66

47. IYENGAR, M. S. & LAHIRI, A.: The nature of reactive groups in coal, *Fuel, Lond.*, **36**(3) (1957), 986

The heats of wetting in methanol, water and chlorobenzene for coals of different rank are compared with their corresponding hydrogen bonding energies as calculated from the reactive oxygen groups. It is shown that assumption of —OH . . . O=C— bonding in coals of carbon content below 85 per cent gives remarkably good agreement between the two values. It is also shown that there is excellent correlation between the S_0 obtained from the B.E.T. equation from sorption isotherms of coals using reactive oxygenated groups obtained after making the necessary allowance for —CH . . . O=C— bonding.

48. IYENGAR, M. S. & SUBRAMANIAM, T. A.: Briquetting of Indian coals: Part V — Briquetting performance of coals of different rank, *J. sci. industr. Res.*, **16A** (1957), 359

The strength of briquettes obtained from coals of different ranks has been found to be influenced by the degree of comminution, briquetting pressure and moisture content. The extent to which these variables influence the strength depends on the rank of coal. Maximum strength is obtained when briquetting is carried out at a moisture corresponding to the air-dried moisture content (at 60 per cent relative humidity and 40°C.). The order of variation of strength under optimum briquetting conditions, however, is: medium rank < high rank < low rank coals. Strong briquettes can be obtained from all ranks of coal (—72 mesh B.S.S.) on compressing at suitable pressures. For coals containing less than 76 and more than 88 per cent carbon, the minimum briquetting pressure is 5 tons/sq. in. For coals having carbon between 76 and 88 per cent it is above 12 tons/sq. in.

49. MAZUMDAR, B. K., BHANGALE, P. H. & LAHIRI, A.: Further studies on the reactive oxygen groups in coal, *Fuel, Lond.*, **36**(3) (1957), 307

Estimation of hydroxyl groups in different ranks of coals and vitrain (C=65-91 per cent) has been done by acetylation. In lower ranks of coal (C=85 per cent) a constant proportion of oxygen occurs in hydroxyl form (43 per cent in coals and 53 per cent in vitrains). It is suggested that higher hydroxyl contents in vitrains account for their more pronounced hydrophilic character. The probable significance of the results to the mechanism of coalification is also indicated.

50. SIBAL, D. N., GHOSH, R. S. & IYENGAR, M. S.: Briquetting of Indian coals: Part IV — Carbonization of lignite briquettes, *J. sci. industr. Res.*, **16A** (1957), 321

The influence of moisture and rate of heating on the carbonization of South Arcot and Palana lignites at 600° and 850°C. has been determined. Briquettes with 3500-6000 lb./sq. in. compression strength can be obtained by maintaining moisture below 5 per cent and the rate of heating below 5°C./min.

F56 Drugs 615.54

51. GOPALCHARI, R.: Studies in potential amoebicides: Part IV — Synthesis of 4-substituted aminomethyl-5-chloro-8-methoxyquinolines, *J. sci. industr. Res.*, **16C** (1957), 143

Some 4-substituted aminomethyl-5-chloro-8-methoxyquinolines have been synthesized by the application of Sonn-Muller reaction to N-substituted amides of 5-chloro-8-methoxycinchoninic acid. Attempts to convert these compounds into the corresponding 8-hydroxy derivatives were unsuccessful.

52. IYER, R. N., NITYA ANAND & DHAR, M. L.: Studies in potential amoebicides: Part V — Synthesis of 3-alkyl-8-hydroxy-(and 8-methoxy)-3 : 4-dihydroquinazolines, *J. sci. industr. Res.*, **16C** (1957), 157

Some 3-alkyl-8-hydroxy- and 8-methoxy-3:4-dihydroquinazolines have been synthesized as possible amoebicidal agents.

F9491 Wax 665.13

53. MHASKAR, V. V. & KULKARNI, A. B., Composition of sugarcane wax, *J. sci. industr. Res.*, **16B** (1957), 374

The composition of sugarcane wax has been re-investigated using modern techniques. The acid fraction (35·5 per cent) of the wax consists of long chain hydroxy acids, small quantities of oleic, linoleic, and normal fatty

acids from C_{14} to C_{24}, and a high proportion of normal fatty acids of the order C_{30}-C_{36}.

The unsaponifiable matter (60 per cent) of the wax was mainly composed of long chain fatty alcohols of average chain length C_{30}, stigmasterol, sitosterol and small percentage of hydrocarbons.

FJ3 Food Technology 664

54. DESIKACHAR, H. S. R. & SUBRAHMANYAN, V.: The curing of freshly harvested paddy: Part II — Applications, *J. sci. industr. Res.*, **16A** (1957), 368

By steaming fresh paddy for 15-30 min. and heaping the hot paddy for 1-2 hr. before drying it by aeration in the shade, a rice which possesses the appearance and cooking qualities of old raw rice and the nutritional properties of parboiled rice is obtained.

A simple type of rice cooker which can be used to cook freshly harvested rice has been constructed for use in the household. As the rice is steamed preliminary to cooking, pastiness during cooking is avoided.

The method of treatment has been applied successfully in rice mills.

55. DESIKACHAR, H. S. R. & SUBRAHMANYAN, V., The curing of freshly harvested paddy: Part I — Principles of curing, *J. sci. industr. Res.*, **16A** (1957), 365

Suitable 'wet heat' treatment of freshly harvested paddy or an incipient parboiling of the rice just prior to cooking reduces the pastiness, on cooking, of rice. Such heat treatment can be used for curing paddy or rice to enable its use immediately after harvest.

The viscosity of the gruel obtained by cooking under standard conditions or the content of alcohol precipitable solids in the gruel can be used for comparing the cooking quality of rice samples.

56. JAIN, N. L., GIRDHARI LAL & KRISHNAMURTHY, G. V.: Further studies in the preparation and uses of mango cereal flakes, *Indian J. Hort.*, **14**(3) (1957), 172

Further studies on the processing and uses of mango cereal flakes have shown that for satisfactory packing and storage of the product a relative humidity of about 40 per cent is critical for this product which keeps well in airtight metallic and glass containers. Preparation of flakes with improved nutritive values by incorporating groundnut cake flour (fat free), Bengal gram flour, skim milk powder, etc., has been described.

57. JOSEPH, K., NARAYANA RAO, M., SWAMINATHAN, M. & SUBRAHMANYAN, V. : Supplementary value of Indian multipurpose food to poor vegetarian diets based on Italian millet (*Setaria italica*) and Little millet (*Panicum miliare*), *Food Sci.*, **6** (1957), 205

Growth experiments with rats carried out to study the supplementary value of Indian and American multipurpose foods to poor vegetarian diets based on Italian millet and Little millet showed that both Indian and American multipurpose foods, when incorporated at 12·5 per cent level, had a marked supplementary value to poor vegetarian diets mainly based on the millets and there was no significant difference between the Indian and American multipurpose foods with respect to their supplementary value to the diet based on Italian millet.

58. JOSEPH, K., NARAYANA RAO, M., SANKARAN, A. N., SWAMINATHAN, M. & SUBRAHMANYAN, V.: The relative value of the proteins of Indian multipurpose food, Bengal gram (*Cicer arietinum*) and skim milk powder in meeting the protein requirements of protein-depleted animals, *Ann. Biochem.*, **17** (1957), 103

Three groups of protein-depleted rats were fed on diets (14 per cent protein) containing multipurpose food, Bengal gram and skim milk powder for a period of 21 days. The average food and protein intake of the different groups of animals were nearly equal. The animals fed on skim milk powder retained greater amounts of nitrogen than those fed on multipurpose food and Bengal gram. The body-water content of rats fed on the Bengal gram diet was slightly higher than that of rats fed on diets containing skim milk powder or multipurpose food. The increase in cell solids of the rats fed on diets based on skim milk powder or multipurpose food was slightly greater than that observed in rats fed on Bengal gram diet. The ability of the different foods to meet the protein requirements of the protein-depleted rats ranged in the following descending order: skim milk powder, multipurpose food and Bengal gram.

59. KRISHNAMURTHY, K., PANTULU, A. J., SWAMINATHAN, M. & SUBRAHMANYAN, V.: Studies on the stability of oils in pickles, *Food Sci.*, **6** (1957), 133

Mango and lime oil pickles were prepared using different oils, viz. refined cottonseed, crude groundnut, coconut and sesame oils. They were stored in glazed earthenware jars both at room temperature and 37°C. The stability of different oils was studied by determining periodically both acid and peroxide values. The rate of development of rancidity in the different oils ranged in the following ascending order: coconut oil, groundnut oil, sesame oil, and refined cottonseed oil. Organoleptic evaluation showed that the pickles containing both crude coconut oil and groundnut oil were acceptable even after 12 months' storage at room temperature (25°-30°C.) and also at 37°C. Under the same conditions the pickles containing crude sesame oil were less acceptable while those containing refined cottonseed oil were unacceptable.

60. PINGALE, S. V., KADKOL, S. B., NARAYANA RAO, M., SWAMINATHAN, M. & SUBRAHMANYAN, V.: Effect of insect infestation on stored grain: II — Studies on husked, hand-pounded and milled raw rice and parboiled milled rice, *J. sci. Fd Agric.*, **8** (1957), 512

Husked, hand-pounded, milled raw rice and parboiled milled rice obtained from the same strain of paddy (*Halubbulu*) were infested by *Calandra* (*Sitophilus*) *oryzae* (Rice weevil) for a period of eight months and the changes brought about in the different samples due to infestation studied. The results show that husked rice was infested to a greater extent than the other samples and developed an unhealthy appearance within two months of infestation. Milled samples of parboiled and raw rice were found to be least susceptible to infestation. Infestation of the rice grain increased the loss of starch in the gruel during cooking, the loss being maximum in the case of husked rice. An appreciable increase in the acidity of fat and a decrease in the thiamine content due to insect damage were observed. No significant difference was noted in the other constituents of the grain, such as total nitrogen and soluble nitrogen. Some correlation was observed between the weight/volume ratio of uncleaned grain and the proportion of dust, loss in total weight, loss in thiamine and insect population.

61. PRUTHI, J. S.: Spin-pasteurizer — its principle, performance and industrial applications, *Food Sci.*, **6** (1957), 179

The working principle and performance of a new spin-pasteurizer (agitating cooker) adaptable for the efficient thermal processing (spin-pasteurization) of various types of fruit products are described. To illustrate its working, typical heat-penetration data collected by using suitable copper-constantan thermocouple wires and a 'Speedomax' recording potentiometer, on stationary and spin-pasteurization of canned water, single-strength lemon juice, four-fold and six-fold lemon concentrates are presented and discussed. Depending upon the nature of the product, spin-processing takes one-half to one-tenth the time normally taken in the conventional stationary processing. The advantages, industrial applications and the future scope of the use of spin-pasteurizer in fruit preservation are also discussed.

62. SUBRAHMANYAN, V., CHANDRASEKHARA, M. R., SWAMINATHAN, M. & BHATIA, D. S.: Production of infant food in India, *Indian Dairym.*, **9** (1957), 276

The large-scale production of infant food from buffalo milk at the Kair Co-operative Milk Union, Anand, according to the formula developed at the Central Food Technological Research Institute, Mysore, is described. The following steps are involved in the process: (1) quality control of raw milk, (2) adjustment of fat and pasteurization, (3) adjustment of composition, (4) concentration, (5) fortification with vitamins and homogenization, (6) spray drying, and (7) packing. Feeding trials carried out on infants have shown that the food is readily digested and promotes satisfactory growth in infants.

FM97 Leather Technology 685.2

63. BHASKARAN, R. & SEN, S. N.: A note on the control of some dermestid beetles by biological methods, *Bull. cent. Leath. Res. Inst.*, **3** (1957), 457

The method of attack of a *Bethylid ecto* parasite, parasitizing on the larval forms of the beetle *Anthrenus vorax* (Wat), is described.

64. RAMASWAMY, D. & NAYUDAMMA, Y.: Spectrophotometry in leather research: Part VIII — Investigation of chrome complexes with inorganic acids and salts, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 37

A u.v. spectrophotometric method was applied to the study of the complex nature of the basic chrome solutions containing various inorganic acids and salts. The salts studied were: sulphate, chloride, sulphite, silicate, thiocyanate, fluoride of sodium and calgon. The absorbance data indicate that the inorganic ions may be grouped into three categories: (1) those having no effect on the penetration of the chrome complexes, like chloride, sulphate, silicate, (ii) those that give a maximum in the absorbance curve, namely sulphite and thiocyanate, and (iii) those that produce a minimum in the curve like calgon, sodium fluoride. The causes for the maxima and minima in the absorbance and the nature of chrome complexes formed are discussed.

65. RANGANATHAN, T. S. & NAYUDAMMA, Y.: Combination tannages: Part V — Combination chrome vegetable tanning in single bath, *Bull. cent. Leath. Res. Inst.*, **3** (1957), 445

The factors that govern the fixation of chrome by hide powder tanning with veg-chrome liquors like concentration, *p*H, effect of neutral salts like sodium chloride and oxalate and the nature of chrome complex fixed in the tanned hide powder have been studied. The results further confirm that veg-chrome liquor imparts the characteristics of both chrome and vegetable tan to the leathers tanned with it.

66. RANGANATHAN, T. S. & NAYUDAMMA, Y.: Combination tannages: Part VI — Combination chrome vegetable tanning in single bath, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 1

The leathers tanned with veg-chrome liquors were analysed stratographically for the chrome, organic matter and degree of tannage. The dyeing characteristics of these leathers, the physical properties like fulness, thickness, smoothness, etc., and the microscopical assessment of these leathers were studied. The results indicate that tanning with veg-chrome liquors results in leathers superior to those tanned with straight chrome, or vegetable or retanned leathers. The leathers possess the characteristic properties of both chrome as well as vegetable tanning material, together with properties of their own.

67. UDAYA VARMA, M. K., MATHEW, E. C. & DAS, B. M.: Effect of acid and salt adjustment — E.I. tannage with *Peltophorum ferrugineum* bark, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 45

E.I. tanning experiments using *Peltophorum ferrugineum* bark have been carried out with various quantities of sodium sulphate, sodium formate and sodium lactate. Sodium sulphate and sodium lactate effect improvement in colour. Since stiffness of the leather is increased by all the three salts, the addition of these salts does not seem to be beneficial for E.I. kip tannage with *Peltophorum* bark. However, as sodium lactate gives greater firmness, this addition may be useful for sole leather tannage using the bark.

G BIOLOGY 57

G12 Histology 576.72

68. CHATTERJEE, J., CHATTERJEE, B. R. & CHAUDHURI, S. N.: Haemagglutination in tissue culture fluid: Correlation of number of explants to agglutination titre, *Ann. Biochem.*, **17** (1957), 123

The amount of antibody produced *in vitro* growing tissue slices from immunized animals is proportionate to the amount of tissue cultured. The tissue quantities were determined from 5, 10 and 20 explant groups of tissues by measuring their phosphate contents and a good correlation was observed with the number of explants and their phosphate contents. The antibody titre also showed a relative rise with the corresponding increase in phosphate content, the phenomena being better demonstrable at higher dilution of the culture fluid.

G91 Microbiology 576.8

69. BHASKARAN, K.: Lysis of *Vibrio cholerae* by thymol, *Nature, Lond.*, **180** (1957), 43

Broth cultures of *V. cholerae* are rapidly lysed by thymol. Such lysates obtained

from lysogenic strains do not reveal any appreciable increase in free phase particles.

I BOTANY 58

I : 6 Plant Genetics 581.16

70. NAYAR, B. K.: Studies in Polypodiaceae: IV — *Drymoglossum* Presl, *J. Indian bot. Soc.*, **36** (1957), 169

A phylogenetical evaluation of the morphology of the gametophyte and sporophyte of *Drymoglossum piloselloides* (L.) Presl, collected from N.-E. and S.-W. India, is attempted. From a detailed study of the sporophyte and the gametophyte, it is concluded that, contrary to the current belief, *Drymoglossum* may not be a direct descendant of *Pyrrosia*, but may have branched off from a common ancestor during the evolution of the latter genus.

λ VETERINARY SCIENCE 619

λ35 Poultry 636.5

71. BABBAR, O. P. & DHAR, M. M.: Effect of adenylic acid on the virulence and immunological properties of Ranikhet disease virus in fowl, *J. sci. industr. Res.*, **16C** (1957), 166

A virulent strain of Ranikhet disease virus has been found to be avirulent to fowls when treated with adenylic acid *in vitro* or when fowls are administered adenylic acid within 1 hr. of infection. Fowls so infected are unable to withstand re-infection. Adenylic acid, however, has no effect on the virulence of the virus when administered to fowls 6-18 hr. after infection.

72. BABBAR, O. P. & DHAR, M. M.: Paper electrophoretic studies on sera of normal fowls and those vaccinated against Ranikhet disease, *J. sci. industr. Res.*, **16C** (1957), 170

A significant change in the composition of the electrophoretically slow-moving globulins in the serum proteins is correlated with the formation of Ranikhet virus antibodies.

L MEDICINE 61

L : 3 Physiology 612

73. BANERJEE, SACHCHIDANANDA & SINGH, HAOBAM DEVENDRA: Studies on the adrenal cortical activity in scorbutic monkeys and guinea-pigs, *Amer. J. Physiol.*, **190** (1957), 265

17-Ketosteroid excretion diminished in both guinea-pigs and monkeys during the early stages of the depletion of ascorbic acid in animals. The excretion of this steroid, however, increased tremendously in all the three monkeys and in seven out of ten guinea-pigs, just before the animals died of severe scurvy. In three guinea-pigs the excretion was considerably diminished when they became acutely scorbutic.

The excretion of both corticosteroids and 17-ketosteroids increased to a considerable extent in four out of five guinea-pigs when they became severely scorbutic but in the fifth guinea-pig both these excretions diminished when the animal became severely scorbutic.

74. INDERJIT SINGH & ACHARYA, A. K.: Ionic changes in unstriated muscle immersed in sodium-free solution, *Proc. Indian Acad. Sci.*, **46** (1957), 47

The ionic changes in frog's stomach muscle immersed in hypotonic solution of sucrose have been studied. The spontaneous contractions begin when sodium has been completely removed from the interspaces. The mechanical response is related not to extracellular sodium but to intracellular potassium. This shows that intracellular potassium and not extracellular sodium is mainly responsible for excitability of the muscle. The inhibitory action of sodium is not prevented by calcium.

L : 4 Diseases 616

75. ROY, A. N. & BANERJEE, (MRS.) GOURI: Correlation between haemagglutination reaction and tuberculin skin sensitivity in leprosy, *Ann. Biochem.*, **17** (1957), 111

Possible correlation between haemagglutination reaction of serum and tuberculin skin sensitivity in leprosy patients was investigated. Statistical analysis of the results showed a significantly higher percentage of

detection of leprosy by haemagglutination reaction. There was no association between the serological and standard tests. In most cases reactions which were positive by the standard test were also positive by serological test, but not vice versa.

Tuberculin skin test was negative in sera showing positive haemagglutination titre of their sera. There is thus no correlation between the haemagglutination reaction and skin sensitivity to tuberculin of leprosy patients.

L : 421 Tuberculosis 616-002.5

76. GUPTA, S. K., DHAR, D. C. & VORA, V. C.: Effect of sulphones on the changes in the serum protein composition in experimental tuberculosis of guinea-pigs, *J. sci. industr. Res.*, **16C** (1957), 186

The effect of sulphones on the changes in serum protein composition of guinea-pigs infected with *Mycobacterium tuberculosis* var. *hominis* $H_{37}Rv$ has been studied. On the basis of the data obtained, it is difficult to establish any definite correlation between A/G ratio and necropsy score.

L : 423 Virus Diseases 616.91

77. MUKHERJI, A.: Effect of X-ray irradiation on excised earlobe specimens from cases of Lepromatous leprosy, *Int. J. Leprosy*, **25** (1957), 1

Pieces of earlobes from lepromatous leprosy patients were subjected to X-ray irradiations, some 63 γ and others 84 γ over periods of 45 and 60 min. respectively. It was found that the leprosy bacilli were either beaded or disintegrated, but no damage to the tissue cells was detected. This would suggest that, at this dose level, local lesions can be treated or even generalized lesions can be treated.

L : 441 Poisons 615.9

78. RAO, (MRS.) SHANTA S. & RAO, S. SRINIVASA: Proteolytic activity of Russell's Viper venom and its inhibition by heparin, *J. sci. industr. Res.*, **16C** (1957), 148

The proteases in venom of Russell's Viper seem to be largely responsible for its toxicity and blood coagulating property. The proteolytic activity of the venom was measured using heat denatured haemoglobin as substrate. The presence of two enzymes — one having an optimum at *p*H 3·6 and the other at *p*H 9·0 — is indicated. Heparin, which inhibits the blood coagulating property of the venom *in vitro*, inhibited the protease active at *p*H 3·6 completely and the other partially. Heparin showed protective action on the toxicity of Russell's Viper venom when tested on mice.

L : 573 Nutrition 613.2

79. SUBRAHMANYAN, V., KRISHNAMURTHY, K., SREENIVASAMURTHY, V. & SWAMINATHAN, M.: Effect of garlic in the diet on the intestinal microflora of rats, *J. sci. industr. Res.*, **16C** (1957), 173

Investigations were carried out to find out the effect of garlic on the intestinal microflora of rats fed on diets containing large proportions of pulses and *ragi*. The results show that the abnormal increase in the intestinal microflora of rats fed on these diets can be effectively checked by feeding garlic along with the diet.

80. SRINIVASAN, M.: Effect of certain protein foods on blood-sugar levels and glucose tolerance, *Lancet*, **317** (1957), 11

It was observed that in hyperglycaemic patients fed on tender field-beans (*Dolichos lablab*) glycosuria disappeared. Unlike the tender seeds, the mature *dolichos* was less effective. Diets such as *idli*, or diets containing a lot of skim-milk powder had similar effect. The effect of a number of protein foods on blood-sugar levels and glucose tolerance of hyperglycaemic men has been studied. It was found that casein, protein from tender *dolichos* (*Dolichos lablab*) and protein from black gram (*Phaseolus mungo*), as also black gram itself were effective. *Thur dhal* (*Cajanus cajan*), protein from mature *dolichos*, gelatin, and a mixture of amino acids as in casein were less effective. In addition to variation due to proteins, this effect varied with the individuals studied.

Possible mechanisms for the observed effects, which bring out a hitherto neglected function of proteins, are discussed.

L : 63 Pharmacology 615.1

81. CHAKRAVARTI, R. N., DE, U. N. & MUKERJI, B.: Studies in experimental atherosclerosis: Part V — Therapeutic effect of ascorbic acid and vitamin B_{12} in cholesterol atherosclerosis, *Indian J. med. Res.*, **45** (1957), 315

Experimental atherosclerosis was produced in rabbits by feeding cholesterol in olive oil for a period of twelve weeks. During this period ascorbic acid and vitamin B_{12} injections, alone and in combination, were also given to different groups of animals. Vitamin B_{12} alone and in combination with ascorbic acid, produced greater degree of inhibition of aortic atheroma than ascorbic acid alone. Vitamin B_{12} markedly increased free cholesterol and free cholesterol/total cholesterol ratio in serum.

82. GUPTA, S. K. & MATHUR, I. S.: Therapeutic activity of S.N. 44 (*p*-ethylamino-*p'*-aminodiphenyl sulphone) and S.N. 47 (*p*-isobutylamino-*p'*-aminodiphenyl sulphone) in experimental tuberculosis of mice, *J. sci. industr. Res.*, **16C** (1957), 192

The therapeutic activities of S.N. 44 (*p*-ethylamino-*p'*-aminodiphenyl sulphone) and S.N. 47 (*p*-isobutylamino-*p'*-aminodiphenyl sulphone) have been compared with that of *p*, *p'*-diaminodiphenyl sulphone (Dapsone, D.D.S.) in experimental tuberculosis of mice. The results indicate that S.N. 44, S.N. 47 and D.D.S. caused a significant prolongation of the survival time when compared with the untreated controls.

83. KAR, AMIYA B. & DE, N. N.: Influence of 19-nortestosterone on antiphlogistic action of cortisone, *J. sci. industr. Res.*, **16C** (1957), 146

19-Nortestosterone (19-NT) neither antagonizes the antiphlogistic action of cortisone nor interferes with granuloma tissue formation in rats. This property enhances the reported efficacy of 19-NT as a drug capable of protecting the adrenals from the harmful effects of cortisone.

84. KOHLI, J. D., BALWANI, J. H., RAY, C. & DE, N. N.: Pharmacological action of Rauwolscine: Part I — Adrenergic blocking activity, *Arch. int. Pharmacodyn.*, **111** (1957), 108

Adrenergic blocking activity of Rauwolscine, an alkaloid isolated from *Rauwolfia canescens* Linn., has been compared with yohimbine and tolazoline. It is observed that the nature and intensity of adrenergic blocking activity of Rauwolscine are similar to those of yohimbine. Further, the former appears to be 2·5-3 times more potent than tolazoline as regards this activity.

85. MUKHERJEE, S. K., DE, U. N. & MUKERJI, B.: Alpha-cell activity and its relation to glycaemic level and insulin sensitivity in albino rats — A comparative study of the action of Nadisan and cobalt chloride, *Indian J. med. Res.*, **45** (1957), 337

Nadisan feeding produced a fall in the blood sugar level of fasting albino rats. On prolonged administration, however, practically no variation in the fasting blood sugar level was observed after initial variation. Subcutaneous cobalt chloride injection induced hyperglycaemia in fasting albino rats, which lasted for 24 hr.; on repeated subcutaneous injection, the fasting blood sugar level was raised in a few rats. Compared to normal and $CoCl_2$-treated rats, Nadisan-treated rats were more sensitive to insulin, as hypoglycaemia produced thereby was prolonged. No appreciable change in the liver glycogen was found in cobalt chloride and Nadisan-treated rats. Liver cholesterol value was definitely increased following cobalt chloride injection.

86. SRIVASTAVA, G. N., CHAKRAVARTI, R. N. & ZAIDI, S. H.: Studies in experimental atherosclerosis: Part IV—Serum fibrinolysin activity in cholesterol atherosclerosis, *Indian J. med. Res.*, **45** (1957), 311

Experimental atherosclerosis was produced in rabbits by feeding cholesterol in olive oil daily for a period of twelve weeks. Serum fibrinolysin activity was estimated at zero hour, three, six, nine and twelve weeks. A retardation of fibrinolysin activity was noted at six and nine weeks of cholesterol feeding but it was fully restored at twelve weeks when generalized atheroma developed.

87. VORA, V. C., SHETE, (Mrs.) K. & DHAR, M. M.: Antibiotic X 340: Part I — Isolation, antibacterial action, chemical data and its partial constitution, *J. sci. industr. Res.*, **16C** (1957), 182

An antibiotic (X 340) active against a large variety of micro-organisms has been isolated from an unidentified *Streptomyces* species. On the basis of chemical data a partial structure of the compound is suggested.

L 24:4 Stomach Diseases 616.33

88. BANERJEE, A., CHATTERJI, D. N. & PRAMANICK, K.: Gastro-enteritis in different age-groups and its association with certain serological types of *Escherichia coli*, *Ann. Biochem.*, **17** (1957), 99

The *E. coli* strains obtained from the cases of non-specific gastro-enteritis in infants, children and adults collected during the summer of 1956 were typed against the following 0 sera: 0111, 055, 026, 086, 0119, 04, 02, 06, 073 and Cd 64a. No strains of 0111 or 055 were obtained from any of the cases. But 026 types were obtained from cases of gastro-enteritis in both infants and adults. Group A consisting of acute cases of gastro-enteritis in infants had 026 types in 33 per cent of the cases and Group D consisting of acute non-choleric gastro-enteritis in adults had 026 types in 30 per cent of cases. Besides 026 the other types detected were 0119, 073, 02, 06 and Cd 64a.

L9F Gynaecology 618

89. BANIK, U. K. & CHAKRAVARTI, H. S.: Some factors influencing the common Indian male toad test for pregnancy, *Ann. Biochem.*, **17** (1957), 85

Studies confirm the suitability of the common Indian male toad, *Bufo melanostictus*, collected from Calcutta and suburbs, as the test animal throughout the year for the diagnosis of human pregnancy at an early stage. A method is described to estimate the titre of chorionic gonadotrophin present in the urine for which the minimum effective dose (MED) or 'toad unit' to *B. melanosticus* weighing 30-40 g. is established. This unit varies with the season, the toad being more sensitive in autumn and least sensitive in winter.

M7 TEXTILES 677

M72 Wool 677.3

90. MITRA, S. K.: A new technique for the detection of damaged sheep-wool, *Bull. cent. Leath. Res. Inst.*, **4** (1957), 12

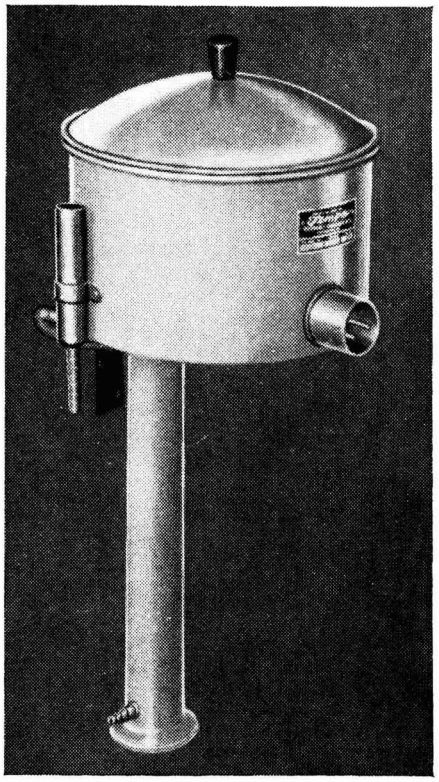
A simple and very quick microscopical technique for the detection and estimation of damaged sheep-wool (white variety) by staining only is reported and explained with the help of photomicrographs.

U GEOGRAPHY 91

U28 Meteorology 551.5

91. KHASTGIR, S. R., TANTRY, B. A. P. & SRIVASTAVA, R. S.: Electric field changes during cloud-to-cloud lightning discharges, *J. sci. industr. Res.*, **16B** (1957), 318

The sign of the electric field changes during the lightning discharge and the relatively small time interval (0·5-2·5 milliseconds) between the successive discharges in multiple strokes have enabled identification of the oscillograms showing waveforms originating from cloud-to-cloud discharges. A large number of oscillographic records taken at Banaras during 1952-55 with the help of the automatic atmospherics recorder constructed in the laboratory have revealed that the waveforms due to cloud-to-cloud discharges have features similar to those due to cloud-to-ground discharges in respect of multiple strokes, 'pre-discharges', return-stroke pulses with or without ionospheric reflections, c-field changes and 'hook-components', and junction field changes.



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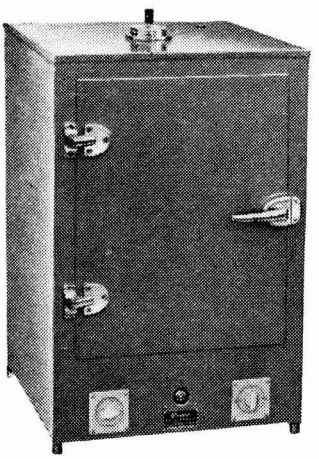

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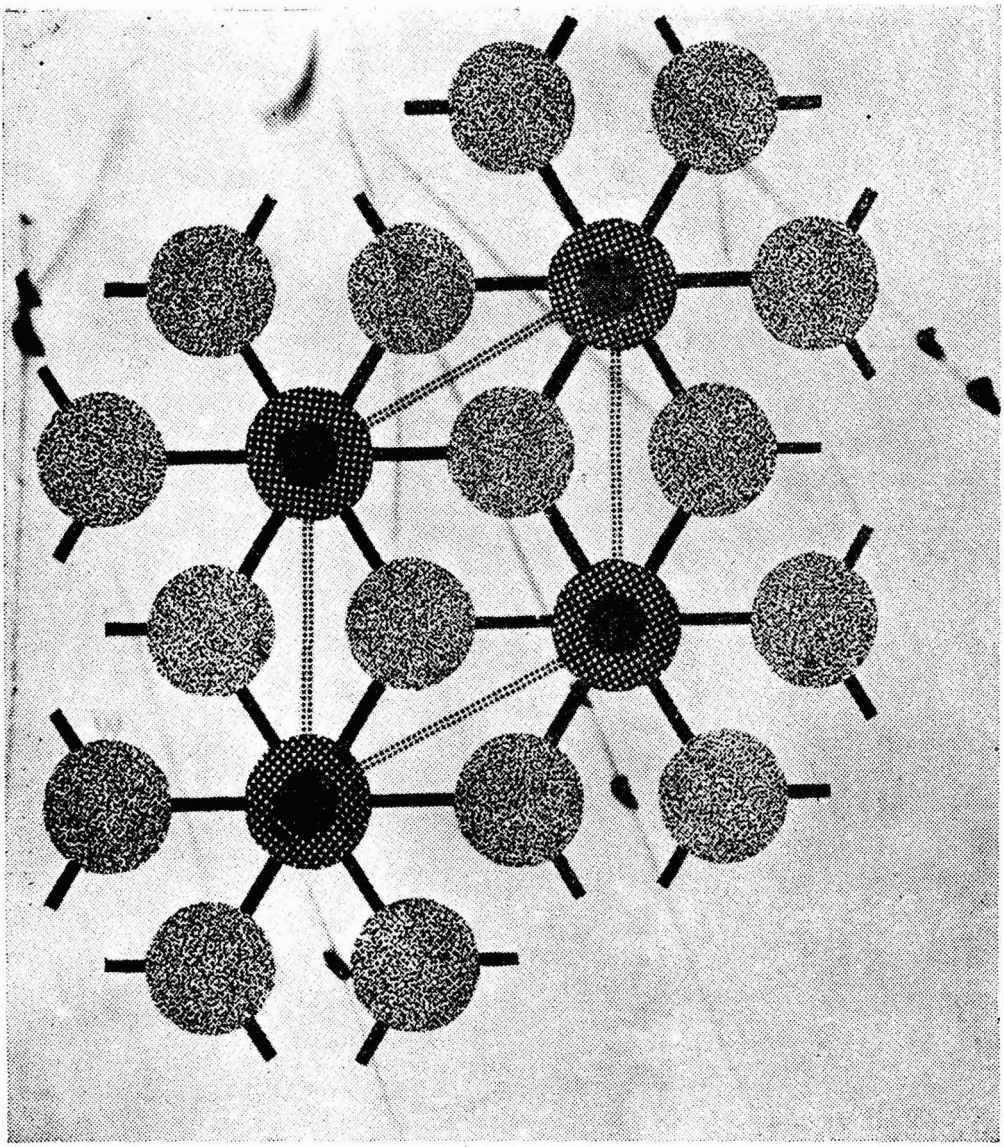

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