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Founder President: **LATE SHRI JAWAHARLAL NEHRU**

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CONTENTS

Financial Control of Scientific Research

Since the Second World War, there is evidence of increasing State interest and participation in scientific research even in countries like U.K. and U.S.A. where private industry contributes substantially to the national research effort. This is in recognition of the key role of scientific research in the overall development of the national economy, social well-being and defence. State would also seek to control the guidelines of national policy through increasing financial participation and strategic control of the crucial areas of research. In the USSR, the State Committee for Coordination of Scientific Research of the USSR deftly handles financial controls so that these could be manoeuvred to shift emphasis on selective projects or areas of national importance.

With the late Prime Minister Jawaharlal Nehru, science was a favourite child. It is the good fortune of this country that science in its early stages received his fostering care. He foresaw that financial support to science was an investment in the country's progress and future prosperity. He cautioned the impatient administrators and chided the recalcitrant financiers and industry against making demands of immediate economic returns on the Nation's investment in research. Science in India has now come of age and is capable of rendering its role in terms of its contribution to national income and development. The level of growth and of achievement of different scientific institutions may vary, but there is no question of the overall contribution of the 'science front'. The industry has also shown increasing appreciation of scientific and industrial research as an instrument of process and product improvement and development. Sector after sector of industry is coming forward to form cooperative research associations or set up their own research organisations, seeking financial support and organisational guidance. The patriotic traditions of the Indian industry and the support they lent to the national struggle for independence are proof of their resolve for enlightened economic independence. The forward-looking sections of the industry are aware of the need to attain self-dependence in technology and know-how and minimise the drain on the national economy by way of payments for fees, royalties etc. The use of indigenous research facilities and utilisation of the results of research by the industry and their building up of their own research and development potential will witness a phenomenal increase, given proper support and guidance.

It is against this background of national industrial upsurge and growing research consciousness that one must view the apparently shortsighted policies of denying financial support for optimal growth to the research institutes and their deleterious consequences on the national economy. While it would be incorrect to mechanically draw a parallel in regard to their investment in scientific research by the advanced countries and India, and unrealistic to expect the scale of investment to be anywhere near that; there is nothing against taking a lesson from our hostile neighbours, the Chinese. Except for the political set-up, the economic and technological level after the Second World War, in the two countries (India and China) was comparable. The remarkable progress achieved by Chinese science is not unrelated to official encouragement and financial support received by it. Prof. P.C. Mahalanobis and other scientists in responsible positions have categorically stated that the present level of investment in scientific research effort in India is inadequate for its healthy development and have considered a recurring increase of 20-30% as optimal. The Prime Minister Shri Lal Bahadur Shastri has wisely declared that Indian science will not be allowed to suffer due to shortage of funds. In view of this, it is difficult to understand the rationale of the attitude of the financial authorities.

The Special Committee of the Second Reviewing Committee of the CSIR under the Chairmanship of late Dr. J. C. Ghosh had recommended that every research institute should be given a block grant for a period of five years and permitted to function with a degree of autonomy under the overall charge of its Executive Council and Scientific Advisory Committee. The Third Reviewing Committee of CSIR under the Chairmanship of Dr. A. Ramaswami Mudaliar has recommended that CSIR be given the funds proposed by it for Fourth Five Year Plan and fresh resources provided to it where necessary. While commending the steps already taken, they have advocated a still larger degree of autonomy to the research institutes. The CSIR as a research organisation should function without the encumberance of the administrative rules and procedures.

Not only must Indian science be assured of financial support but this should be on a long range basis. It should also be free from the day-to-day controls applicable to administrative departments to enable the research organisations to exercise their functional autonomy—so essential for creative enterprise. The present situation brings into focus the need of a drastic reappraisal of the present financial policies and methods in their relation to research. As at present they neither respect the autonomy of the research institutions nor lead to concentration of the available financial resources to areas of national importance in the planned development of the country.

According to the present dispensation, the research institutes have to ask for yearly grants, duly processed and approved by their Scientific Committees and Executive Councils where a representative of the finance ministry is a member. These grants are subject to a veto by higher financial authorities who have neither the technical means nor the requisite competence to judge the requirements of the institutes or appreciate the relative importance of different projects in the context of the country's plans for scientific and industrial development. There are no well-laid criteria with the financial authorities to determine as to how to regulate the finances or impose the cuts. It is to their credit if in spite of all this red tape, something worthwhile is turned out by the scientists.

The present financial methods at times set at naught the deliberations of the scientific advisory and research committees who screen and formulate the research programmes and assign priorities to the projects in the research institutes. The uncertainty of funds even for the approved projects and research schemes gives rise to the gloomy atmosphere which pervades the research laboratories and hangs like a Democle's sword on the scientists whose research programmes and salaries are under threat. Recently we had the humiliating spectacle of four eminent scientists waiting on the financial authorities with the beggar's bowl. Others who did not catch the eye have no means to state their case and persuade the authorities of the relative economic merit and industrial importance of their projects. The intellectual elite of the country deserve better than this!

The country and the parliament are committed to the Science Policy Resolution moved by late Shri Jawaharlal Nehru in 1958. The country has accepted 'scientific planning' as a technique of attaining its social and industrial objectives. The present methods of financial control of scientific research are hardly in consonance with the science policy or of a planned approach to scientific research as an instrument of social and industrial development. As an accepted instrument for planning, the Planning Commission, should be the proper authority for bringing together the requirements for (*i*) development of different technologies and know-how in keeping with the Plan and (*ii*) resources to be made available to research organisations for investigation and development of these. Jointly with scientists and representatives from research and technological organisations, departments responsible for industrial development and licensing and planning and financial experts, priorities in the research organisations should be determined. Adequate financial resources should be made available and research organisations allotted responsibility, authority and finance to carry out the projects. A proper follow-up, periodic assessment and revaluation could be suitably organised, but the research institutes should have their functional autonomy to spend their resources to maximum advantage based on their own strategy.

Finances are important for all activity and the government have every right to ensure that they bring the maximum returns particularly when invested for industrial and technological research. However, the present cavalier attitude of the financial authorities needs to be immediately revised if it is not to cause irretrievable damage to the entire 'science front'.

SCIENTIFIC SOCIETIES IN INDIA

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RECENT investigations of the sociology of science have suggested a major shift in the organization of science and scientists. The general suggestion is that although science previously was a closed system,[1] now it is not so. Science is now a part of society and, as such, is subjected to the same pressures as any other social process.[2] This change, it is contended, has also effected a change in its values. In the period when science was a closed system, as pointed out by Merton,[3] its values were centred around the professional recognition of scientists. In this system societies had a major part to play, their transactions published the papers, and these, along with other non-published reports, were discussed in the formal and informal meetings of the societies. This criticism, or appreciation, of the work of fellow scientists built up the reputation of scientists and led to recognition. This process, as Storer mentions,[4] suggests that the values of science are rooted in the requirements for continued, adequate allocation of professional recognition rather than in the utilitarian relationship of the value to the aim of science.

With the rapid development of science, and the fact that it has become a large scale activity, scientific criticism is losing much of its edge[5] and hence professional recognition does not really enjoy the same status as before. In addition, money, prestige and power have come to enjoy greater status than professional recognition[2]. The informal atmosphere has also been replaced by more business like methods. Greater specialization and the larger number of scientists have also broken the scientific community as of old. What is the impact of these changes on the role of scientific societies? Have societies continued to grow as of old, or have they also undergone changes to meet the new requirements and trends? These questions have great relevance to the growth and development of science. A number of roles are ascribed to scientific societies, that is, bringing together scientists specialised in the same area of knowledge, affording them an opportunity for inter-communication of ideas within a discipline or between various disciplines through conferences, symposia, and publication of journals, serving as a platform for general discussion by scientists of problems of science, and acting as a forum for crystalization of ideas regarding the relation of science to society. They are also supposed to popularize science and confer distinctions on members as a recognition of contributions to science.

No investigation has so far been carried out as to whether these are pertinent roles of scientific societies and how far the various national and international societies are fulfilling these and other related roles. Is there a need to change the role of scientific societies, and in what direction? What are the activities they should undertake and how should they organize themselves? Could there be

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various levels of organization according to the needs of specialization and possible social role?

In the context to the growth of science, these questions are very pertinent and, in our opinion, a time has come when we should ask these questions and carry out specific investigations to find the answers.

To fill this lacuna, a survey was conducted by us. The aims of the survey were limited to the collection of data and examining the historical development and activities of the societies and their financial condition. A detailed questionnaire was sent to 150 societies and 115 responded. A directory of the societies was also compiled. The societies were classified as physical sciences, biological sciences, medical sciences, engineering and technology and general societies.

Historical Development

India, before the beginning of the twentieth century, had only four scientific societies, namely, Asiatic Society (1784), Royal Agricultural Horticulture Society of India (1860), Indian Engineering Association (1895), and Bombay Textile and Engineering Association (1900). By the end of the First World War, the total number increased to 16, of which one was physical, three were medical, two biological, six engineering and technological and four general science societies. It is interesting to note that, even though engineering and technology were not very much developed during this period, India had the maximum number of engineering and technological societies, most of which were of a professional nature rather than academic.

Prominent societies founded during 1900-20 were the Indian Association for the Cultivation of Science (1909), Indian Mathematical Society (1907), Indian Science Congress Association (1914), Indian Botanical Society (1920), and Institution of Engineers (1920). They provided a forum for specialists to discuss academic problems in their fields and also provided scope for scientists of different disciplines to meet to discuss and gain knowledge of the developments occurring in other fields or in borderline disciplines. In fact, in the age of non-specialisation in specific areas such general science societies had a special part to play.

The total number of societies increased to 38 by the end of 1940. Between the two World Wars, more specialized societies were founded. During this period, India had four physical, seven medical, five biological, 10 engineering and technological and four general science societies. Most of the non-professional societies, upto this period, used to promote active research work besides providing forums for scientists to meet and discuss; the shift from this activity now becomes noticeable.

Prominent societies which were formed during this period were: Institution of Chemist (1928-29), Indian Academy of Sciences (1934), National Institute of Sciences of India (1935), Indian Physical Society (1939), etc.

During the decade 1941-50, the number almost doubled, the number of societies increasing to 71. The greatest relative increase in societies occurred in the physical sciences group, which increased from four in 1940 to 11 in 1950. The number of medical societies more than doubled, from seven in 1940 to 15 in 1950. Biological science societies increased to 15; engineering and technological societies increased to 10 by the end of 1950.

Independence brought a spurt in the growth of science societies in India. The next decade also saw an equal increase in number. Among those who responded to our questionnaire we find that 33 societies were founded during 1951-60. At the end of 1960, we find that we had 17 physical, 23 medical, 26 biological, 26 engineering and 12 general societies. It is interesting to note that with the increase in specialization in the country the proportion of general societies decreased. Another interesting point is that most of the societies which were established during the 1951-60 decade, in contrast to those established earlier, do not conduct or support scientific research, but only provide facilities for specialists to meet, discuss and cross-fertilize ideas and publish journals or look after the professional interest of members.

Since 1961, the tempo of the growth in number has been slower. During 1961-63, only six societies have been established. Perhaps there may be a few more to which our attention has not yet been directed.

Concentration and Branches of Societies

There is a heavy concentration of scientific societies in the big cities (Calcutta, New Delhi, Bombay, Bangalore and Madras). As many as 118 out of 150 societies are located in these places. Most of the professional societies (in the field of medicine and engineering and technology) have large numbers of branches, but that is not true for other societies. Out of 18 physical science societies, 14 have no branches, and four have 1-5 branches; out of 28 biological science societies, 22 have no branches, three have 1-5 branches, one has 6-10 branches and two have more than 10 branches; out of 15 general science societies, 12 have no branches and three have 1-5 branches. The medical, engineering and technological societies, which have a pronounced professional character, have a large number of branches; for example, out of 26 medical science societies, 12 have no branches, six have 1-5 branches, four have 6-10 branches and four have more than 10 branches. Among the 28 engineering and technological societies, nine have no branches, 11 have 1-5 branches, three have 6-10 branches and five have more than 10 branches.

Membership of Societies

It is significant that the membership in 1962 of professional societies was higher than that of the academic societies. Out of 18 physical science societies, seven had membership below 100, eight had 100-499 and three had more than 500 members. None of the societies had more than 1,000 members.

Out of 25 medical societies whose membership figures are available, four had less than 100 members, 14 between 100 and 499, four between 500 and 999, and three had between 1,000 to 4,000.

Biological science societies usually have a larger membershp than physical science societies. Out of 27 (whose data were available), six had less than 100, 16 between 100 and 499, three between 500 and 999, and two between 1,000 and 5,000 members.

It is observed that the membership of engineering and technological societies is heavy, mainly because of their professional nature. The Institution of Engineers is the only society which has more than 5,000 members; in fact, it had more than 42,000 members in 1962. Out of 28 societies in this group, four have fewer than 100 members, 10 between 100 and 500, seven between 500 and 1,000, six between 1,000 and 5,000 and only one more than 5,000.

Membership of general societies is usually limited to 100-500 members. Out of 16 such societies whose membership figures were available for the year 1962, 13 have membership between 100 and 500, two between 500 and 1,000, and one (Indian Science Congress Association) had a total membership of 4,683.

Mode of Becoming Members of Societies

There is not much group difference here. The common mode is by election and payment of subscription. Out of 115 who have reported, in 48 societies, membership is through paying a fee, in 52 through election and payment of fee, in four by election only; in eight engineering, two physical and one medical science societies, one can become a member by passing examinations conducted by the society.

Only 16 out of 115 societies conduct examinations, and, of these, 10 are engineering and technological societies, two physical, one medical, two biological societies and one general science society.

Activities of the Societies

The societies which conduct examinations also provide library facilities. About 50 per cent of the societies confer some kind of honour, by way of award of a gold medal, cash prize or membership or fellowship, to their members.

About 88 per cent of the societies publish one or more journals; in all, out of 115 societies which replied, 101 publish 123 journals. The details are as follows:

Out of 18 physical science societies, 15 publish journals and they publish 19 journals in all; out of 26 medical societies, 21 publish 24 journals; out of 28 biological societies; 26 publish journals and they bring out 32 journals, out of 28 engineering and technological societies, 26 publish 33 journals, and out of 15 in the 'general group', 13 publish 15 journals.

It is interesting to note that 49 out of 115 societies had not conducted any symposium, seminar or conference during the past 10 years. Out of 66 who arranged any of the aforementioned meets, scarcely 20 per cent did so as an annual feature; many of them do meet a number of times in a year but only to conduct the business of the society. This may suggest that societies are playing a limited part in the promotion of science, and that only through publishing journals. They give little opportunity to members to discuss specific research topics or academic problems.

Financial Support

Our investigation reveals that, in all, only 41 societies get direct or indirect support from the Central Government, 35 societies get little financial support from State Governments, 21 societies get support from industry and 16 from endowment funds. It is interesting to note that those who receive support from Central or State Governments also get support from other sources. Of those who receive support from the Central Government, many of them get support from State Governments also. The support which is available mostly goes to a selected few societies, while the rest depend solely on their own resources. Seventy-five per cent of the funds which come from Central or State Governments are distributed to a few of the societies, with the result that funds for most of the others are not enough even to run their journals, let alone arranging seminars or symposia at an all-India level, which usually demands heavy expenditure.

This investigation reveals the following features:

(1) Growth of scientific societies had kept pace with that of science and technology.

(2) General and professional societies (that is, engineering and medical) were founded earlier and were followed by more specialised societies. Recent trends have been towards the establishment of more sophisticated societies in the newly developing fields of science and technology like Operations Research Society of India, Institute of Information Scientists (of India).

(3) Societies are mostly concentrated in the big cities of Calcutta, Bombay, Madras, Delhi and Bangalore. This is in keeping with

the concentration of scientific research institutes in large cities. It may be observed here that most of the earlier academic type of scientific societies were founded in the Calcutta region. In recent years, however, new societies are being formed at a faster rate in the Delhi and Bombay regions.

(4) Earlier societies of the academic type were mostly institutional in nature, that is, as a part of their activity they not only provided a forum for scientists to meet, arrange symposia and publish journals, but also they encouraged scientific research or carried out research as a part of their activity. The last-named activity is not a feature of the more recent societies.

(5) Professional societies in the field of engineering, technology and medicine have usually a larger number of branches and members. Specialized societies in more academic fields have usually smaller membership. The increase in membership of more academic type of societies is not in keeping with the rise in number of research workers in those fields.

(6) Most of the societies do not receive any support from the Government, either Central or State. Those who receive from one source, receive from others also. Whatever support is available from the Government, most of it goes to a few. Many of the societies are publishing journals from their own resources, in view of their limited finance, and the standard and regularity in publishing the journals suffer. It is of interest to note that most of the support from Government goes to the more academic type of societies rather than to professional engineering and medical ones.

(7) The most curious feature is the lack of activity of societies by way of organizing academic activities, namely, somposia, seminars and specialized discussions. This may be due to the lack of financial resources available to them, as against the established institutions.*

Two major conclusions could be drawn from this work: one for India and the other more generalized. For India the conclusions are the need for critical examination of the activities of the societies and the support they are receiving from the Government. There is an urgent need for the developing of a proper policy for support of scientific societies, particularly for those which cover the newer fields of science and technology and those which deal with the social problems of science or with science as a whole.

It is suggested that the Government should not only finance the academic societies to arrange the seminars and symposia but should also make sufficient provision in the budget of the research institutes to enable active research scientists to attend seminars or symposia, organized by the societies. Finally, there is also a need for associating the scientific societies in forming decisions. This is vital for the healthy growth of science, and its democratization in India where most of the decisions are taken by a discrete group. This would not only add to the prestige of the societies but would also enable them to become alive and take an active part in the promotion of their field of specialization and science as a whole.

The more generalized conclusions are with regard to the role of specialized societies in

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* It appears from the historical records that the work of earlier societies had greater impact on India of their day, though the standard of work and publication appears higher to-day.

giving direction to research in their field of interest. At the moment the quantum of information and the nature of symposia are such that at no place could a critical appreciation of the trends of research in a particular field be made. This requires immediate attention. Secondly, with the growth of greater degrees of specialization in science, there is a need for more generalized discussions, where more than one discipline could be integrated and where problems of policy, planning and other social aspects of science could be discussed. To have a specialised society for such discussion would not serve the purpose. What is needed is the participation of scientists from different fields of specialisation to take a synoptic view of science and contribute to such generalized problems, which means a greater emphasis on general societies.

Finally, there is a need to re-examine some of the traditional activities, the impact they are creating and the efficiency with which they are fulfilling their objectives.

In the light of such an analysis and the trends in science, the need for reorienting the activities of societies might emerge.

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1. Merton, R., *Amer. Social Rev.*, **22**, 635 (1957).
2. Storer, Norman W., *Science*, **142**, 464 (1963).
3. *Op. cit.*
4. Storer, Norman W., *Amer Behavioural Scientist*, **4**, 27 (1962).
5. Hubbert, M. K. *Science*, **139**, 884 (1963).

SCIENCE IN IRAQ

Dr. MOHAMAD SALIM SALIH
University of Baghdad

I am very glad to have this opportunity given to me by the Association of Scientific Workers of India to attend the great Symposium of 1964, and I am very glad to congratulate the Association for the great success and fruitful results of what have been done. I hope that with this honest scientific spirit of various workers and scientists and with the advice of brilliant leadership of the President of India, India shall be in near future one of the great and powerful countries who seeks for the world peace and cooperation between various nations of the world.

India in my opinion is the most rapid developing country in the world since the date of independence.

India and Iraq are both old and young countries, old since they are ancient countries which established the great civilization in the world. The ancient Arabian and Indian scientists have the privilege of propounding the earliest scientific theories in various fields of science. Both are young from the point of view of the time they achieved independence.

India and Iraq are similar in other respects concerning the internal problems of each country which are the results of the colonialism. These problems are classified into three groups:—Sickness, Poverty and Ignorance. Colonialism strongly rooted these three diseases in both the countries but with science and science only can we conquer them.

As far as the education and scientific development in Iraq are concerned I can mention the following facts very briefly.

Before the revolution of 14th July, 1958, the educational facilities were limited. The number of students and schools were small. The University of Baghdad had started in 1908. At that time the University had just one college (College of law), and then the following colleges were subsequently added:

College of Education	1923
,, ,, Medicine	1924
,, ,, Pharmacy	1936
,, ,, Agriculture	1939
,, ,, Engineering	1940
,, ,, Girls	1945
,, ,, Art	1949
,, ,, Science	1949
,, ,, Dentistry	1953
,, ,, Veterinary	1955
Institute of Engineering	1950-1951

After the revolution of 1958, other groups of institutes were added, as the institute of Forestery, Institute of Arid Zones, Institute of General Management, Institute of Athletics, Institute of Languages, Institute of Industrial Engineering, and Institute of Mensuration.

In addition to the University of Baghdad, a new university was established in northern part of Iraq in 1959-60 which consists of College of Science, College of Engineering and College of Medicine.

The Government also decided to establish a third university in southern part of the country in 1964-65. Besides this, two night public universities were opened in Baghdad last year.

The number of scientists in the country is around 300 apart from the laboratory demonstrators.

Earlier the facilities and scientific equipment were so limited that even the needs and requirements of the small number of students could not be met. After the revolution of 1958, improvement took place in this direction and more equipment was provided either by the Government or in the form of scientific and technological aid by the UNESCO and the United Nations.

As far as the scientific research is concerned the university lays emphasis on important points and all facilities are provided for such activities. Various researches in different fields are proceeding.

In the field of agriculture, various aspects have been studied to improve the plant products by using the best and helpful fertilizers, to destory various plant enemies by using the best suitable insecticides, etc.

Most of the area of Iraq can be divided into two parts: first is the arid zone and the second is the semi-arid zone. The establishment of Institute of arid zones came up as a result of the need of the information concerning the characteristic of salty and alkaline areas and the methods of their improvement, the nutrition of the plants, adaptation of plants to grow in salty areas, the use of solar energy for various purposes etc. In addition, studies are being conducted related to the problem of dust and the use of salt water in agriculture.

In the field of public health and medicine especially in the field of parasitology, extensive research work is being done dealing with the biology and taxonomy of the parasites which infect our people as well as our domestic animals and to find the best way for protection and treatment.

In the field of Biology, the university established the Biological Centre for Research in 1963, in order to:

(1) Encourage and support the biological research, support the specialists and to cooperate with the foreign institutes,

(2) Publish the scientific researches which have been done in the institute or in various colleges, and to distribute it to various national scientific institutes as well as to foreign countries as an exchange of scientific publications

(3) Prepare and establish a good and satisfactory reference library in biological science,

(4) Exchange knowledge between scientists of Iraq and foreign countries through participation in the conferences to be held in or out of the country.

Problem of Scientific Vocabulary and Text Books

English text books and references are being used by our students especially in science, although our native Arabic language is being used in some of the colleges. Therefore an important problem has arisen concerning the scientific vocabulary in Arabic. For this reason the Arab countries are making a unified attempt in regard to the scientific terms.

The University of Baghdad is giving all the facilities and encouragement for the purpose of translation of the foreign text books and references in Arabic.

Exchange Scientists

Iraq is still in a stage of construction and the country is badly in need of specialists in various fields. We are very glad to have now a number of professors from foreign countries including India as the exchange professors or as visitors for teaching purposes and also for scientific research.

The Government is sending these days few of our young scientists abroad to be in direct contact with the experts in various fields in various parts of the world.

The scientific inter-relationship is one of the most beneficial method to promote ideas and thoughts between the individuals of various countries, and this is one of the most important factors to bring peace and settlement in the world.

Paper presented at the Symposium 'Science and the Nation' held in New Delhi, July 27-30, 1964

PLANNING FOR MEDICAL RESEARCH IN INDIA

Dr. C. G. Pandit

Prior to 1911, medical research was being conducted mostly by medical members of the East India Company and later by the Officers of the Indian Medical Service, mostly Europeans, on problems in which they were individually interested. Very important observations have been made during this period; for example, Carter investigated the aetiological agent of relapsing fever, Donovan of kala-azar and Ross of malaria. Most of these researches were in the field of communicable diseases. With the establishment of the Indian Research Fund Association in 1911, first organized effort for the development of medical research in the country was made. This epoch covers the period from 1911 to 1947 when the country became Independent. The Indian Research Fund Association was very active during this period and major emphasis in research was in the field of communicable diseases since they had posed problems of utmost public health importance. This period was indeed very productive. Kala-azar, one of the major communicable diseases of the time, was investigated in all its aspects by a special Commission appointed for the purpose. The efforts culminated in transmission of infection to human volunteers by Swaminathan and Shortt in 1942 or thereabout. Malaria was the most important major public health problem affecting the country during this period. Through the efforts of the Malaria Survey of India and later the Malaria Institute of India, the prevalence of the disease, the mode of its transmission and other factors were investigated, paving the way, after Independence, for the launching of an all out campaign for the eradication of the disease. Leprosy and cholera were investigated and suitable measures for the treatment of these diseases were evolved. Roger's contributions in the development of saline therapy in cholera and the use of chalmugra oil in the treatment of leprosy are, indeed, well known. It was during this period that Semple discovered the technique of manufacture of anti-rabies vaccine which has since been the sheet anchor in the treatment of bites by rabid animals. While these efforts are commendable, no specific steps were taken to promote researches in other disciplines of medicine and public health. As pointed out by the Health Survey and Development Committee in 1946, there was complete neglect of research in the then existing medical colleges.

Soon after Independence, it was decided to re-orientate the activities of the Indian Research Fund Association which was rechristened as the Indian Council of Medical Research. This was followed by active steps for initiating and development of research programmes in a wide variety of subjects covering almost all the disciplines of medical sciences. At the same time, there was no relaxation of efforts to promote research in the field of communicable diseases with the help of the newer knowledge and techniques which were then available. For example, in the field of communicable diseases, researches were undertaken to ascertain the manner in which filariasis could be controlled and ultimately eradicated from the country. Newer methods for the treatment of leprosy were evolved which had helped in the launching out of a leprosy control programme on a nation-wide basis. The methodology of attack on smallpox with a view to its eradication was developed. A new focus of schistosomiasis was discovered and methods were suggested for its prevention. In the field of virus diseases, to investigate the whole field of arbor virus diseases, a special Institute was established with the active collaboration of the Rockefeller Foundation and many interesting observations were made on the virus encephalitis of various types prevalent in the country and a new virus disease affecting men and monkeys in certain parts of South India was discovered. At the same time steps were taken to ascertain the extent of poliomyelitis in the country including the prevalence of the three types of the virus and the basic epidemiological knowledge obtained which might help in the institution of total control programme for the disease with the use of newly developed vaccines. In addition, steps were also undertaken to ascertain the extent of morbidity and mortality due to several other diseases, e.g., infantile diarrhoeas with special reference to their bacterial and virus aetiology. While these efforts were being continued, researches were initiated in various aspects of nutrition, including nutritional disorders prevalent in all parts of the subcontinent and also in the field of maternal and child health, in industrial health and in several facets of the environmental sanitation programmes. Side by side with these efforts, one of the main activities of the Council since Independence, was the promotion of research in the teaching medical institutions in the country. To develop a research outlook and atmosphere in these institutions, a special fellowship programme was instituted to train the junior members of the staff of such institutions in the methodology of research. Specific problems were allotted to them for investigation wherever suitable facilities for the purpose existed. The Council has published periodical reports and participated in radio programmes dealing with the results obtained in the field of medical research.

During the last 18 years, the above mentioned research programmes of the Council have been implemented stage by stage. There is no doubt that our research workers have made spectacular contributions in the field of medical research within India and can stand even a fair comparison with other investigators in the world. In the initial stages of any organization it is not possible to adhere to or execute research activities on a strictly planned basis. Nevertheless, the Council had a broad idea of the several fields in which simultaneous and parallel progress had to be achieved to bring medical research in India on the world map.

For the pursuit of the above goals, the Council acted through a number of agencies, namely its permanent research institutes like the Nutrition Research Laboratories, Hyderabad and Virus Research Centre, Poona, "Research Units" centred round eminent and experienced workers who have made a major contribution in their particular field of work and, a large number of research service units and research enquiries to cater to the needs and expectation of all the interested research workers in the country. The Council had also undertaken a number of urgently needed field surveys to gather all relevant epidemiological, clinical and other information regarding the morbidity patterns of specific diseases.

As a result of these efforts, during the last 18 years fairly satisfactory progress has been achieved. Hence it was considered appropriate to take stock of the whole situation and analyse the progress achieved against the background of the original aims and objectives of promoting medical research all over the country, employing generally adopted principles of research statistics. This type of information will be of undoubted value in formulating the future policies of the Council. It might also provide more objective criteria and parameters to assess the overall needs and requirements of medical research in the country as a whole down to the smallest "unit of research activity in a medical college."

The main trends of medical research under the auspices of the Council have indicated the quantitative as well as the qualitative flow of research activity in the major fields of research under the Council. It is noticed that during the last 18 years there has been a gradual rise in the number of research schemes received and sanctioned by the Council. The number varied between 350 to 500 in recent year. Little over half the schemes were approved and the others had been rejected, a part of them due to unavailability of funds and the others due to technical reasons. While a few individuals appear to be in a position to undertake research on more than two or three investigations, a very large proportion (81%) seem to be engaged on one investigation at any given time. This would clearly suggest that there is no undue aggregation of schemes around individual workers. However, when examined on an institutional basis, there are reasons to believe that a relatively smaller number of teaching medical institions and research institutes appear to take a large share in the research activities of the Council. While the intensity of research activity in these places is to be welcomed, it is also a matter for consideration whether the Council should not review its efforts to ensure more equitable and uniform distribution of the research activity under the Council. This would avoid the dangers of domestic brain drain, a problem in many of the developed countries.

With regard to the content of medical research on a subject-wise basis, there seems to be a gradual shift from epidemiological studies and communicable diseases to a greater variety and number of problems in the field of basic medical sciences and experimental and clinical medicine. Similarly, there is also an increasing interest in researches on scientific aspects of family planning and on indigenous drugs.

The analysis also revealed that by and large substantially more research is being carried out in research institutions rather than in medical colleges. This is obviously due to the fact that the former are better equipped and better staffed. Some of the clinical subjects are preferentially investigated in medical colleges, e.g., studies on cardio-vascular diseases, etc. Nevertheless, there is great scope for enlarging the extent and depth of research in medical colleges. Obviously, there is a need for creating a co-ordinated type of research activity in medical colleges by drawing together a number of active departments of research. In this connection, based on its experiences, the Council has proposed to create "research cells" on a multi-departmental basis in as many colleges as possible. The analysis has also shown that of the 80 and odd medical colleges in the country, less than half of them participate in the activities of the Council at any one time. Even amongst them, except the top few institutions referred to above, the rest generally confine themselves to participation in one or two research schemes. Thus in planning for the future, while we should not retract from the erstwhile policy of granting assistance to really worthwhile schemes, there is a need to re-orient and change the basic policies so that we bring into the fold of medical research practically every new college once it has gone through its initial teething troubles of establishing itself. Before one attempts to draw a countrywide plan of research, it would be desirable to know all about the main trends and patterns of staffing, financing and costing of medical research in the country which is practically the responsibility of the Council.

Man-power under the Council

The distribution of different categories of scientific, technical and administrative personnel revealed interesting features. The Council, as is well known, is dependent to a great extent upon the efforts and activities of the honorary scientific officers supported by its own smaller group of senior research workers and a larger contingent of Assistant Research Officers and Research Fellows. By comparison the technical personnel employed by the Council constitute a much larger group than that of the responsible scientific workers. However, in comparison with the distribution of scientific and technical workers in other countries, particularly the U.K., it would appear that there is a great need for not only increasing the relative proportion of technical workers but also improve their capacity and function. The support ratio between scientific, technical and assistant class under the Council is of the order of 1:1.08:1 in contrast with the generally recommended figure 1:2:1for scientific research institutes. This trend suggests that the Counc l has to concentr te on recruiting a more qualified type of technical personnel with a B.Sc. or M.Sc. qualification. Such workers should be gradually trained in the several fields of medical research and later on considered for promotion into the technical scientific officer class. A reclassification of the man-power under the Council as between "qualified" and "unqualified" workers, the former being constituted of all the scientific workers plus half the number of the senior grade of technical personnel, would appear to be well within the range of the ratio 1:1 expected in scientific research laboratories in comparison with industrial research laboratories. While this is to be expected, it is gratifying that the staff pattern has tended towards what prevails in pure scientific research.

Financing of medical research

The Council is dependent mainly upon the annual grant from the Government of India plus occasional grants from international agencies. Like any other grant-giving agency, the Council has its own machinery for screening and approval of research schemes on the basis of which the annual budget or estimate of expenditure is drawn. Due to the inherent limitations and complications of working a large number of *ad hoc* research schemes, there are bound to be lapse of funds due to failure either in starting or continuing an investigation to its logical conclusion. Consequently, a certain proportion of the approved budget is never utilized. These difficulties have been overcome by a careful balancing of the approved budget grant or expenditure. The pattern of expenditure of the Council would indicate that, while it is responsible for all the expenditure like that on capital, rent, personnel cost and running expenses in connection with its permanent institutes, it has only to defray the personnel and running expenses of *ad hoc* enquiries, the rest being taken care of by the host medical college or institution. This is an aspect of utmost importance in the planning of research in the country. It shows that it may not always be necessary, nor even desirable, to spend a large amount of money on building and equipment in merely duplicating the existing facilities. On the other hand the practice of the Council of financing the running expenses of research would appear to be a simple and economical one.

A year-wise analysis of the data reveals that out of the annual grant available to the Council not more than 12% is spent on non-research expenditure as per the general definitions suggested by O.E.E.C. Manual. This figure has remained more or less constant during the entire period of 18years,except for one or two years consequent on the shifting of the Nutrition Research Laboratories to Hyderabad and the building of the Virus Research Centre, Poona. Out of the 12%, 7.5% is on account of the headquarters establishment of the Council, which once again proves that most of the expenditure of the Council is on research and development and related activities. Out of a total of 87% nearly 84% is spent on research and development and the rest on related activities like publication of special reports, the journal, etc. This study has also revealed that the overall financing of the Council is quite in accordance with the sound principles of management of scientific laboratories and scientific organizations. It is noteworthy that the percentage of non-research expenditure remained constant in spite of the rise in the grant from Rs. 14 lakhs in 1947 to Rs. 80 lakhs at pre ent.

With a view to assess the costs per unit scientific activity, an attempt was made to compare the man-power distribution under the Council with the financial resources of the Council. As per generally accepted criteria, a series of indices pertaining to personnel costs have been worked out. On the basis of 18 years study, the total and research costs per "total employee", "scientific employee" and worker "qualified" have been estimated. From these figures, it would appear that the average cost per total employee is of the order of Rs. 3,460 or £280 which is one-fourth or one-fifth of that in many other countries. Similarly the cost per scientific worker would amount to nearly Rs. 16,300/- and per "qualified worker" Rs. 10,000/-. All these figures are relatively speaking about 1/4th to 1/5th or even lesser than the corresponding figures from other countries. Instead of causing undue concern, it is a matter for satisfaction that it is possible to promote gainful research activity in the country with a relatively smaller investment. This is an aspect which should be taken advantage of in the country. It is neither necessary nor desirable that we should imitate the West in every respect. What is needed is that we ensure an adequacy of funds and personnel to meet our own needs.

Although it is not customary to evaluate the cost of individual research schemes due to the peculiar working and function of the Council, it was considered worthwhile to examine the average cost of an enquiry under the Council. This figure fluctuated between Rs. 14 to 18,000 with an average of Rs. 14,000 in recent years. This, once again, would show that within the existing framework of medical research in the country, i.e., working in co-operation with the medical colleges, the overall needs for research fund are not exhorbitant.

On the basis of the data collected by the Council with regard to the support ratio and the need for their further modification, the cost per scientific worker and the cost per research scheme, it is possible to assess approximately the requirements of a "unit of research activity." This can be defined as a "worthwhile research project under the care of a Professor of a medical college who would be provided with the funds for personnel and running expenses to prosecute an investigation of his choice." In the light of the experience of the Council, research can be instituted in each department by providing one research fellow, one senior grade technical worker, one junior grade technical worker and one attendant with a total financial grant of Rs. 15 to 16,000 which in exceptional cases might go up to Rs. 20,000 per year. On the assumption that 6-12 departments would participate in continuous research activity, the need of a college would vary from Rs. 1 to 2 lakhs per year. Correspondingly the overall financial requirements for research in all the colleges can be estimated to be of the order of Rs. 100 lakhs excluding expenses on institutes and post-graduate research institutions.

Apart from the foregoing research statistical analysis, the Council has also given considerable thought to the machinery or agency by which the research can be initiated or promoted in medical colleges. As a result of all these years of experience it is felt that while the principle of *laissez-faire* is conducive to the flowering of a natural or instinctive scientific leadership in itself, it would not be adequate to meet the challenge that the country faces today. While every effort should be made to maintain the present tempo of individual-centred research activity, there is also a need for simultaneous development of medical research particularly in institutions wherein such talent is not readily available. The Council, for a number of years, has been concerned about this disparity which is not only true of India but even of some of the advanced countries like the U.S.A. If this trend were to continue, sooner than later, we are likely to end up in the same dilemma which is facing the more advanced countries, namely, the continuous and rapid progress of a few institutions to the comparative neglect of a large number of other newly started institutions. This domestic brain drain, which is already in evidence in the countries like the United States might have far greater consequences in India. Hence, the Council has repeatedly urged the need to foster research in medical colleges, if necessary by cutting new ground. Though much progrerss has been made during the last 20 years, it is felt that the stage has come when new ways and means have to be tried. In keeping with the data collected above, the Council is organizing a number of research cells in selected medical colleges. A pilot experiment is already under way in Trivandrum and will be instituted in a few other centres shortly. If these results justify the hopes and expectations entertained, it is proposed to extend the same to increasingly large number of colleges.

From the organizational point of view on the basis of the experiences of the Council, it is suggested that every medical college or research institute must have a local Research Committee which would be concerned with the formulation and execution of research. The several medical research committees in turn would be under the overall charge of the State Medical Research Board which will be concerned with the formulation of broad policies and financing of the research investigations. The Council, by virtue of its unique position, might be able to play a useful role not only in initiating such activities but by providing technical information for the organization of such country-wide measures.

In conclusion it is felt that a review of the progress of medical research in the country through the several phases of its growth during the last 50 years has many lessons to teach us. While urgent and important problems used to be investigated in earlier decades, gradually there is a shift from such investigations to more planned and deliberate investigations in the field of clinical and experimental medicine or basic medical sciences. While doing so the need for epidemiological and other data is not lost sight of. With a fairly satisfactory growth of medical research in the country and the general awareness of the need for research, it might be safely concluded that the atmosphere is most congenial for widespread dissemination of the concept of medical research. To enable such a development, the Council has taken a forward step in working out not only the qualitative aspect of medical research in the country but the quantitative aspects with regard to the management of research, financing of research and the costing of research and lastly the functional machinery for translating the research principles and policies of the country with particular reference to the medical college through the medium of research cells, college research committees or State Medical Research Boards.

Paper presented at the Symposium 'Science and the Nation' held in New Delhi, July 27-30, 1964.

NOTES AND COMMENTS

Prof. P. Maheshwari

On behalf of the Vijnan Karmee, we offer our heartiest felicitations to Prof. P. Maheshwari, Head of the Department of Botany, Delhi University, on his being honoured by election as an honorary Fellow of the Royal Society, London. Prof. Maheshwari's pioneering work in the field of genetics is well known to scientists all over the country and we hope his example will be a source of inspiration to his colleagues and younger scientists.

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Prof. Ajit Ram Varma

We are happy to learn about the appointment of Prof. A. R. Varma, Head of the Department of Physics, Banaras Hindu University as Director of the National Physical Laboratory, New Delhi. We hope that under the guidance of this young and brilliant physicist the Laboratory will go from strength to strength.

* * *

Royalties and fees from patents: U.S. receives $700M. annually

A recent study of the Commerce Department has revealed that the U.S. is receiving over $700 million annually in royalties and fees through the foreign affiliates of the U.S. firms and patents.

The number of patents received by foreigners abroad for U.S. products has been increasing year by year with the expansion of world trade and growth of technology. More and more patents are being sold abroad which has been bringing back to the U.S. economy high remunerations.

The study covered patents in the years 1959 to 1963. In these years, the total number of patents issued has been 57,738, 64,292, 69,817, 78,517 and 82,377 respectively.

During the same period, the U.S. patents for the Indian collaborations on industries have also shown similar increase. In 1959, the total number was 684, in 1960 it was 875, in 1961 1,173, in 1962 1,531 and in 1963 it reached 1,600. The figures for 1964 are not yet available but it is presumed to be much higher.

The Canadian industries have the largest number of U.S. patents, almost one-fifth of the total patents registered in the U.S. followed by Britain, Germany, France, Japan, Australia, Netherlands, Belgium and Sweden.

(*Financial Express* 1965, *April* 3, p. 7 v)

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Second-hand Plant and Equipment

The import of second-hand plant and equipment from the UK is not unusual although the practice is ordinarily frowned upon by the Indian authorities.

Indian subsidiaries of British companies particularly chemical companies often import renovated equipment from their principals under a third party performance guarantee, insisted upon by the import licensing authorities in India.

Reliable estimates of such imports are not available, but between 10 and 20 per cent of capital goods imports into India are said to fall under this category.

(Abstracted from *Chemical News* 7 (161):6p.)

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Handicaps to Small Scale Industries

(*Extract from Address of Shri B.N. Bhaskar, Chairman, Reception Committee, Silver Jubilee Conference of the All India Manufacturers' Organisation, May* 1, 1965 *at New Delhi p.* 5-6)

Here, I may mention, Sir, some of the handicaps under which industries in general and small scale industries in particular have to function in Delhi. The salient need of the small industrialist, who has to be himself every kind of a department manager, is the setting up of one and only one government agency to scrutinize and provide the small industrialist with all his needs and materials or provide a solution to his problems through an inordinately simplified procedure. There is lack of coordination among various Government departments. There is no one single authority with which we could deal. In the absence of such an authority the position sometimes becomes very frustrating. One department may grant a licence for setting up an industrial unit but power may be denied by another; and yet another may be rejecting building plans duly certified by the Chief Inspector of Factories. Can a small entrepreneur afford the luxury of having to chase multiple Government departments and also run his small industry ? The small industrialist is eager to contribute his best for raising the industrial growth of the country. Why not harness it in time to the advantage of the consumer?

* * *

National Approach

(*Extract from speech of Shri Hansraj Gupta, Chairman of the All India Manufacturers' Organisation at the 25th Annual Conference of the Organisation held at New Delhi on 1st May,* 1965/p. 11-12)

I am constrained to make a few observations on the need for having a national attitude and approach in several of our endeavours, whether they relate to utilisation of power and water resources, starting of public sector projects and employment therein, imposition of tax measures by the Central Government, State Governments or Local authorities, enaction of labour legislation, etc. In the past, our Organisation had stressed the need for development of our power and water resources on a national basis through the setting up of appropriate development authorities. I do not propose to go into them once again. However, I cannot but regret that the proposal to establish river boards has been given up by the Union Government presumably because of lack of co-operation from some State Governments.

On this occasion, I would like to refer to the recent tendency of each State Government to clamour for a steel plant, an oil refinery, a fertiliser factory and even an atomic energy unit. Political pressures are brought in and some States even go to the length of carrying on negotiations with foreign countries for starting these projects on a collaboration basis. While the zeal of State Governments to industrialise more rapidly their own individual State can be understood, it will be appreciated that the starting of industries without the regard to their economic feasibilities will be detrimental to the nation as a whole and to the tax payer and the consumer individually. To some extent, this tendency is due to (i) lack of prescribed prodedure for due consultation with State Governments and for quick decision thereon, and (ii) the Centre's shouldering of the entire financial responsibility for these projects. It is time that a suitable procedure is evolved for joint consultation and responsibility for sharing a part of the burden squarely placed on the shoulders of the concerned State Government.

In the case of employment in the public sector projects too, there is a tendency on the part of some State Governments to agitate for employment of State people in preference to these from outside. While there may be some justification for this, it is advisable to lay down a suitable employment policy which should prescribe different formulae for unskilled labour, skilled labour, technical and managerial personnel, etc.

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Production and Prosperity

(*Extract from speech of Shri Hansraj Gupta, Chairman of the All India Manufacturers' Organisation at the* 25*th Annual Conference of the Organisation held at New Delhi on* 1*st May,* 1965 p. 3-4)

It is needless for me to review at any length the present economic situation in the country, as it has been done only recently by Government in the Economic Survey brought out at the time of the presentation of the Central Budget. The Survey has rightly emphasised what should be proper accents of economic policy at present in view of the prevailing shortages and high prices of a number of essential commodities and goods required by the industry and the consumer.

The Government's Economic Survey has pointed out that the objective of economic self-reliance, on less than the problem of higher living standards, calls for concerted efforts to increase production and productivity in all fields. It is no doubt true that since the commencement of Planning in 1951 our country has made considerable progress in various fields. Yet a glance at the following figures relating to average per capita gross national products by sectors in countries of the ECAFE region will reveal the great lee-way that our country has yet to make even among these countries of Asia in achieving reasonably high per capita output and rate of growth of per capita output which are absolutely essential, if the living standards of our people are to be raised—

Average per capita National Product 1961/62 *and its Growth Rate between* 1952/53.- 1961/62 *by Sectors* (*in US Dollars at* 1960 *prices*) .

Country	Agriculture		Manufacturing		Others		Total	
		Growth rate		Growth rate		Growth rate		Growth rate
Australia ...	189*	—3.4	424*	2.0	890*	2.4	1,503*	1.4
Japan ...	71	2.8	152	12.0	272	10.0	495	8.6
Malaya, Federation @	106	—1.5	14*	1.4	121*	—0.3	241	—0.5
Philippines ...	60	—1.1	29	6.5	93	3.4	182	2.0
China (Taiwan) ...	45	1.1	29	5.8	76	3.9	150	3.3
Ceylon	64	—0.5	7	1.8	67	2.8	138	1.1
Korea, Republic of	52	0.2	17	9.9	60	1.3	129	1.6
Thailand ...	37	0.3	11	1.1	52	2.8	100	1.7
India** ...	33	0.0	12	2.2	30	2.4	75	1.3
Pakistan ...	38	—0.3	10	4.3	25	1.5	73	0.8
Burma	22	0.5	8	5.7	25	2.7	55	2.1
Indonesia ...	32	1.4	4	0.0	16@	—0.9	52@	0.6

*1961 only
@1960 only

**"Construction" and "utilities" are included under "Manufacturing."

Some Problems in Utilisation of Petroleum Products and Processing of Hydrocarbons in India

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1. The role of petroleum as a growing source of energy, wealth, and human comfort has been too well established during the past fifteen years to need any further justification. Recent trends in consumption of petroleum products in India have shown that she is no exception to the techno-economic criteria applicable in the industrially advanced countries. The social and economic conditions prevailing in India have shaped a pattern of demand for petroleum products which is substantially different from that in other countries.

1.1 Comparison of patterns of demand in different countries shows that kerosine constitutes a substantial proportion of products used in India and Latin American countries; diesel and fuel oils form a major part of the total. A characteristic feature of the Indian pattern is the low motor gasoline consumption. On the other hand, the patterns in industrially advanced countries are characterised by high consumption of motor gasoline, diesel oil, and fuel oil. In several countries,a substantial increase in fuel oil demand has been noticed in recent years. In Europe, in particular, this has been found to take place at the expense of coal.

1.2 Another characteristic feature of the Indian demand pattern is that about 90 per cent of the total kerosine is used for domestic lighting and the remaining for cooking. About 90% of the kerosine is used in the rural areas where about 82% of the total population reside. A very small proportion (below 4%) of the kerosine used in rural areas is used for cooking purposes, and that too, mostly by families living in small towns.

2.0 Forecasts of demand of petroleum products are dependent on several factors, social, economic, and technical. Easy availability of alternate fuels at competitive prices is one of the most important. Estimates of demand of energy products have shown that nearly 14 million tonnes would be required in 1966, rising to 22-23 in 1971, and about 40 million tonnes per year by 1976. Kerosine and diesel fuels are expected to constitute about 55%, and fuel oil about 33% of the total energy products needed in 1971. Even by 1976, this trend is not likely to change substantially, particularly with reference to the kerosine demand.

2.1 Comparison of demand and internal production of petroleum products in 1963 shows that production of kerosine was less than 18% of the total compared to a consumption of about 25%. Diesel and fuel oils were also in deficit. Motor gasoline (naphtha), was, however, in surplus. Taking into consideration the product pattern likely to

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be obtained in future refineries during the period up to 1971, and assuming that some measure of restraint would be exerted on the demand of kerosine, there are likely to be deficits in middle distillates and fuel oils, with substantial surplus of motor gasoline or naphtha.

3.0 This continuing imbalance between demand and production should form a background to all research and development work in petroleum technology in India. In addition, the general growth of industry and agriculture in India, and the urgent need to minimize expenditure of foreign exchange provide strong incentives for further research.

3.1 In this context, it is important to note that about 85% of the petroleum products are used for production of energy in one form or another. Alternative and competitive sources of energy should, therefore, be kept in view. Actually, in European and other countries, oil, as a source of energy and chemicals, is fast replacing coal. India cannot be immune to such international technological trends for two reasons:—

(1) India, in order to earn foreign exchange and to improve its economy, is entering export market. This dictates that costs of production should be kept low which, in turn, demands low fuel and energy costs and high efficiency of energy untilisation.

(2) The coal resources in India are most concentrated in the east-central part of the country and generally Indian coals are of high ash content. Until now coal utilisation is mostly restricted to use as direct fuel and to carbonisation for production of metallurgical coke. There is as yet no significant secondary fuel industry based on coal. Large parts of the country and most of the industries have been facing severe fuel shortage and are ready to use petroleum fuels if made available.

3.2 The peculiar problems existing in India, therefore, demand, at least to some extent, special and fresh scientific approaches to achieve satisfactory solutions. Some of the problems facing utilisation and disposal of oil products and efforts needed to solve them are now discussed.

4.0 *Kerosine Problem:* There is a large deficit of kerosine in India which is likely to continue for several years to come in spite of efforts to choose proper crudes to maximise kerosine production. The major proportion of the demand in India for kerosine is for providing illumination. One of the problems involved in the processing of the Nahorkatiya crude is the high aromatic content of the kerosine fraction, necessitating solvent refining to raise the smoke point to the limits prescribed by Indian standards. Solvent treatment, on the other hand, results in an aromatic extract without a ready market.

4.1 In view of the shortage of kerosine, one should consider whether kerosine with high aromatic content (about 40%) cannot be utilised as an illuminant in suitably designed lamps thereby increasing the availability of kerosine. This is not a new idea, when one recollects the fact that in 1846, distillate oils from coal were first sold in the U.S.A. under the trade name 'kerosine oil' as an illuminant.[1] Subsequently, based on the work of James Young in 1848 in the U.K., several factories were established in the U.S.A. by 1860, to produce illuminating oil from cannel coal imported from Britain. Studies have shown that "in a suitably designed lamp with good draught, the most aromatic types of kerosine will burn brilliantly and well." [2]

4.3 There is thus every justification to improve the design of lamps to make them suitable for use with highly aromatic kerosine and also to review the Indian Standard Specifications. This would mostly obviate the necessity for hydrogenation or solvent extraction of kerosine. In this context, it is necessary to mention that properties of kerosine should be considered in relation to the lamps in which they are used and to the precise type of application. For example, the char value in the burning test is designed to meet the requirement of kerosine which is intended to be burnt continuously for long periods as in light house and railway signalling lamps. Since the most important use in India is in domestic lamps where a lamp may be used continuously at full luminosity for an average of only 5-7 hours per day, char value does not appear to be important.

4.4 It is, therefore, desirable to undertake work on improvement of domestic lamps and make them sufficiently cheap and yet suitable to burn efficiently aromatic kerosines. It is also desirable to review, where necessary, existing specifications of kerosine which were originally borrowed from foreign specifications intended for imported products.

4.5 Another solution to the kerosine shortage is to produce it from alternative sources. Although there are many alternative sources which are theoretically possible, each has its problems to be solved before they become economically feasible.

4.5.1 *Petroleum Sources:* Conversion of naphtha which is a surplus product is very desirable. This is theoretically possible, by conversion of naphtha into olefines followed by controlled polymerisation. Considerable work is, however, necessary to make the product acceptable and the process economic. The price of raw naphtha becomes important. Waxy residues form another source. Ideally, if a long chain wax molecule can be broken into two molecules with equal carbon numbers, the product can be a good middle distillate. Unfortunately, however, theoretical considerations show that each carbon-carbon link is equally susceptible to cleavage and very often small molecules are obtained. It is necessary to apply hydrocracking techniques to convert waxy residues into middle distillate. Here again, intensive work is required to develop process-know, work out the economics and test product quality.

4.5.2 *Coal Tar Sources:* Coal tar distillates are another important source. Although coal tar distillates were the earliest source of illuminants, they ceased to be used ever since the development of the oil industry, whose rapid growth in the early stages was chiefly determined by the demand for kerosine. High temperature tar, a product of conventional high temperature carbonization, is completely aromatic, and therefore, burns with a highly smoky flame in ordinary lamps. On the other hand, low temperature tar contains 25-30% saturated hydrocarbons. Several of the aromatic compounds present in the low temperature tar have paraffinic side-chains which tend to reduce the smoking nature.[3] Fractions of this tar can, therefore, be used as illuminants[4] in suitably designed lamps. Lignite tar which is more paraffinic in nature would also be good source. If, in India, low temperature carbonisation plants are established to produce smokeless domestic coke, the resulting tar forms a good source of illuminants. Work should be intensified in this direction.

4.6 It is worthwhile pointing out at this stage that there is a traditional antagonism between coal and petroleum industries in many foreign countries. It would be most desirable for India to maintain a neutral outlook in this sphere. In view of the shortage of kerosine, every source should be explored to produce illuminants.

4.6.1 It is well to remember that, due to the present undeveloped condition of the Indian coal tar chemical industry, and due to the already advanced stage of petrochemical industry abroad, there is little chance for the Indian coal tar chemical industry to develop with the same vigour and on the same lines as had taken place in Germany and the U.K. It is, therefore, in the best interests of the Indian economy to divert coal tar to other channels. Production of diesel oil by hydrogenation would soon become a marginal case, even in India, due to the anticipated rapid growth of petroleum refineries. Kerosine as an illuminant would continue to be in short supply.

4.6.2 Efforts should, therefore, be intensified to work out the full process know-how and economics of the process. This is a direction in which no other country is likely to be interested and efforts by Indian scientists are likely to meet with success.

5.0 *Naphtha problem:* All studies and estimates made so far show that there would be continuing surplus of naphtha, as surely as there would be shortage of kerosine. Unless effective methods are available for disposal of naphtha, the Indian refining industry is likely to suffer under-production resulting in further shortages and loss. Export may not be an entirely reliable method from long-term point of view, because, every country, however small, is likely to establish its own refinery. This is facilitated by recent trends in economic design of small refineries. Efforts should, therefore, be made to utilise naphtha in India. The fertiliser plants and petrochemical complexes which are already planned would provide adequate solution if implemented punctually. There are also many reasons for likely delays. It would, therfore, be necessary to provide more outlets for utilisation of naphtha so that it can be suitably diverted to compensate for delay in one project or another. Establishment of fuel gas plants of suitable capacity based on naphtha at the major cities would be one such outlet and also provide the much-needed domestic and industrial fuel. It is not necessary to begin with an integrated network because each plant can be economic and plants suitably located can be integrated into a grid at the appropriate stage. Initial investment for long-distance gas pipes of large diameter can also be reduced. Although there is a proposal for one such plant at Bombay (40,000 tonnes /annum), more plants are justified.

5.1 Another outlet for naphtha which is under consideration is its injection in suitable form into blast furnaces. It is well known that substantial economies can be achieved by injection of hydrocarbons into blast furnaces supplemented by other modifications in operation. In view of the increasing cost and ash content (about 23%) of blast furnace coke used at present in India, it appears that production of pig iron per blast furnace can be substantially increased and cost reduced,if hydrocarbon fuels are injected. It can be expected that the iron and steel industry would be required, in future, to reduce cost of production to meet increasing competition from abroad and to improve national economy. All efforts should therefore be made to use hydrocarbon injection systems. A project is already initiated to conduct pilot plant trials in this field.

6.0 *General problems and lines of work:* Besides the specific and urgent problems discussed above, there are others which can be solved by proper utilisation of alternative resources. Shortage of fuel oil is one such. The abundant reserves of low grade coals can be substituted to meet the general demand of industries and power stations.

6.1 There are, however, some general aspects of the Indian petroleum industry on which scientific effort is needed. A pertinent point which is often raised in this context, is the justification for such scientific effort in India when a high level of specialised technical know-how can be readily purchased from abroad. The answer is two fold: technical and national.

6.2 *Technical:* (1) Several applications of petroleum products in India have special features closely connected with local conditions. Two such features dealing with kerosine and naphtha were discussed earlier in this paper. In the case of naphtha injection in blast furnaces, no detailed published work appears to be available on injection of light liquid hydrocarbons, probably because disposal of naphtha is not generally a problem in most industrially advanced countries. However, literature is available on injection of gaseous hydrocarbons, fuel oils, coal-oil slurries, etc., which have been and are being used abroad. This is a field where work needs to be done in India.

(2) The desperate need for self-sufficiency in nitrogenous and other chemical fertilisers, in the context of the rising Indian population and food requirements, requires no special emphasis. The target for nitrogenous fertilisers by 1966 is one million tonnes per annum. The hydrogen requirement is more than 1/5th by weight of that of nitrogen and the quantity for fertiliser manufacture alone would be about 214,000 tons by 1966. If fertiliser production is to be maintained at an adequate level, the requirement of hydrogen would be continuously increasing. It is well known that the main cost component of hydrogen manufacture by non-electrolytic processes is the gasification of feedstocks. All over the world, efforts have been in continuous progress for several decades to reduce cost of production of hydrogen. It is, therefore, of vital interest to India to make intensive and coordinated efforts to develop methods of production of cheap hydrogen. Reactions between steam and carbonaceous materials have been used for several decades for this purpose. Yet, each method has its problems. Complete elimination of carbon deposition and complete reaction between carbon in a hydrocarbon and steam is yet to be achieved, although the I.C.I. steam-reforming process, recently developed, is very near the target. In a way, the old water-gas process based on coke nearly achieved it; the process is however fast losing ground in view of more economic developments. Investigations on reactions between steam and hydrocarbons to produce cheap hydrogen would, therefore, be fruitful. In the Indian context, it may be worthwhile to conduct intensive investigations on the reactions between steam and the more refractory aromatic hydrocarbons.

(3) It can be generalised that India is not rich in sources of saturated hydrocarbons which are more amenable to many types of chemical conversion and efficient utilisation. On the other hand, a large potential exists for production of aromatic hydrocarbons whose hydrogenation has always attracted attention in many countries but could not be competitive against naturally occurring saturated hydrocarbons from petroleum. In the modern petroleum industry, 'hydrogen-treating' processes play a major role in obtaining the desired products. Obviously, apart from development of methods of production of cheap hydrogen, it would be of great advantage to develop methods of easy hydrogenation of aromatics. It is important to note that every country rich in aromatic hydrocarbons has always attempted to develop processes of hydrogenation and faced severe competition. The basic difficulty has been the highly stable condition of the aromatic nucleus. If methods can be developed to increase the energy of the aromatic mole-

cule and thereby decrease its stability, it can be made more amenable to hydrogenation and other dearomatizing reactions. So far, hydrogenation of aromatics to produce saturated hydrocarbons has been achieved by application of pressure, catalysts and temperature. In addition to development of selective catalysts, it appears desirable to look to other methods, such as, radiation treatment to induce easy hydrogenation in presence of hydrogen or compounds containing hydrogen.

(4) Another field which might be gaining importance in India is the design of furnaces facilitating inter-changeability of solid, liquid, and gaseous fuels. In view of the uneven distribution of coal fields, long haulage distances, and also the likely necessity of curtailing imports of petroleum products or crude to the minimum, the rapidly growing industry may not have adequate flexibility in the choice of fuels and may have to depend upon fuels available at any given time, as is happening even now. Studies in the field of combustion and design of furnaces to facilitate quick interchangeability are, therefore, desirable.

(5) There are many other aspects, such as, the vast range of chemistry and technology of petrochemicals, standardisation and standard testing, etc. on which work can be undertaken. A judicious choice of problems is required keeping in view the urgency and local requirements. It is not within the scope of this paper to discuss details of these problems.

6.3 *National:* Apart from the technological justification of the lines of investigation discussed above, there are many aspects on which indigenous technical know-how has to be developed. A projection into future of the Indian demand of petroleum products to reasonable levels of per capita consumption reveals the large quantities of crude to be processed and the magnitude of the future potential industry in India. A substantial proportion of the costs of refineries and petrochemical plants, almost all of which are imported, is paid for process and engineering know-how, catalysts, and individual units. Whereas it is not desirable nor easy for India to develop such know-how in the more sophisticated branches of the industry, it is essential to start to develop indigenous process and design know-how on the more basic aspects and on others of strategic importance. Advantage can be taken of the natural process of flow of scientific and specialised technical knowledge from advanced to developing countries. This process is inherent in the post-world war development which has witnessed the establishment of small refineries in consumer countries based on expertise developed only in a few organisations, thereby creating nuclei for development of technical know-how in developing countries. India should not, at any rate, lag behind other developing countries in this regard. Training of personnel to meet the demands of the industry in all the fields discussed above, assumes great importance.

7. Many of the problems discussed above, concerning utilisation, improvement of quality and augmenting the resources of kerosine, disposal of naphtha and conversion of hydrocarbons to fuel gas and hydrogen are actively being investigated at the Indian Institute of Petroleum. Besides, evaluation of indigenous crudes, testing of fuels and lubricants in engines, process evaluation,design and engineering, techno-economic surveys, and training of personnel have formed priority activities of the Insitute.

8. *Conclusion:* It may be concluded from the above discussion that, while the levels of science and technology in the petroleum and petrochemical industries in foreign countries are already high and rapidly advancing,

Indian social and economic conditions and pattern of utilisation pose many special problems in the utilisation and disposal of petroleum products. Improvement of quality, and increasing the availability of kerosene, improvement of design of lamps to use the more aromatic illuminants and disposal of surplus products, such as, naphtha, are of immediate importance to India. Production of cheap hydrogen and conversion of hydrocarbons are of much significance. It appears desirable to review some of the Indian specifications of petroleum products, and formulate them more in conformity with user requirements and habits in India, keeping in view the safety requirements, than to fall in line with the properties of imported products. Emphasis may be laid on the training of personnel to develop know-how for process design and engineering at the basic and some strategic levels of the petroleum and petrochemical technologies.

9. The author is grateful to his colleagues for their criticisms during discussion of ideas contained in this paper.

REFERENCES

1. Kewley, J., and Gilbert, C. L., in "The Science of Petroleum", Vol. IV, Ed. by Dunstan A.E., Nash A.W. Brooks, Benjamin, T., Tizard, H. (Oxford University Press), (1938), p. 2470.

2. Ibid, p. 2476.

3. Ibid, p. 2478.

4. Krishna, M. G. Vaidyeswara, R. Narayana Rao, B. S., Khan, M. J. A., Zaheer, S. H., Ind. P. 74596 (Council of Scientific and Industrial Research India) (1961).

SCIENCE NEWS

Block Making Machine

An automatic machine for making concrete blocks can produce 9,000-10,000 4-in. blocks per eight hour shift at "negligible" running cost. The machine compresses aggregate and cement by an infinitely variable vibratory process.

Once the block has been compressed, the machine moves forward, leaving the finished block on the ground. This eliminates the double-handling necessary with machines that make blocks on pallets which have to be lifted from the machine and then stacked for drying.

(*Brit. Inf. Serv. BF* 268)

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Major Break-Through In Telephone System

Clearer telephone calls, speedier connections, and fewer "busy" line signals, are some of the advantages of a telephone system which takes tiny sample of conversation 8,000 times a second, turns them into a code and sends it along a pair of wires in the form of electrical impulses.

At present one pair of wires is needed for each conversation, but if the new system is adopted widely, existing cables could carry many times their present number of calls at any one time with less digging up of streets and roads to lay new cables.

Known as pulse-code-modulation (PCM) the technique was first invented as long ago as 1937 by a British scientist, but like any other telecommunication ideas it has only just become economic with the advent of low-cost transistors.

A big advantage of the system is that since only brief samples of a speech need to be taken, there is enough time left to take samples of 22 other conversations. In all 23 channels of conversation can be carried along the same pair of wires in a telephone cable.

(*Brit. Inf. Serv. BF* 268)

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Protective Layer at Bottom of Oil Tanks

A chemical compound designed to prevent internal corrosion of fuel oil storage tanks by forming a protective layer at the bottom of the vessel is being produced in Britain. The chemical is added at the same time as oil is pumped in, and one treatment is effective for a year. Tanks holding up to 300 gallons need only one pint of the chemical, while a 2,000 gallon tank would need an annual dosage of one gallon.

When water enters oil storage tanks as rain water or condensation, it falls to the bottom where galvanic or acidic corrosion occurs. The new chemical, which is heavier than both water and oil and which is compounded with dispersing agents to ensure efficient distribution, falls to the bottom of the tank and seals the metal against the corrosive action of water.

(*Brit. Inf. Serv. BF* 268)

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Washing Thirty Cars an Hour

A fully automatic four-minute car washing plant developed by a Scottish firm, is claimed to be among the fastest and cheapest of its type. It can handle up to 30 cars an hour.

The plant conveyor is 56 ft. 6 in. long and is split into three sections—washing, rinsing and drying. The machinery in each section is operated by an electronic beam as the car is moved forward by a conveyor belt.

As the car is sprayed by detergent, brushes come into operation at the sides and top of the body. They are arranged to follow the contours of any car. Rubber rollers which the car contacts on each side operate a hoop of high pressure water jets. Then a hot air system dries the car, ready for polishing.

(*Brit. Inf. Serv. BF* 268)

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Indian Orders for Britain's Most Advanced Computer

Orders have been received from India for eight of Britain's most advanced computer—the 1900 Series developed by International Computers & Tabulators Ltd., London.

A spokesman for ICT said that orders for over 160 computers had been placed with the firm, nearly a third of them by oversea buyers. The eight for India have been ordered by the Calcutta Electric Supply Corporation; the B.E.S. & T. Undertaking of the Bombay Municipal Corporation; the Ahmedabad Electricity Undertaking; Hindustan Machine Tools, Bangalore; Kirloskar Oil Engines Ltd.; Century Rayon Mills, Bombay; Saxby & Farmer Ltd., Calcutta; and the Board of High School and Intermediate Education, Allahabad.

Another ICT computer—of the 1300 Series—has just been installed at the Swatantra Bharat Mills in Delhi.

The first of the 1900 Series to go into operation has been installed at the Northampton College of Advanced Technology in London. The college has been operating a course in computer training for some time, but now it is to start a university degree course for computer specialists.

The 1900 Series can have units attached to it to undertake a variety of tasks—it can even play music.

Other countries which have ordered the computer include Australia, New Zealand, South Africa, Zambia, and a number of European nations.

(*Brit. Inf. Serv. BF* 259)

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Machine Speeds Up Leather Drying

A machine developed by a British firm enables high quality chrome and vegetable tan leathers to be dried without undergoing the long process of natural loft drying.

The machine has been designed by the firm in conjunction with the British Leather Research Council, and operates at lower temperatures than conventional types of leather driers.

With the use of automatic control equipment, the machine is self-compensating in temperature based on the degree of generated humidity.

In addition to the control of temperatures and humidity, the drying cycle is phased to retard evaporation from the leather at the mid-stage which tends to eliminate migration of tanning agents and salts in the leather.

(*Brit. Inf. Serv. BF* 351)

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Automatic Dust Collector

An automatic industrial dust collector has been developed by a British firm. It is cheap, compact and simple to maintain. Rapping noise has also been eliminated and a new method of filtration shaking introduced.

The collector follows the established principle of mechanical shaking combined with counter current purging of the filtration medium.

A fractional horse power reversing motor is coupled to a gearbox with high and low speed output shafts. The high speed shaft drives the shaking gear while the low speed shaft operates the main and scavenging air dampers, the rotation of which is controlled by limit switches.

The filter tube cleaning cycle can be continuous or intermittent according to individual working conditions.

(*Brit. Inf. Serv. BF* 351)

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Big Output from Small Press

Tickets can be produced at the rate of 120,000 an hour on a "baby" rotary press developed by Timsons Ltd., Perfect Works, Kettering, Northamptonshire, England.

The press prints two colours and numbers on the front of the ticket, and one colour on the back. Suitable for the production of cinema, theatre, cloak room, bus and similar types of tickets, it can also be built to meet individual needs.

(*Brit. Inf. Serv. BF* 351)

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Making High-Grade Steel from Scrap

A cheap and simple process for making high-grade steel from scrap by using "everlasting" plasma electrodes in an electric arc furnace, is being developed at a major British steel manufacturing firm in Northern England.

The one-stage process, already proved experimentally in the firm's research laboratories, could result in new steels specially suitable for the aircraft and tool industries. The new method is a "three-in-one" way of producing high-quality steel with a low hydrogen and oxygen content.

The conventional technique for removing impurities is to produce steel in a consumable-electrode electric arc furnace, transfer it to a vacuum degassing plant, and then subject it in ingot form to vacuum re-melting treatment. The new method simply uses one plant—a furnace in which the scrap is melted in an inert atmosphere of argon gas.

(*Brit. Inf. Serv. BF* 351)

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Portable Anaesthetic Machine

A British firm has introduced a portable anaesthetic machine that will operate either with or without a supply of medical gas and oxygen. The machine weighs only 32 lb. and is carried in a case 20 in. × 22 in. × 11 in.

The machine is mounted on a tubular steel stand and built around a vaporiser unit which can contain any type of volatile anaesthetic. Medical gas, such as nitrous oxide, and oxygen, are passed into the vaporiser through an inlet valve, and the mixture of gas, oxygen and anaesthetic is released through a discharge valve to the breathing tube and face mask.

When a supply of medical gas and oxygen is not available, the anaesthetic can be blended with air drawn from the atmosphere; the action of the patient breathing through the face mask draws air into the vaporiser.

(*Brit. Inf. Serv. BF* 351)

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Plastic Etching Tank

A six-sided plastic etching tank developed by a British firm is claimed to be the only one of its type in the world.

The hexagonal shape of the tank speeds up production because it allows more copper clad material to be etched at one time.

The tank was made of plastic because ordinary metal does not stand up to the ferric chloride solution necessary for the etching process. Earthenware, normally used for the conventional four-sided tanks, would not lend itself to the making of such a complicated shape.

(*Brit. Inf. Serv. BF* 296)

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Polypropylene Fans

A range of centrifugal and bifurcated axial flow fans manufactured almost entirely from polypropylene has been introduced by a British firm.

Specially designed for use in hospitals, laboratories and chemical plants, the fans are resistant to corrosive fumes and moist gases at temperatures up to 100 . °C. The centrifugal fans are particularly suitable for installation in all types of fume extraction plant and for laboratory ventilation.

(*Brit. Inf. Serv. BF* 296)

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Respiration Machine

A portable self-contained respiratory resuscitation machine, claimed to be the first of its kind, is completely automatic and can be used by an untrained operator. The machine, developed by Blease Anaesthetic Equipment Ltd., Chesham, Buckinghamshire, England, calculates and supplies the pressures, volumes and frequency of the breaths required by the patient, whether adult or baby.

The apparatus, which weighs 27 lb., is carried in a case, and consists of a 72-gallon oxygen cylinder, tubes, facemask, and harness. All the operator has to do is to turn on the cylinder and apply the mask to the patient's face. A gauge tells the operator the number of minutes that the oxygen remaining in the cylinder will last. A full cylinder runs for 40 minutes and a new one can be attached in 12 seconds.

(*Brit. Inf. Serv. BF* 324)

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Analyses by Atomic Absorption

Low cost, versatility, high operational speed and compactness are the main features of a new atomic absorption spectrophotometer developed by a British firm.

The makers say the instrument has been specially designed to exploit all the advantages of the spectrophotometry analytical technique.

Up to 60 quantitative analyses can be made in an hour and results read directly from the long scale micrometer which is calibrated in extinction units.

(*Brit. Inf. Serv. BF* 324)

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Whiter Paints

A new chloride process, developed in Britain, for producing titanium oxide claims to offer superior whiteness and brightness. It can be used in specialised paints and other products which require pigments of high quality.

Titanium oxide is the principal white pigment used by industry throughout the world. Pigments are normally produced by the use of sulphate, but chlorine has now been substituted for sulphur as the basic reacting material.

(*Brit. Inf. Serv. BF* 324)

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Computer Type Setting for Book Production

Computer type-setting is now being used in Britain for book production. The system uses a computer to convert manuscripts, via punched paper tape, into electronic signals on magnetic tape. It means that book assembly takes place at computer speeds. In the final computer stage a punched paper tape is produced for use by automatic line casting or film type-setting machines, either in the plant or, by means of high speed wire transmission, at a distance.

After the original manuscript is converted into punched paper tape, the tape is fed into a computer using special programmes, and then stored on magnetic tape. In all, four high speed computer runs take place, each giving a printed out version.

In the first or galley proof stage a high speed print out is produced for the correction of errors. In the second stage corrections are fed into the system on paper tape together with instructions on type style and line lengths. The computer then arranges the manuscript into neat, hyphenated lines. Stage three provides complete page by page book assembly as make-up instructions are given to the computer, and finally a punched paper tape is produced for feeding into the type machines.

Now that manuscripts can be stored on magnetic tape it means that they can be revised, edited and reintroduced for subsequent editions without re-keyboarding.

(*Brit. Inf. Serv. BF* 254)

New Packing Process Keeps Cooked Meals for a Year

Cooked meals containing meat, fish, butter, fruit or vegetables can be stored in a newly developed polymer bag for at least a year without deep-freeze protection or dehydration. The meals can be cooked by dropping the bags in a saucepan of boiling water for 15 minutes. Saucepans are left clean and the meals can be opened directly on to plates, say the British manufacturers. Five different meals are already being marketted by the firm under the name "Boil-a-Pak." There is a choice of two spaghetti dishes, a paella, chicken curry and meat curry.

(*Brit. Inf. Serv. BF* 254)

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Image-Shearing Eyepiece for Microscopes

Precision, versatility and easy reading facilities are the main features of an image-shearing eyepiece being produced by a British firm.

The instrument will fit most microscopes which have Royal Microscopical Society standard tube diameters and is suitable for particle size analysis, diameter measurement of fibres, yarns and wires, the measurement of transistor components, photographic masks, biological specimens and bacteria and also of diamond pyramid indents in hardness testing. Moving objects can also be measured.

(*Brit. Inf. Serv. BF* 254)

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