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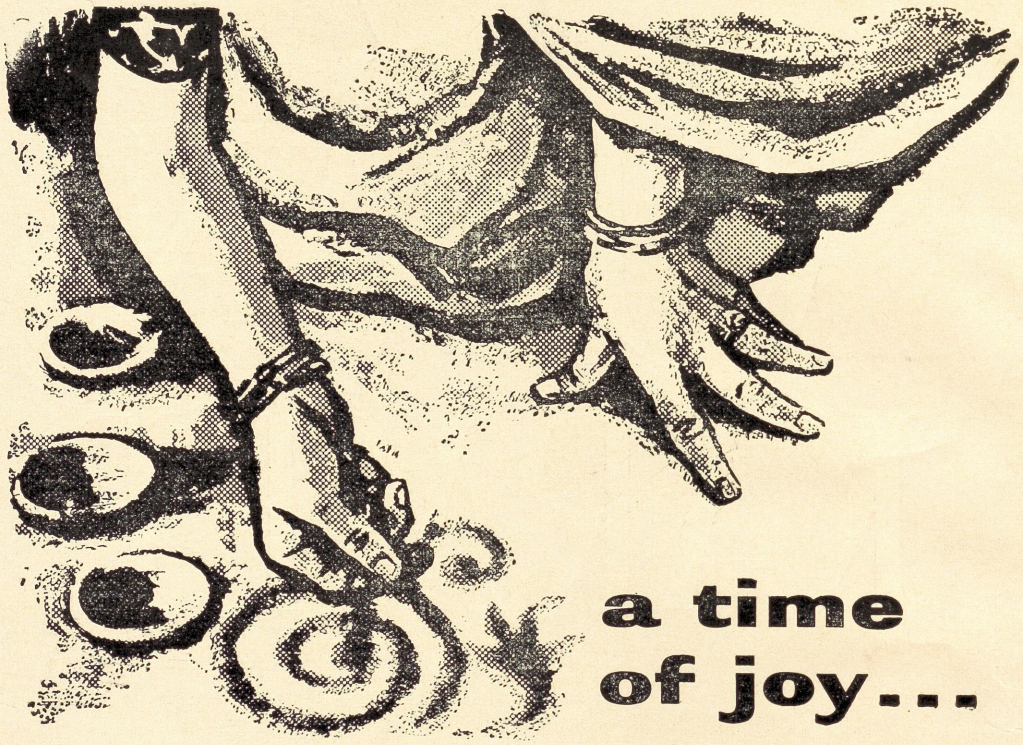

a time of joy...

When swords of lightning no longer flash,
the roll of thunder loses its echo, the
pitch laden sky clears and the sun breaks
through wisps of cloud cotton-like
in the sudden blue—that is the time
of the harvest, and the year's work is done.

For this end; the effort, the toil. For a
world that offers a little more—
a little less of the care, a little more of the joy.

Today, as in the past, our products help to make homes cleaner, healthier, happier. But today we are also working for ... **Tomorrow,** when the evergrowing urge for better living will demand still greater efforts. And we shall be ready with wider service, new ideas, new products ...

Today and Tomorrow... Hindustan Lever serves the home.

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VIJNAN KARMEE

Journal of the Association of Scientific Workers of India

(Founder-President : Shri Jawaharlal Nehru)

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S. Ramabadran
Publisher.

Dated 7th March, 1960.

EDITORIAL

Future of Association

The ASWI had completed its twelfth year of life and the annual general body meeting had been held as usual alongwith the Indian Science Congress Association at Bombay. This meeting has been a conspicuous one as the whole life of the association during the past twelves years has been introspected.

One would know that the Association was founded for the benefit of scientists in India and to strengthen the bonds between the scientific class and others in this country. Just as politicians, philosophers, religionists lawyers, doctors and engineers have been understood by the laymen as entities or groups of particular individuals with a professional status, the scientists have a claim of their own to be recognised and understood. Just as others are, they are first and foremost human. The modern thinkers have rightly come to say that the present day scientists should not be living in castles of their own but come down and made themselves known to the common man. The politicians, philosophers, lawyers and the religionists have an advantage as they speak in a language understood by one and all. The doctors and engineers have established a professional standing during the past 100 years and a common man though not able to understand the technicalities of their profession is able to appreciate what they are doing for him. Unfortunately the scientist is still far from the common man. He is still a mystic dabbling in his own jargon and understood only by his fellowmen profession.

Apart from the above, as a professional worker a scientist has also a claim to a status in society. This position is still to be attained as the recognition from the employer and the ultimate beneficiary namely the common men are yet to understand and value a scientist. This can only be achieved when the professional scientist evolves a language which can be understood by one and all as politicians have done. One of the methods by which a certain amount of relationship can be built is popularisation of science.

The third and most important aspect in the life of the scientist is the advancement of his own pursuit. The impact of science on society has now fully realised and all the nations in the world are trying to vie with one and other in the furtherance of scientific studies which will ultimately benefit the human race as a whole. In this country the efforts are still wanting a general forum in which scientists can group and lay out methodology for the advancement of science as essential. Though one can argue that there are sufficient learned bodies like the Indian Science Congress Association, Association of Physicists, Chemists, Engineers etc., it should be noted that there are places for exchange of views and ideas in too technical a manner.

Taking into consideration all these aspects, it is worth while to point out that an association like ASWI is the only one and best suited for the purpose mentioned. Though these idealogies have been the basic foundations of the association, somehow or other, there had not been much of a response from the scientific class in the country to strengthen the hands of the association.

This year's general body meeting had dealt with the various factors influencing the retardation on the growth of the Association and has posed the real question whether it is worth having such an Association or not. The answer lies in the hands of the scientific profession. Those who have had the advantage of being in the association feel that the answer is yes and the Association should be the only one to represent the professional workers under one banner.

Let us end with a fervent hope that there will be a good augury for the association in the future years.

EDITORIAL NEWS

CULTURE AND SCIENCE

At the world level the UNESCO have been engaged in keeping the co-operative and planned human efforts constantly alive. Education, Science and Culture have been the three dimensions on which the super structure of this world organisation is built. In 1956 UNESCO convened a seminar on urbanism at Bankok. Some of the outstanding thoughts of a study circle convened at Madras in 1958 were later brought out in the form of a book, "Tridítional cultures in South-East Asia", under UNESCO sponsorship.

An eminent author in this book, Prof. Nilakanta Sastri, has devoted his contribution to the analysis of the future for traditional cultures. For working definition culture has been taken to mean "the total accumulation of material objects, ideas, symbols, beliefs, sentiments, values and social forms which are passed on from one generation to another in a given society". The concept of traidition again is lop sided if taken to mean static values. Dynamism is as much part of culture as it is of any other human activity. Prof. Sastri has also attempted to outline the great stabilising and balancing values in tridítional cultures. It is, however, with the process of cultural change that the scientist is mainly concerned and often comes in contact even as a professional individual.

Cultural crisis has been presented in three forms. Firstly a static attachment to what is understood as traditional, the second seeks a compromise between situation arising out of the impact of the ancient and modern, and the

While wishing the readers a more purposeful new year the Editors want to convey to them that through these columns attempt will be made to touch the more neglected side of the life of scientists as individuals. Comments may not fall strictly in the scope of scientific activity but all the same, the integrated individual that the scientists is will be the subject matter of these reviews.

—EDITOR.

third stands for wholesale replacement. The situation obtaining in countries which are determined to come out in the field of socio-economic advancement by a process of intensified industrialisation and planned economy is poignant with cultural conflicts. This undercurrent of cultural conflict can be no more ignored by the scientist.

From scientific viewpoint, the analytical side of cultural study has made some sound advancements in the form of social sciences. Whereas some of the causative mechanism of social imbalance are now being understood, the technology of social balance has been a process intimately connected with a field so much akin to science, namely demagogy and politics. No doubt, for a long time to come, cultural values and moral dictates which govern social behaviour will continue to be outside the field of scientific analysis and discipline. But we cannot on the other hand ignore the causative principles underlining these phenomena on which to a very large extent depends the very existence of science.

In a lecture to British Associotion for advancement of sciences, Lord Adrian, the eminent physiologist, went at a great length in this subject of the study of man. Again very recently, Professor Gray touched the subject in a thought provoking lecture. Both of these scientists have very lucidly analysed this field of human studies *vis-a-vis* science.

Present circumstances in South-East Asia have certainly created a situation in which the scientist has got to share the responsibility of meeting the social and cultural imbalance with the rest of the society and at least present the means of safeguarding whatever the body of humanity consider as valuable and worth preserving. Already scientists have been alive to the dangers of nuclear age, perhaps because of the notion that the era is certainly a progency of science itself. The cultural crisis is in no way less dangerous and in it is a challenge which the scientist has to meet. The history of science of past four hundred years, if at all it is any evidence, will reveal that science is capable of triumph over this crisis.

SCIENCE NEWS

A Century of Biological Thought

The centenary of Darwin—Wallace—theory of evolution was celebrated in July 1958 at London. Exactly a hundred years back, on 1 July, 1858 the famous Darwin-Wallace paper was read before the Linnean Society, London. Purely from Bibliophilic angle, it is worth to note—that the first edition of Darwins classical book *"On the origin of species by means of natural selection or the preservation of favoured races in the struggle for life" by Charles Darwin M. A.*, was published in November 1859.

The historical importance attached to Darwinian exposition of biological thought of his contemporary period is stupendous. In fact, the theory itself evolved as traces of it are detectable in the writings of Erasmus Darwin to whom is credited a nursery rhyms on principles of evolution! In a way the entire period of Darwinian era has centered round the question of gathering newer means of variations in living organisms. As it is today Darwinism has attained an almost invulnerable position though several transformations have taken place in the 'theory' itself. The two international conferences, the one at London and the other at Malaya have revealed one thing, that from academic point of view there is still much to clarify in the side branches of life sciences. It is to the genius of this great man or rather two men, the other being oft forgotten Alfred Russel Wallace, that the main stream of Biology is flowing in a sure and certain course.

Darwin convinced the Biologists of the fact that what he called as evolution had actually occurred. The proof for this was presented in an array of data based on observations which could not be interpreted in any other conceivable yet logical way. The deductive part of this evolution theory was based on a general theory of natural selection which offered a 'mechanism' by which evolution could have taken place.

There has been a series of controversy regarding this latter, deductive part of Darwinian operator. The new desciplines like experimental geneties resulted in temptations for an extremist view point. However, much rationalisation has already occured in the field of geneties by the brilliant work of statistical minded biologists, noteworthy amongst them being Dr. R. A. Fisher and Prof. J. B. S. Haldane. The recent trend in evolutionary biology is towards the analysis of this 'mechanism' of evolution in which the Mullerian gene tranformations afford the matrix and population statistics, the various means by which newer types arise and become stablised. The greatest tribute to the Darwin-Wallace crusades is that evolution today is an unchallenged fact, and study of its mechanism the greatest stimulation which keeps the applied aspects of biological research like resistance mechanisms in insects and micro-organisms, to count just one, alive for scientific curiosity and human ingeniuty to tackle.

New Trends in Lubrication

There are several situations where conventional lubricants fail completely, usually due to incompatibility of the very nature of substances on which they are based. For instance, advances in heavy engineering materials called for special types of lubricants which have a terrific capacity of bearing loads. These are the conventional 'heavy

duty' lubricants. Extremes of temperature again necessitate modification in lubricants. Special properties are attained in synthetic lubricants like 'nucous', 'silicones', or dry lubricants such as 'Molybdnum disulphide'. The huge atomic generators offer yet new type of challenge. An interesting development in this field has been 'air lubrication'. Direct metal to metal contact is avoided in air lubrication by holding a thin film of air between metallic parts.

A new material for unlubricated, i.e. completely dry bearings has recently been developed. The base for this technique of lubrication is a chemical called polytetra-fluoroethlene. This material has low thermal conductivity, low creep strength, and elastic memory, and a co-efficient of friction of the order of 0.06 dry. Details have been perfected for combining PT FE on the bearing surface. As perfected to date, some of the forms in which this material is now available offer bearing designs which can carry heavy load, and can operate at high speed without the aid of any external lubricant.

Courtsey Indian Scientific Liaison Office Science News letter No. 515.

Advances in River Bottom Mining

Nature's resources often present insurmountable difficulties of approach to the site of the raw materials as well as their extraction. For instance, several, river beds are known to be rich in minerals like coal or gold. Its exploitation is always a mining feat which conventionally is supposed to be impracticable unless the top layers are at least 300 to 350 times, as thick as the seams themselves. However, the solution to this problem seems to be well within achievement. It has been possible to extract coal from beneath the bed of the Arctic river Vorkuta, where about 117 million tons of fuel lie untapped. Mining could be carried out at a depth of over 40 thicknesses of the coal seam. This could boost coal production by one million tons without a single new colliery having to be put to operation.

Ind. Science News letter No. 515.

Foot Note

"You are witnessing the birth of a different kind of world, a world in which there are new duties and responsibilities. For we are not advancing towards an era of assured peace and tranquility. Before us lie unknown danger, undreamed of adventure and countless inventions—the embryos of countless others".

—Gaston Berges, in a broadcast at the occasion of the inauguration of new UNESCO H. Qrs. at Paris.

Milk For Tropics

Milk agitate by ultrasonic impulses and then promptly frozen can be kept frozen and stored for at least a year and will then thaw out into its natural state. This process, developed at the National Institute for Research in Dairying at the Shinfield, near Reading, is being patented and steps are being taken to supply frozen milk for long storage to ships and to tropical countries where only tinned milk is at present available.

Previous attempts to keep milk for long periods have not been successful in preventing the separation of the fat content or in avoiding certain physical changes in the protein content which lead to a slightly

clotted effect on thawing. In the United States and in Scandinavia, slow freezing of homogenized milk has secured for it a storage life of six to eight weeks. In the new process, pasteurized milk is given the full treatment in less than an hour and a half and is then ready for storage.

On thawing, this milk, if allowed to stand, gives a "cream line" like fresh milk, also tests have shown that no changes occur in its protein. The cost to the consumer is not likely to exceed by much that of canned milk. The rights in the process are held by the National Research Development Corporation. Frozen milk for the market is being produced by the Eldorado Ice Cream Co. A commercial plant is also working in Rotterdam. Milk so treated can be moved in refrigerated ships, trains or lorries in gallon containers properly sealed or in liquid-proof cartons down to the halfpint size. It has to be kept at or below 10°F (—12°C).

There seems to be no doubt that the ultrasonic treatment is at the heart of the matter. It appears to be responsible for holding together the milk emulsion during freezing. How and why is not yet clear. One theory holds that it modifies the sheath of the protein molecule another that it degasifies the milk and so inhibits oxidation. Whatever the reason this also seems to be the first instance in which ultrasonics have been used to stabilize an emulsion. They have, of course, been used before the preparing emulsions.

The story of the development is something of a romance, Dr. W. G. Wearmouth who is responsible for it began his experiments with a tiny ultrasonic generator of about 20 watts of the type used in school demonstrations. As he appeared to have found something valuable, the NRDC took a hand and called in the Mullard company. Soon a bigger generator was brought into use and then one of 500 watts, capable of treating 80 to 90 gallons an hour, was installed for a firm at Ashton-under-Lyne, which had a contract to supply milk to the P&O Line. There hundreds of gallons have been treated.

Now a plant has been supplied to Eldorado. The ultrasonic equipment cost less than £ 1,000. There, the milk is treated in a tank 2 ft. 6 in. high. It is pumped up a column from the bottom and is ultrasonically agitated for five minutes. It comes out at the top into containers which are immediately heat-sealed and are then passed on for freezing at—15°C, for one hour. From there they go into cold store at—12°C. The ablility to treat such large quantities at such a low ultrasonic power intensity accounts for the economic value of the process.

Meanwhile, a new type of reconstituted milk is reported from Sweden. In this process, water, skimmed milk powder and unsalted butter are used. A piece of apparatus which is put into a milk churn to do the mixing is sold by Axel Kistner of Stockholm. The method is to mix 11 litres of water at 60°C. with 1.5 Kg. of butter and 4 Kg. of milk powder. After five minutes, 40 litres of cold water is added and mixed. The churn next spends five hours in cold store and is then ready for use.

Fire Fighting With A Turbo-Jet

Jet engines may become part of the fire fighter's equipment. The idea is to use their exhaust to starve fires of oxygen, by blowing the good air out of a burning build-

ing and replacing it with the inert gases of the exhaust.

A standard tube-jet engine of the smaller kind is now being modified for fighting fires by the National Gas Turbine Establishment near Farnborough. At the same time a large experimental building is going up at the Fire Research Station, Boreham Wood, Herts.

When both engine and building are ready, experiments will begin to find out how long it takes for the exhaust from this single jet engine to fill the building with enough inert gas to put out the fire.

The promoters of this revolutionary approach to fire-fighting hope that it will be particularly useful where the firemen cannot get at the seat of the fire, which may be underground or in the centre of a large building. The fire in the subterranean chambers of Simithfield market in January, 1958, which killed two firemen and burned for eight days was a good example of this awkward type.

Fighting flames will no longer mean sending firemen wearing breathing apparatus into smoke filled buildings, to face unknown hazards at every step. Protective clothing would be needed because of the temperature of the exhaust gas, but this hazard, too, can be reduced.

Starving it out

Normal air contains about 20 per cent oxygen, which supports combustion, and about 80 per cent nitrogen and one or two other gases, which do not. About four per-cent—of this oxygen is consumed by a jet engine when it is functioning normally. But the addition of an after-burner in the tailpipe uses up another four per cent and produces more power.

The Farnborough Scientists are also adding a water-sprayer between the after-burner and the end of the tail-pipe. The exhaust best turns the water into steam and this vapour further dilutes the oxygen content of the exhaust.

It also lowers the exhaust temperature to about 120°C. Such a temperature would still enforce special clothing for anyone working in a building filled with this kind of exhaust.

The present plan is to inject 70 gallons of water a minute through the sprayer. Such a quantity is paltry when compared with the consumption of the big hoses. But this 70 gallons could exhaust into 45 percent Steam and reduce its oxygen content to a mere 7½ percent. Flames normally go out when the oxygen proportion is between 10 and 12 percent, but smouldering may continue at 7½ percent.

The building at Boreham Wood which is to be the subject of the test has a capacity of 250,000 cubic feet. The turbo-jet engine developed will be able to supply 50,000 cubic feet of exhaust a minute. If it could drive the air out of the building with 100 percent efficiency the job would take only five minutes. Merely mixing the air with exhaust gases would not lower the air's oxygen content enough to dowse the flames.

One major advantage of this method is that there would be no need to drown burning buildings with water. Quite often the water does as much damage as the fire.

Migratory Pole

Japanese scientists who went to the Antarctic as part of their country's contribution to the International Geophysical Year have just announced a remarkable finding. It is their opinion that the magnetic North Pole was once in the middle of the Pacific Ocean.

To be slightly more precise, it was there "between 500 and 1,000 million years ago". At that time, it was three degrees north of the Equator and 127 degrees West of the Greenwich. Now it moves about the upper regions of Canada.

The Japanese reached their conclusion by examining some very early rocks. Certain rock formations acquire, at the moment when they are laid down and solidify, a magnetism which lies in the direction of the earth's magnetic field. Even though the strength and character of this field may change, the rocks will still retain something of their original magnetism. The poles wander but the polarisation remains to an extent the same.

In this theory finds support from other researches, notably a British team from Birmingham University who went to the Antarctic for the same reasons, it will add tremendous impetus to the many well trampled theories of continental drift.

Wegener's theory of 1910 sums up most of them. He said the America had once been joined to the continents of Europe and Africa. The Western bulge of Africa fitted in the Gulf of Mexico, while the bulge of Brazil fitted into the Gulf of Guinea.

Once you start moving continents about, it is much easier to make many of the world's anomalies disappear. The problems of paradoxical rock similarities and curious distributions of similar animals vanish.

Apart from helping with this geological jig-saw of the past, the Japanese findings of the North Pole. In 1580, when records became reasonably reliable, the magnetic north was II degrees east of true north. By 1800 it was 24 degrees West of True North. Now it is still west of north but is moving eastwards by a fraction of a degree every year.

To a certain extent this migration is predictable. Every 20 years a new time-table is calculated. But it is generally expected that about 780 years will be necessary before one migratory cycle is complete, which will take us to the year 2060.

THE STORY OF GLASS

By Raymond Schuessler

According to Pliny, the Roman historian, around 5000 B. C. a group of Phoenician sailors, marooned on a storm-washed Mediterranean beach, were unable to secure stones to support their cooking pot. One of them suggested placing the pot on the soda blocks they had salvaged from their ship. They did so and were amazed when a liquid began oozing out of the fire. The heat had fused the beach sand and soda—and man had caught his first glimpse of the fundamental process of making glass.

The glass industry has become an important part of our life and is continuing to make important contributions every day. In the tenth century the Byzantine artisans thought they had reached the apex of glass miracles in their exquisite window glazing, but they never suspected that glass one day would be tied into knots, twisted into yard, woven like silk, welded and sawed and nailed and bent like rubber—and even floated.

Glassmaking might be called America's first industrial enterprise, since John Smith built a glass furnace in order to produce beads for trading with the American Indians. Today the glass industry in the United States is a leader not only in quality and quantity produced, but also in pioneering new and vital uses for glass in virtually all branches of science and industry.

The manifold uses of glass and the countless benefits derived there-from can be attributed to one thing—reasearch. Here, as in many other industries, the freedom and courage to invest in experiments has led to social progress.

Consider the Corning Glass Works, founded in 1851. During the first quarter century of its existence there was little about its operations to distinguish it from any other glass company of the period—except for an awakening interest in the development of new ways of producing coloured glass. In 1877 problembs were encountered in the production of coloured railroad signal glasses. The solution was found by Corning with the help of university scientists. This marked the first recorded call of any glass company upon science and was the beginning of a long series of glass developments.

The year 1879 was an important one in glass history: Corning made the glass bulb for Thomas A. Edison's first incandescent lamp, the "wire in a bottle". During the next 30 years, many uses of glass were innovated in commercial and industrial fields—ovenware, laboratory and pharmaceutical ware, heat-resistant glass, the Mount Palomar (California) telescope and many others.

It has not been throgh new compositions and formulas alone that the uses of glass have been extended. Much has been due to the mechanisation of manufacturing methods. A striking example is found in the electric lamp industry. In 1900 most city homes still used gas for lighting. Country homes used kerosene, even though the Edison lamp had been invented as far back as 1879. The bulbs for the lamps of 1900 were blown by hand. With the gradual electrification of communities

during the early part of the 20th century, glass bulb requirements far exceeded any possible production by hand.

By 1916, hand methods were giving way to semi-automatic machines; small melting pots had been replaced by larger continuous melting tanks, and expensive lead-glass compositions had been replaced by more economical lime glasses. The biggest factor in high-volume, low-cost bulbs for incandescent lamps, however, was the development in 1926 of the fabulous ribbon machines which today make 1,000 glass bulbs in one minute, more than a two-men team of expert glass blowers formerly could make in an eight-hour working day.

In many different and vital ways, glass has accelerated the evolution of modern science and technology. It serves critical functions in all industrial laboratories. Medical science would be seriously handicapped without glass, whether as hypodermic syringe parts or the glass 'boot' that works miracles of healing in case of arterial disease, whether as microscopic lenses or as germicidal lamps whose ultraviolent rays free the air of bacteria. There is a tiny electric lamp of glass no larger than a grain of wheat, which blows at the end of the bronchoscope and enables the physician to see inside the bronchial tube.

Communication in practically every modern form is dependent on glass which has contributed in large measure to the birth and growth of the entire electronics industry. The entertainmemt that is ours by merely turning a radio or television dial—the telephone, telegraph, radar and many other devices that render effective service—not one of these would be possible without glasses that stand up under high power and voltages at higher frequencies.

Nowhere is the versatility of glass more evident than in the home. Glass first entered the kitchen as a tumbler and remained to participate in every phase of modern food preparation, serving and storing. Glass vessels for making coffee were preferred by so many people that an entire new industry was established for their manufacture.

In the laboratories where atomic experiments are being carried on, glass plays a vital role. Windows which do not darken under ray bombardment are needed to see into the ray-filled interiors of "hot" laboratories. Many of these rooms are so filled with the lethal rays that they can never be safely entered. Work carried out in them must be done by remote control from behind thick barriers. These windows are made of glass so heavy that one measuring 6 × 8 feet weighs upto 12 tons.

You would think that some limit had been reached—but at Corning no such impression is conveyed. As one engineer said, "Our business of tomorrow lies in newer glass products. We are going to keep expanding the horizons of glass as far as possible, which means constantly and endlessly". This means better jobs for the worker and better living for all.

(By the courtesy of *Partners*, received from U. S. Information Service.)

ARTICLES

Blind spot in the Fertilizer Programme of India

By S. Husain Zaheer and Y. Venkatesham

Regional Research Laboratory, Hyderabad

Potential nitrogen requirements of our country

The fertilizer requirements of our country have been estimated differently by different experts. The Planning Commission, basing calculations on the data supplied by the Ministry of Agriculture, has estimated that if all the arable irrigated lands in the country receive an adequate does of nitrogen, the requirements of nitrogen fertilizer will be 2 million tons of nitrogen annually. In 1953, Dr. F. W. Parker and J. M. Blumo, in their note on "Fertilizer Programme in India", estimated the potentional requirements as 1,000,000 tons of nitrogen per year. In 1954, the Standing Committee on Manures and Fertilizers of the Government of India estimated the fertilizer consumption in India as 4,35,000 tons of nitrogen by 1960-61, while the Ministry of Food and Agriculture indicated the levels of consumption of nitrogen fertilizers during the 2nd Plan period as below :—

Year	*Nitrogen tons*
1956-57	150,000
1957-58	190,000
1958-59	240,000
1959-60	300,000
1960-61	370,000

Actual consumption of nitrogen fertilizers

The consumption of ammonium sulfate which was about 275,000 tons (55,000 tons nitrogen) in 1950 showed a steady expansion and reached 420,000 tons (84,000 tons N.) in 1953 and is estimated to have risen to about 610,000 tons (122,000 tons N.) in 1955-56.

According to the information received by the Development Council from Ministry of Food and Agriculture, the demand for ammonium sulfate for 1957-58 was 10.7 lakh tons (214,000 tons N.) against their estimate of 9.5 lakh tons (190,000 tons N). The Ministry have estimated the requirements for 1958-59 at 14.55 lakh tons ammonium sulfate (291,000 tons N.) as against their previous estimate of 12 lakh tons (240,000 tons N). According to present indications, they feel that the 2nd Plan target will be exceeded and may reach 20 lakh tons of ammonium sulfate (400,000 tons N) during 1960-61. They hope that the annual consumption by 1965-66 will not be far below one million tons nitrogen. The Development Council, in view of the increasing demand, have suggested (in January 1958) that the target of nitrogen fertilizers should be raised to 500,000 tons N from the original figure of 300,000 tons N per annum by 1961. Later (December 1958), the Council decided that the total available nitrogen fertilizers by the end of 1962, should be 870,000 tons N annually.

Production targets

The 1st Five-Year Plan envisaged the expansion of nitrogen fertilizer capacity from 15,734 tons in 1950-51 to 96,254 tons/yr. by 1955-56. The Sindri Fertllizer Factory went

into production in November 1951 raising the nitrogen fertilizer capacity to 85,000 tons/yr.

According to "Programmes of Industrial Development, 1956-61" published by the Planning Commission, the expansion of Sindri Fertilizer Factory initiated during the 1st Five-Year Plan was expected to be completed by the end of 1957, augmenting the installed capacity from 70,000 tons of 117,000 tons of nitrogen per year. Further expansion of the industry under the 2nd Plan was decided at the following locations :—

Location	*Annual capacity Tons of N.*	*Products*
1. Nangal	70,000	Diluted or pure ammonium nitrate.
2. Neyveli	70,000	Ammonium sulfate-nitrate; Urea
3. Rourkela	80,000	Nitro-limestone.
4. Bhilai Steel Plant 5. Durgapur Steel Plant	72,000	By-product ammonium sulfate.

According to the Planning Commission, the Nangal Fertilizer Factory will require 160,000 KW of power which is to be supplied through the installation of power generators at the Bhakra Dam. The factory was expected to go into production by the end of 1959 and a production of 40,000 tons of nitrogen was expected in 1960-61.

When in full production, the Neyveli Fertilizer Factory is expected to consume about 400,000 tons of lignite per year. This plant is scheduled to go into production by the end of 1960 and production upto 20,000 tons of nitrogen is envisaged in 1960-61.

The Rourkela Fertilizer Factory was expected to go into production by the middle of 1959 and a production of 70,000 tons of nitrogen was envisaged during 1960-61.

On the basis of schedules of development mentioned, the following was expected to be availability of nitrogen fertilizers from domestic sources during 1956-61 :

Year	*Annual installed capacity Tons N.*	*Total Production Tons N.*
1956-57	85,000	85,000
1957-58	132,000	102,000
1958-59	142,000	140,000
1959-60	305,000	175,000
1960-61	382,000	290,000

Staggering imports

It can be seen that since the Sindri Fertilizer Factory went into production in 1951, the nitrogen fertilizer capacity of the country has remained at 85,000 tons per year till today, and the actual production in 1958 has been only 76,800 tons N (384,000 tons of ammonium sulfate). In contrast to this, our actual consumption has been 84,000 tons N in 1952, 122,000 tons N in 1955-56 and 214,000 tons N in 1957-58, and is estimated to be 291,000 tons N during 1958-59. This stagnation in the fertilizer producution has led to continued imports of enormous quantities of fertilizers during the entire 1st Plan period and almost the entire period of the 2nd Plan. Besides, huge quantities of foodgrains have also been imported. Import figures of nitrogen fertilizers for the past several years, along with their value in rupees are given on the facing page :

Inadequate planning

Out of a potential requirement of 2 million tons of nitrogen per year, our plans had very low production targets of 96,254 tons N by 1955-56 and 290,000 tons N by end of 1960-61. Even the targets of consumption set by the Ministry of Food and Agriculture

Year	*Quantity* *Tons*	*Value* *Rs.*	*Approx. value* *U. S. $*
		Ammonium sulfate	
1951-52	139,656	4,40,95,105	8,819,021
1952-53	205,535	7,21,19,068	14,423,814
1953-54	76,042	1,71,50,718	3,430,144
1954-55	67,825	2,12,71,563	4,254,313
1955-56	203,620	5,73,35,276	11,467,055
1956-57	230,000	6,44,85,475	12,897,095
1957-58 * (April-Oct).	320,000	8,95,00,000 (based on 1956-57 value)	17,900,000
		Urea	
1952-53	1,027	6,56,172	131,234
1953-54	3,070	20,91,898	418,380
1954-55	9,158	59,69,180	1,193,836
1955-56	14,368	96,30,541	1,926,108
1956-57	9,907	63,42,303	1,268,461
1957-58 * (April-Oct.)	53,000	3,40,00,000 (based on 1956-57 value)	6,800,000
		Ammonium sulfate-nitrate	
1955-55	8,085	28,55,292	571,058
1955-56	16,416	63,69,904	1,273,980
1956-57	14,283	61,66,225	1,233,245
1957-58 * (April-Oct.)	30,000	1,30,00,000 (basen on 1955-56 value)	2,600,000
		Calcium ammonium nitrate	
1954-56	2,037	6,75,963	135,193
1957-58 * (April-Oct.)	7,000	23,25,00 (based on 1955-56 value)	465,000

* The total estimated value of imported nitrogen fertilizers for 7 months of 1957-58 (April to October 1957) is about Rs. 13.9 crores ($ 27.8 million) and proportionately the imports for the whole year can be estimated at approximately Rs. 24 crores ($ 48 million).

had been very low and the figures of actual consumption have far exceeded these targets. In recent meetings of the Delopment Council (18th meeting, of March 1959), it has been said that only 55% of the demand for fertilizers from various States is being supplied*. In view of this, it can be seen that the actual consumption could be almost twice the present consumption, provided the fertilizers were easily available to the consumers.

The targets for the 3rd Plan have now been worked out by the Ministry of Food and Agriculture. The targets established call for an annual use in 1965-66 of 1,500,000 tons of nitrogen, 750,000 tons of phosphorous (as P_2O_5) and 200,000 tons of potash (K_2O). In the view of the Agricultural Production Team sponsored by the Ford Foundation (April 1959), these targets are the very minima if the food goals are to be reached. The amounts that could be used to advantage and which would pay cultivators if used with other good practices, would be of the order of two times the Committee's target of nitrogen, four times that for phosphorous and seven times that for potassium.

Inadequate implementation

To begin with, the targets of production themselves, as has been said earlier, are very low compared to the potential as well as actual requirements of the country. Even these low targets of production were not implemented during the 1st and the 2nd Five-Year Plan periods, and the actual nitrogen fertilizer capacity remained stagnant at about 85,000 ton N from 1951 up-to date.

The projected fertilizer plants which were fondly hoped to be in production during the 2nd Plan period were all made secondary appendages to other big projects like construction of Bhakra Dam and generation of hydel power at Nangal, mining of lignite and establishment of a power station at Neyveli and the installation of steel works and coke ovens at Rourkela. These primary projects themselves are far behind schedule due to their own difficulties which are well known by now.

The non-recognition of the primary importance of the fetilizer projects and making them dependent on othe problematic projects has been the chief reason for the miserable shortfall in production on the one hand and staggering imports of fertilizers and food-grains on the other.

In our opinion, the reasonable course would have been to have planned and implemented the construction of at least one, if not two, fertilizer factories having capacities of the order of 100,000 tons of nitrogen per year based on the raw materials already available in plenty during the 2nd Plan period itself. This would have, to a great extent, bridged the wide gap between the planned targets and actual production during this period.

In short the blind-spot in our fertilizer programme has been : our targets were far below the targets and our aehievement was far below the plans.

It is hoped that at least during the 3rd Plan period higher priority will be given to fertilizer production and the factories will be located at places where suitable raw materials are already available in plenty, to ensure speedy implementation of the production schedules.

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* "Mr. M. Bhaktavatsalam, Minister in charge of Food, will discuss with the Union Minister for Food, Mr. S. K. Patil, next week the food situation in the Madras State, with particular reference to the inadequacy of fertilizer supplies.

Entries show that the quota of fertilizers fixed for the State constitutes not even 50 per cent of the demand made by the Madras Government in the current year and that only a fraction of that allotment has so far reached the State". (The Hindu, Nov. 24, 1959—'FERTILIZER SUPPLY TO MADRAS').

Science Contributes To Turkmenia's Economy

By S. B. Batyrov,

President of the Turkmenian Academy of Sciences.

The Turkmenian people have traversed a great path in their development from a backward colonial outskirt of tzarist Russia with an illiterate population to a highly cultured industrial republic. The Turkmen people, with the assistance of all the peoples of the USSR, transformed Turkmenistan into a vanguard blossoming republic which has its own statehood, a developed industry, a socialist agriculture, a network of educational and scientific-research establishments with its scientific centre, the Turkmen Academy of Sciences.

There are 17 academicians, 200 corresponding members of the Turkmen Academy of Sciences, 80 masters of science and 345 other scientific workers engaged in the 16 scientific institutions under the Academy. It should be noted that over half of these scientific workers are Turkmenians including 11 Turkmenian women. Some 100 young specialists are taking post-graduate courses.

A leading place in the activities of the Academy of Sciences is occupied by physics, chemistry, geology and biology which are of great importance in developing industry and agriculture.

Turkmenistan has great oil and gas prospects. At present the efforts of geologists are concentrated on elaborating the ways and means for the most rational prospecting of minerals. Research is being conducted in using solar energy for the needs of the national economy.

Large-scale geological prospecting has resulted in the discovery of a number of major oil deposits and the setting up of oil fields. The new towns and workers' townlets including Nebit-Dag Kum-Dag, and Kotur-Tepe, to mention a few, have been built up in places where the desert reigned supreme some 15-20 years ago. The oil extracting and oil refining industries have become the leading branches in the republic's economy.

On the republic's territory is the Karabogaz-Gol natural salt deposits, a unique gulf containing inexhaustible resources of sodium sulphate and sodium chloride salts, magnesium, potassium and rare elements.

The development of the salt resources of this gulf will make it possible to start the production of fertilisers on the spot and by using magnesium compounds to manufacture building materials. Scientists are developing methods for the extraction of these salts and their utilisation in the chemical industry.

The Institute of Geology of the Academy of Sciences is studying the geological structure of the republic's territory in order to appraise the prospects for extracting oil, gas and other minerals. They have elaborated a variant for the high-way to the new Kotur-Tepe deposit, from Molla-Kar to Uzun-Cu which will make it possible to reduce the length of this section which is subjected to sand drifts, thus providing for an economy of some two million rubles.

The Institutes of geology, botany, zoology and parasitology are rendering great assistance to the designers and builders of the Kara-Kum Canal, the greatest project under construction.

In order to combat effectively the canal becoming over-grown with reeds and other

water plants, ichthyologists of the Institute of Zoology and Parasitology are conducting work on the acclimatisation of the Chinese "white Amur," a herbivorous (plant-eating) fish. The Institute of Botany has conducted geobotanical research in the area between the Murgab and Tedzhen rivers, an area of some 200,000 hectares which will be developed along the second section of the Kara-Kum Canal, and 95,000 hectares in the Tedzen River basin.

Zoologists have conducted large-scale work in studying the fauna along the first section of the Kara Kum Canal. Practical recommendations on combatting sand-fixing plant pests were made. Research of the republic's lakes for determining their use for breeding coypy and muskrat has been completed.

Geologists have published a collection of materials with the results of the hydrogeological, engineering geological and canal siltation research as well as the use of local building materials in combatting sand drifts which are of assistance in designing and building the Kara Kum Canal.

Hydro-geologists have eleborated optimal hydro-melioration projects for developing the lands in the areas of the first and second sections of the canal.

Our institutes and laboratories have also rendered great assistance to other branches of the republic's economy.

The method of protecting timber against thermites was elaborated by the scientific-research institute of the cable industry together with the Institute of Zoology and Parasitology is being used in seven plants in the Soviet Union which are supplying goods to Burma, India, and Indonesia. The biological method of combatting pathogene nematodes which threaten the health of man and livestock by using voracious fungi is being used in Kirghizia, Azerbaijan, Kazakhstan, Georgia and other republics. This method is used in the Mary Region of our republic for sanitation purposes.

The Institute of Botany has turned over to the trust engaged in developing pastures and in land improvement geobotanical maps of the Ashkhabad, Kara-Kalin and Kizyl-Arvat districts which were drawn up under the guidance of V. V. Nikitin, a Corresponding Member of the Turkmen Academy of Sciences.

The current Seven-Year Plan has placed before the republic's scinetists especially important tasks.

The development of the oil, gas, chemical, light and food industries in Turkmenistan during the current seven-year period demands that scientists make an all-round and profound study of many problems.

Thie means that during the next seven years natural sciences, mainly physics, chemistry, geology and biology, which are of great importance for the successful development of the republic's industry, agriculture and medicine, will occupy a leading place in the scientific researches conducted by Turkmen scintists.

Turkmenistan is situated in areas with a rather high seismology which cover almost all the mountain areas of the USSR in the southern and eastern outskirts of the country. The data which the scientists at present have are insufficient for drawing up an accurate seismic map.

The work conducted by the Turkmenian Academy of Sciences will help in accomplishing this task as well as in studying the structure of the earth's crust. The result of these

researches will be widely used in mapping the republic's seismic districts and in designing industrial, civil engineering and hydrotechnical projects in these districts.

The physico-technical institute will be engaged in making a study of semi-conductors and their technical use. During this period it plans to make a study of the power resources of Turkmenistan and the means for their utilisation. This work is of great importance owing to the shortage of coal, forests, peat, combustible state, etc. in the republic. Turkmenia's favourable climatic conditions make it possible to use widely solar energy and wind energy in meeting the requirements of the economy by transforming solar energy into cold and electricity, by utilising wind energy for freshening drinking water in remote districts and water reservoirs for distant pastures.

A detailed engineering-geological and hydro-geolgical study of the future track of the Kara-Kum Canal will provide the opportunity for elaborating the physical and mechanical properties of the soil, their chemical composition and for drawing up an engineering-geological map of the district. This will help designers and builders in solving many problems connected with the construction of this major irrigation project under the complicated conditions of the desert and the development of new land.

The hydro-geological research to be conducted includes a study of the water and salt balance of the irrigation lands along the Kara-Kum Canal with the aim of founding the melioration measures envisaged in the long-term land improvement plan for the Turkmen Republic.

The water shortage greatly hampers the growth of the Central Asian republic both economically and culturally. Therefore the study of the dynamics and the conditions of the formation of sub-soil waters in Turkmenia which is planned on a large scale, is a theoretical problem of great importance for the rational solution of the water supply and irrigation of land not only for Turkmenia but for other republics which with similar climatic conditions as well.

A prominent place in the Academy is scientific-research work in combatting sand drifts. Some 80 per cent of the republic's territory is covered by sand. The specific peculiarities of the sand (their extremely low wind-erosion stability, their comparatively easy mobility, etc.) confronts researchers with serious tasks of finding measures to combat drifts, control of the sand relief formation processes which would be used in solving practical problems. This research will result in recommendations being made for combatting sand drifts and for designing projects.

Turkmenia is the birthplace of Soviet fine fibre cotton. The varieties evolved by Turkmenian plant breeders (Academician Maximenko and others) are used for planting about 80 per cent of the total area in the country for growing fine fibre cotton. There are great prospects for developing grape-growing, fruit-growing, sub-tropic and other crops in the republic.

An important question in this matter is the study of soils and combatting salination of irrigated land. At present 420,000 hectares are irrigated. By the end of the seven-year period in the light of the further developing agriculture additional 160,000 hectares of irrigated land will be brought under cultivation.

(*Continued on next page*)

SCIENTIFIC INSTITUTIONS

It is now proposed to set apart this column in the V. K. for use by the research institutions in India, so that the Indian scientists working in the different Universities, Government Organisations and private Research Institutions (which, at present, may not be aware of the type of work carried out in the various sister institutions) might come close together for a free and healthy exchange of ideas and for the advancement of science and technology and with advanced science and technology for the economic progress of India. In this context, it may be recalled that the Journal of the Royal Institute of Chemistry in UK is devoting a special column for the various Universities, Research Institutions, both private and public, existing in UK. These articles in the above journal provides a fund of information about the historical background under which the institution was set up and organised and also throw light on the type of research carried out, the different fields of sciences dealt with and/or taught and the facilities normally available in such institutions.

(*Continued from previous page*)

The Turkmenian Academy of Sciences plans to organise a permanent Kara-Kum expedition base for improving scientific research.

The Academy of Sciences plans to conduct rescarch in biology, physics, chemistry and geology using for this purpose the latest radiological methods including radioactive isotopes for peaceful purposes.

Preparatory work is now under way in setting up a radiological deparment with special laboratories in order to conduct this research.

Thus the seven-year programme which has been elaborated by Turkmenia's scientists will facilitate the further growth of research, the increase in the number of research problems, the establishment of closer contacts between scientific research institutions and production, a more rapid utilisation of the results of scientific research in the national economy.

SCIENCE & INDUSTRY

Science in its many branches has made rapid strides during this century that it now pervades virtually every field of human activity. The whole industrial scene has been transformed and our standard of living owes not a little to the applications of science.

In any industrial enterprise whether it is simple or complicated, there are seven groups of essential functions.

(a) Technical
(b) Financial
(c) Commercial
(d) Accounting
(e) Security
(f) Administration and
(g) Science.

Science serves in a two fold capacity. In the first, manufacturing processes are regulated and controlled. Failures are prevented. In the second, it serves to unfold new manufacturing techniques based on laboratory scale experimention. It should be realised that there is no short-cut to the maintenace of manufacturing processes on their importance except by the method of science and its persuit.

Industries are varied. Some are heavy and others light. The nature of scientific research required in a particular industry is an established one or not. The utilitarian objective of research should never be lost sight of.

A general method for research on established process is given below :

1st. stage—Purely laboratory study of a problem.

2nd. stage—Experiments under selected conditions at the plant in production combined with observation on regular operation.

3rd. stage—Design trial and proof of small experimental plants.

4th stage—Return to full scale plants for application of proved data under conditions of production.

A heavy demand is made on the qualities of men to handle industrial research. These qualities may be grouped under three heads, viz. character, mental disposition and technical foundation.

There has been a great deal of comments in our country on the application of science to industrial expansion and development. Much of this has experessed disappointment that advances in science have been all too slow in influencing progress in established and traditional industries.

With the above objects, this column would be utilised in future for analysing the different groups of industries existing in this country.

SCIENCE PERSONNEL

Technical Manpower In India

The extent of utilization of scientific and technical personnel in industry (government or private) is an index of the quality and calibre of industrial potential (of a country). In advanced countries, scientific personnel are largely engaged in industrial production. The industries have strong research and development wings attached to the manufacturing establishments. Such an arrangement tends to produce the maximum impact of science and technology on national economy. Research and development activities, however, find no significant place as yet in our industries. Most of our large and medium industries have gone into production through imported plants and borrowed technical, know how, for which we pay the foreign industries and their R & D personnel. Industrial techniques of to-day will not take long to become obsolete. It is, therefore, essential that we build up and strengthen the R & D Wings in our industrial establishments.

The National Register has found on the whole, that about 15% of the registrants are working in the private sector, while over 60% have found employment in government and 25% in educational institutions. The private industries have yet to catch up with the spirit of modern science and technology through adoption of adequate research and development activities and quality control, by utilizing the qualified scientific and technical personnel available in the country.

Among Engineers, only 1% of the civil, mechanical and electrical engineers are engaged in research while less than 10%are teaching. But about 12% of chemical engineers and about 5% of the communication and aeronautical engineers are engaged in research. The National Register further revels that about 20% of the technologists are engaged in research and development work. About 42% of all post graduate scientists are engaged by educational institutions while another 50% are in governmental organisations, the remaining 8% being in private industry.

(Extracts from 'Technical Manpower' Bulletin Jan., 1960).

Scientists As 'Administratives'

Registration in the National Register is based on qualifications only, not employment status. Persons working in non-technical fields as also those unemployed, are registerable. This fact does not appear to be widely known. The representation of such persons on the National Register may not be very high.

On a study of about ten thousand employed post graduates in pure sciences, it was noticed that 75 were working as office assistants and clerks. Details are given below :

Field	*Percentage working as clerks*	*Unemployed for over one year*
Maths.	2.5	5.7
Geosciences	0.6	3.4
Physics	0.6	2.2
Zoology	0.5	2.6
Botony	0.3	2.1
Chemistry	0.2	2.6
Agriculture	—	1.2

The percentage of post graduate scientists in each field working as clerks bears a close parallelism to the percentage of registrants in the respective categories who have been registered as 'Un-employed for over one year'.

(Technical Manpower Bulletin : September 1959).

Countries Of Training Abroad

The United Kingdom and the U. S. A. had attracted nearly 2000 out of 2964 Indians abroad registrants in Science, Technology, Engineering and Medicine. Of the total 35% were in U. K. and 30% in USA. The other countries where sizable numbers of our technical personnel are in training or employment are W. Germany (12%), other European Countries 6% & Canada 6%.

Bengal has 311 registrants in UK, the largest group from an Indian State in any single foreign country. Next comes Bombay with 228 and 220 in UK and USA respectively. Bengal has 151 in Germany, U.P. has 128 in UK and 110 in USA.

Analysis of the choice of countries for advanced training by registrants reveal certain interesting regional preferences. Over 70% of the students registered from Bengal, Bihar and Assam were from UK and Germany as against only 16% from USA. The States of Bombay, UP, and Delhi, which contributed about 40% of the total Indians Abroad registrants, have sent over 45% to UK and Germany as against 30-35% in USA. On the other hand, the Southern States of Andhra, Kerala, Madras and Mysore had over 40% in USA as against 30% in UK and Germany. Punjab also has sent about 40% to the USA as against 35% to the UK and Germany.

Most of the registrants in Africa belong to Bombay while a sizable portion of the registrants in Asian countries come from Kerala.

State of Origin	USA & Canada	UK	Germany	Other European Countries	Asian & African Countries	Total
Andhra	77	24	13	6	12	132
Assam	5	12	3	1	4	5
Bihar	27	73	17	2	6	125
Bombay	242	228	59	25	72	626
Kerala	49	23	13	13	46	144
Madras	79	39	18	9	23	168
M. P.	18	10	4	6	1	39
Mysore	87	23	27	9	8	154
Orissa	19	10	7	4	—	40
Punjab	124	73	12	17	14	240
Rajasthan	17	11	4	1	4	37
U. P.	139	123	37	25	16	240
West Bengal	126	311	151	36	18	642
Kashmir	3	6	1	—	—	10
Delhi	87	86	25	20	16	234
H. P.	2	4	1	—	1	8
Total	1101	1056	392	174	241	2964

(Technical Manpower : Bulletin September 1959).

ASSOCIATION NEWS

Minutes of the Annual General Body Meeting held on 4-1-1960 at 09.00 hrs. in the Convocation Hall, University Campus, Bombay.

Reception to the Chief Guest

About two hundred members from the various branches and affiliated organizations attended the meeting. The Chief Guest Shri Jawaharlal Nehru, the Prime-Minister arrived at 0900 hrs. and was welcomed by the President and President elect of the Association Professor P.C. Mahalanobis and Professor M.S. Thacker, respectively.

Secretary's Annual Report and Announcement of the Office-Bearers for the year 1960

The General Secretary (Organisation) Sri M.R. Raman read out his annual report (see Appendix 'A') and announced the office-beares and members of the CEC for the year 1960 (Appendix 'D').

Presidential Address

The President Prof. P.C. Mahalanobis then addressed the meeting. In his presidential address, Prof. Mahalanobis said that he is convinced that the most urgent and yet the most difficult task of national development is the organisation of science and towards fulfilment of which the Association can and should play an important role in the advancement of science and technology in India; and that it was not possible for the Association to function in an effective manner as the Govt. did not appreciate its potential usefulness and did not give it the necessary support. He said that, as in economic planning, the initiative has to come from the Govt. being the biggest employer of scientific workers and that it was not enough to have the passive goodwill of the Govt. towards the Association. He felt confident that the Govt. would take a favourable view and not only give official recognition to the Assocation but also give adequate moral and financial support to the Association to function in an efficient manner. He also submitted that it would be of great help to set up a machinery for joint discussions between what may be called the the official side and the staff side on the lines of the "Whitley Councils".

The President briefly referred to some of the deeper problems also. He is convinced that a strong trade union of scientific workers would be of help; and this is merely a means to an end, namely, the advance of science and technology. The one indispensable condition is an atmosphere of free and objective criticism. He said that science cannot thrive without criticism and he exhorted the members of the Assocn. and all other scientific workers in the country to cultivate the spirit of criticism in sufficient measure. He felt that the preparation of critical reviews would be the most significant first step in creating an objective frame work of scientific criticism in India and he earnestly hoped that some of his young colleagues would come forward to take up this work without delay.

He concluded his address by thanking the Prime-Minister for the encouragement he has always given to this Association and Prof. M. S. Thacker for accepting the office of the President of the Association and exhorting young

scientists for fruitful work for the advancement of science and technology and with science and technology for the advancement of India.

Address by the Chief Guest
Shri Jawaharlal Nehru

Shri Nehru referred to the presidential address of Prof. Mahalanobis and said that it raised some important questions connected with the future of the Assocn. and of the scientific workers in the country; he repeatedly requested the Govt. to come to the aid of the Assocn. The Government, he said, wanted to give greater recognition to scientific workers whose number is fast increasing and who are also gainfully employed. He added that a number of institutions, both in the public and private sectors, were employing scientific workers; the Atomic Energy Estt. and the Departments of Defence Science are rapidly growing in size; the Universities too were employing scientific workers; and the Govt. sector employing scientific workers is, of course, pretty big and likely to grow fast. The future of the Assocn., he, therefore, said was a question for the organisation to decide and that the Govt. did not decide anything unless it is called upon to do so.

Referring to the question of trade unions for scientific workers, Sri Nehru said that this is a subject which needed "careful consideration and discussion." He could not express an opinion "off hand." He could not also say in what way the problems facing these workers could be dealt with. The main consideration should be the future progress of science in this country. He, however, conceded that it is the fundamental right of the scientific workers that they should get a better deal. In this respect, Prof. Humayun Kabir, the Union Minister for Scientific Research and Culture, and he agreed that grsater facilities should be provided for scientific workers so that the nation could have well qualified workers.

Regarding the question of some of our scientists who settled abroad, the Prime-Minister said that perhaps, it was a fact, that India is not in a position to provide these Indian Scientists abroad, with the inducement and facilities for scientific work which those countries can give. But, he added, that this should not mean that they should prefer to stay abroad. India, he continued, wants to progress fast making use of the technological development and in this, he appealed, that every Indian Scientists should assist his country.

Vote of thanks to Chief Guest

The President of the Association Prof. P.C. Mahalanobis proposed a hearty vote of thanks to the Prime-Minister Sri Jawaharlal Nehru.

Messages By Visiting Foreign Scientists

Prof. Chou Pei-Yuan of Peking University and Academician Gyergy Szigeti, Director Research Institute of Tech. Physics of the Hungarian Academy of Sciences addressed the General Body Meeting.

Treasurer's Report

The Treasurer's report (as per Appendix 'B') was adopted.

Resolutions

Six resolutions (Appendix 'C') recommended by the Council were discussed and adopted unanimously.

The Meeting came to a close with Vote of thanks from the General Secretary (ORG.) Shri M. R. Raman.

Presidential Address by Prof. P. C. Mahalanobis

We thank our prime Minister, who is also the Founder President of our Association, for attending this meeting. Since the foundation of this Association in 1947 he has been attending our annual meetings as a mark of his continuing interest in our work. I am grateful to the members of the Association for having elected me its President last year. I had accepted this Office with hesitation. I am aware that I have not been able to do anything of tangible value, and yet I am glad to have had this opportunity of learning something of the problems which face the young scientists of my country.

I am convinced that the most urgent and yet the most difficult task of national development is the organisation of science. I firmly believe that this Association can and should play an important role in the advancement of science and technology in India. The Association had begun its work with high hopes just before independence. Expenditure on scientific and industrial research has expanded perhaps ten or twelves times during the last ten or twelve years after.

And yet my colleagues are aware, and they have made me aware, of the gradual decline in the membership and activities of the Institute. The Annual Report already circulated shows that the membership on the rolls is now something like thirteen hundred (of which more than seven hundred belong to the Federation of Defence Science Workers). The membership dues realized are at the level of less than two rupees per member showing that many have been defaulters. Including the expenses of monthly journal "Vijnan Karmee", the total annual expenditure is now of the order of eleven thousand rupees per year. Is this commensurate with the needs of the Indian Science ? After thirteen years we have reached a truly critical stage. In the discussions in the Executive Committee we felt that either a fresh start has to be made with a clear programme suited to the needs of India, or the Association should be now voluntarily winded up.

This Association was established as a Trade Union broadly on the pattern of the economically advanced countries; but it has not worked too successfully. This has also happened with other institutions which we tried to set up on the model of the advanced countries. In economic affairs theories suited to the advanced countries had acted as a thought-barrier. Fortunately we have broken through this, and have started "taking off" on the way to industrialization. I venture to think that in our Association also, the basic weakness has been the attempt to copy models which are not really suited to the conditions of an underdeveloped country like India.

Trade Unions for scienific workers are a recent development in the countries of West Europe, and had started long after the national economies had become highly developed and also after the trade union movement for industrial workers had gathered strength. A trade union becomes necessary and desirable when there is scope and need of joint discussions or collective bargaining between what is called the official or management side and the staff side. In U. K. and in West European countries the scientific workers used to be employed for a long time either in universities or the industrial enterprizes entirely independent of Government.

In principle, there was complete freedom of "hiring and firing" on the part of educational and industrial authorities and equally complete right of resignation on the part of the scientific workers. University education was comparatively restricted, and scientific workers of ability were somewhat of a scarce commodity in the advanced countries. Both educational and industrial authorities were eager to get the best men they could secure. The scientific workers (except at time of severe trade depressions) could move from one post to another either for higher pay or for better and more congenial conditions of work. In the universities, conditions were somewhat similar to cooperatives; this may perhaps be seen at its best in the structure of the Cambridge and Oxford Colleges. The College property is owned and managed by the self-perpetuating body of Fellows who have equal votes in making management desicions; and the annual share of each Fellow in the income of the College is called the "dividend" (which may be the origin of the phrase used by Joint-stock Companies). In this situation there was no need of trade unions of scientific workers for a long time.

In U.K., during and after the first World War, Government began to engage scientific workers in large numbers, and this tendency has been strengthening in recent years. It is in this situation that the trade union of scientific workers had started in U. K. The trade union of scientific workers was first established in U.K. in the civil service and then spread to other sectors. It is important to note that number of scientific workers are still being employed in non-Governmental agencies like the Universities, higher scientific institutions, and industrial enterprizes. The scientific worker Governmental agencies (or to emigrate to the U. S. A. or other countries). This freedom to migrate provides the real and indispensable sanctions for a healthy trade union movement of scientific workers in Government employment. Government also is becoming increasingly aware of the need of attracting and holding able scientific workers. This is why the Public Service Commission in U. K. has already established a separate wing, manned entirely by scientists to deal with recruitment and other service question of scientific workers.

In the U.S.A. there is no strong concept of a service system even in the Federal Government. Every Federal employee has the right to apply for any post, on his own initiative, in any Government agency just as outsiders also have. There is no reservation of posts for service men nor waiting in the seniority list for a vacancy to occur for promotion. In the U.S.A. in practice, many people continue to work in the same agency ; but there is also a great deal of movement from one Government agency to another, and also between Government and non-Governmental agencies.

In U.S.S.R. there is no concept of a service system for scientists in the British or the Indian sense. There is a dual qualification, firstly, of academic and technological education and training. Secondly, there is a standard system of professional classification, into four or five groups, (a) the laborant (something like junior demonstrators in Universities & Colleges), (b) junior scientific workers (c) senior scientific workers, (d) professors or scientists or equavalent status, and (e) directors, deans, rectors, academicians, etc. Every scientific worker has complete freedom to-resign and move from one post to another

in U.K. thus has the possibility of resigning from Government service and join non-horizontally in the same scientific classification but without any increase in pay. Scientific workers are promoted and get higher pay usually on the recommendation of inter-agency Commissions. Promotion, in principle, does not have to depend on the occurence of vacancies; additional posts are created as men become qualified, but there is no concept of time scales, and scientific appointments are open to review every five years. In the Soviet system this right of free movement and the absence of unemployment gives the scientific worker great independence.

Let us consider the position in India. It is stlll an under-developed country. Organized industries contribute only about seven or eight percent of the national income. Opportunities for employment in scientific posts are comparatively small and research posts are every few in the private sector. Teaching posts are very poorly paid, and facilities and resources for research in most universities are still meagre. In India, Government is by far the largest employer of scientific workers, since independence, most of the new research posts have been created in Govt. agencies or quasi-Governmental agencies like the CSIR, ICAR, ICMR AEC etc. The right of movement from one post to another is restricted. Although the administrators have the highest pay scale and prospects, the scientific workers in Government agencies generally enjoy much higher pay and prospects than their fellow workers in teaching posts or in private enterprizes; migration to post outside govt. agencies is therefore difficult. In this way a kind of monopolistic situation has arisen; and scientific workers have little real freedom of movement. (The only outlet is accepting posts outside India.) The fact that an appreciable number of scientists are leaving the country is a matter of serious concern.

The ASW of India has not received official recognition by many Government agencies. Official recognition, is, of course, essential but by itself would not be enough. In the absence of real economic sanctions or of a favourable Government policy, mere formal recognition may hamper proper appreciation of the intrinsic weakness of the present situation.

In USSR and other socialist countries all enterprizes and institutions (except religious organizations) are in the public sector. It was and is still impossible for any trade union to function in opposition to Government. The trade union movement had therefore, to be started by Government; and trade unions are strong and flourshing only because Government recognize their usefulness, and give them full support. There is, perhaps, nothing very paradoxical in this arrangement if one remembers that in the British Parliament the leader of the opposition gets a reasonably high salary; and in India all members of the Parliament including those in opposition, draw allowances.

In India, Government is already the largest and the most influential employer of scientific workers, and this tendency would become stronger as we advance towards socialism. It is not possible for the Association of Scientific Workers to function in an effective manner unless and until the Government of India appreciates its potential usefulness and gives it necessary support. As in economic planning, I submit the initiative has to come from Government.

This, I think, is the crux of the problem. It is not enough to have the passive goodwill of Government. It is not enough even

to have the sympathy of the prime Minister. I suggest with humility that Government as Government should now seriously consider whether a trade union of scientific workers is likely to be useful. The arguments are well-known and need not be repeated. I should only point out that unrest and dissatisfaction among industrial workers often lead to labour disputes and strikes. This is not likely to happen in the case of scientific workers; but frustration among young scientists may seriously retard the progress of science in India. Strengthening this Association is likely to be of help by providing opportunities for joint consultations and frank exchange of views in matter relating to terms and conditions of work.

I am confident Government would take a favourable view and not only to give official recognition to the Association of Scientific Workers but also give it adequate moral and financial support to function in an efficient manner. I also submit that it would be great help to set up machinery for joint discussions between what may be called the "official side" and the "staff side" on model of Whitely Councils. An announcement may also perhaps be made recommending similar support being given to the ASW of India by State Governments and quasi-Government agencies.

On the financial side I feel it would be advisable to sanction adequate funds—this would not be large—to enable the ASW to have a small but permanent secretariat, maintain a really useful journal, and organize a few meetings at different places. In time the ASW should be able to collect sufficient membership fees to meet most of its expenses out of its own income.

It has been very wise of the Association to have nominated Professor M. S. Thacker for the office of the President, and I am glad I succeeded in persuading him to accept the invitation. No one would be in a better position to help the ASW at this hour.

I should like to refer very briefly to some deeper problems. I am convinced a strong trade union of scientific workers would be of help. But this is merely a means to an end, namely, the advance of science and technology. The one indispensable condition is an atmosphere of free and objective criticism. I have a feeling that we have not yet succeeded in cultivating the spirit of criticism in a sufficient measure. I recall that Professor J.B.S. Haldane in an article stated that Indian scientists were too polite to criticise one another ; and he thought this was a source of weakness of Indian science.

Science cannot thrive without criticism. I am, therefore, glad the Central Executive Committee and the Council have given serious consideration to a suggestion which I had placed before them for the promotion of the spirit of scientific criticism. An individual scientist can try to prepare a critical review of papers published in India in any selected sector of his own shoice. He can give a list of papers covered in his review in the form of a bibliography and mention in the text contributions of outstanding value and other useful contributions. The inclusion of a paper in the bibliography without, however, any mention in the review would itself amount to an evalution, may be, of a negative kind. The preparation of such critical reviews, I feel, would be a most significant first step in creating an objective frame-work of scientific criticism in India. Any scientist with seriousness of purpose, sense of responsibility, and integrity of character can participate in this endeauour. I

earnestly hope some of my young colleagues would come forward to take up this work without any delay.

I have touched only two topics. There are other important problems of the organization of science in India, to which also continuing and serious thought would have to be given in future. This can be done, at first, through informal and frank discussions in small groups ; and then, after some ideas have taken shape, through wider discussions in committees and conferences. In an underdeveloped country like India this also is an important and urgent task.

I shall conclude my address by thanking our Prime Minister again for the encouragement he has always given to this Association, and to Professor Thacker for having agreed to accept the office of the President. I convey my best wishes to the young scientists for fruitful work in the advancement of science and, with the help of science and technology, in the advancement of India.

APPENDIX 'A'

Annual Report 1959—Draft presented by the General Secretaries Shri M. R. Raman and Dr. D. K. Roy.

The 12th year of this Association, since it was inaugurated in the year 1947, has again been a year of uncertainty in the life of the Association. Efforts have been made to strengthen the Organisation and also towards fulfilling the aims and objectives of the Association. Yet, it cannot be said that the year under review has been remarkable for its achievements. However, a brief synoposis is given below of the activities during the current year.

ORGANIZATION

Sl. No.	*Name*	*Old/ New*	*Membership*	*Net increase/ decrease*	*Important activities*
Units :					
(1)	CLRI Unit Madras	Old	29	..	..
(2)	CSIR Unit Delhi	,,	29	Plus 7	Proposal to CEC on status/ working conditions of Information Scientist.
(3)	Izatnagar Unit	,,	17	..	..
(4)	CTRI Unit, Rajahmundry.	,,	27	..	Proposals concerning increase in percentage of Senior Assts. posts and Residential Quarters for the staff and a lecture on role of scientific workers by the President, Dr. G. S. Murthy.
Branches :					
(5)	Aligarh	Old	50	..	..
(6)	Bahadrabad	New	79	..	..
(7)	Bangalore	Old	26	..	..
(8)	Calcutta	Old	87	..	..

Sl. No.	*Name*	*Old/ New*	*Member-ship*	*Net increase/ decrease*	*Important activities*
(9)	Hyderabad	Old	82	..	1. Lectures on— (a) Some impressions on All India Research Workers Conference held at Cuttack. (b) Ideas on present day research. (c) Planned parenthood. (d) Viruses and Bactaria—their uses and abuses. (e) Insects and Insecticides. (f) Pigments of the body. 2. Symposium on Integration of Scientific Education at the University level. 3. Economic and service condition problems pertaining to RRL scientific staff.
(10)	CFRI-Jealgora	Old	Not known	..	Symposium on "Coal & Power".
(11)	Lucknow	Old	101	..	1. Arranged Symposium on Radia activity and its application. 2. Lectures on— (a) Story of Drug. (b) Botanising in the Rocks. 3. Two contributary social meets were arranged.
(12)	Mysore	Old	30	Minus 70	1. Two lectures on scientific topic. 2. Proposals pertaining to Provident Fund Contribution.
(13)	Roorkee	Old	52	..	..
Affiliated Organizations :					
(14)	F. D. S. W.	Old	710	..	1. Symposium on "Scientific Conservation of Materials". 2. Number of Lectures on scientific topics, Film Shows of scientific topics, Visits to places of technical interest, Picnics/Social Meets/Social Film Shows and large number of problems on economic and service conditions of Defence Scientists.
(15)	Southern Rly.	Old	25	..	Problems pertaining to service conditions of scientific workers under the Southern Rly.
(16)	UP., PWD Res. Institute.	New	16	..	Proposals pertaining to forwarding of applications and other service conditions.
(17)	Surveyor's Association.	Old	Returns not received.		Problems pertaining to farwarding of applications and service conditions.

CENTRAL OFFICE

Membership

The newly formed ASW at Pimpri with a membership of about 50 have applied for their affiliation to the ASWI. Efforts towards affiliating IRSSA Jamalpur and formation of Branch at CEERI Karakudi continued. The effective potential membership of the Association is about 1500.

The Association does not have any link with a number of the newly formed National Laboratories, University Centres as also the Technical Institutions under the Plan Projects viz: the Steel Plants, Fertiliser Factories, Rayon Factories and number of Defence Science Establishments.

CEC Meetings

4 CEC Meetings were held during the year—2 at Delhi—1 at Calcutta and 1 at Bombay.

Service and Working Conditions Problems

(*i*) *Resolutions*—Action was taken with the concerned authorities viz. OSIR or the Govt. of India in regard to Resolutlon Nos. 3, 7, 8, 9, 25 and 26. These resolutions pertained to problems concerning protection for Government servants under Article 311 of the Constitution, Housing and Accommodation, Travel Concession, Definition of Family etc.

(*ii*) The CEC considered during the year problems pertaining to Retirement Age for scientific personnel and the status of Information Scientists.

Problems Pertaining to Development of Science

The need for a critical appraisal of scientific work carried out in the country was a topic of basic importance considered by the CEC during the year. The need for initiating selective bibliography work, organizational and planning work pertaining to science and scientific methods and categorisation of scientific work and scientists was also emphasized. In the light of the above, efforts are being made to orientate the activities of the Association to fulfill this work.

The lack of potentially active workers in connection with the above was keenly felt and a call for time subscription (man power) was made by the President Professor P. C. Mahalanobis in particular.

Plan of activities vis-a-vis Organization

The CEC keenly felt the need for the Association to undertake the discussions and to recommend specific proposals in regard to a number of Organizational maladies facing the development of science, the necessity for improving the integrity and stature of the scientific profession and the application of science and scientific methods in the country.

Finances

The year opened on 1st January, 1959 with a deficit of Rs. 3266 and closed 31st December, 1959 with a deficit of Rs. 487 35nP. During the year, a sum of Rs. 500/- was obtained from the NISI and a sum of Rs. 5,000/- in two instalments of Rs. 2,500/- each from the Government of India towards publication grants. The advertiment revenue has been of the order of Rs. 1700/- for the period 1st April to 31st December, 1959 and the Membership revenue has been of the order of Re. 1800/-.

The audit report for the period ending 31st March, 1959 indicates the drastic steps to be taken to tighten up the relationship between the Centre and Branches. The accounts of the Association have got to be

maintained by the Branches/Units etc. in accordance with the normal accountancy procedure and instructions have been issued in this regard by the Treasurer during the year. The attention of the Branches have been drawn to this fact time and again to avoid adverse comments from the auditors.

World Federation

Considering the financial position of the ASWI, the World Federation of Scientific Workers had volunteered to meet the expenses towards 3 Delegates from the ASWI to attend the World Federation General Assembly and Symposium Meetings at WARSAW (POLAND). One of our Delegates—Dr. Rais Ahmed (Aligarh) could attend the meetings though the information from the Government of India regretting their inability to grant permission to this Association to take out our delegation was received later. It would appear that certain procedure errors have been the cause for this in addition to the general policy of the Government of India in regard to such delegations. The ASWI has to consider this question seriously if its relationship with the WFSW is to be continued in a satisfactory manner.

Our publication work began this year under certain handicaps. Dr. D. K. Roy (Calcutta) who had been elected as the Editor and General Secretary (Publications) at the Annual Meeting held at Delhi could not take up the Editorship of the Journal due to unavoidable circumstances. Dr. D. K. Mitra of Calcutta Branch was selected for the post, by the CEC during this year. It required some time to finalise the official procedures necessary for declaring our new Editor to Government authorities.

'VIJNAN KARMEE' came out under new Editorship from Nov-Dec. issue of 1958. During 1959, ten issues have been published and the Nov-Dec. issue is in Press. One salient feature of this year's publication of V. K. is that a number of foreign contributors have encouraged us with their articles; three articles from 'Endeavour' have been reprinted with the kind approval of their Chief Editor ; we have also received Association/Branch news depicting the activity of ASWI members, from some of the Branches/Units.

As before, 1100 copies of the Journal are published per issue. The getup has been made attractive for our members and appreciated by the Advertisers. Besides the members of ASWI, 25 copies are sent to distinguished foreign scientists and scientific workers, 50 to noted Indian personalities, 21 to the members of the Advisory and Editorial Committees, 18 to foreign organisations, 6 to Information Service Centres and 45 to Libraries of National Laboratories and other academic institutions. Advertisement position has been considerably improved through personal efforts of some of the collegues of Hyderabad Branch, particularly Dr. Zaheer, our Vice-President.

Quite a number of active workers of Calcutta, particularly of the University College of Science, have either gone abroad and have left the place. Sometimes the odds against regulur publication of VK weight too heavy due to shortage of active and enthusiastic workers to supervise press and office of the publication. This year, we had to face and still are facing, the short supply position of printing paper for VK. The position could be improved if paper is purchased in bigger lots and kept in stock.

Though our publication has been improved to some extent, we are still facing problems in procuring sufficient articles for publication in the journal. This has been emphasised repeatedly in our meetings and through our letters to various centres. All our Branches, Units and Centres have to cooperate and share this responsibility to procure articles, papers, reviews and News items and informations pertaining to their activities. It is needless to remind our members that this journal is dedicated to, express the thoughts, plans, achievements problems and aspirations of the Scientific Workers of this country; it rightfully deserves a few moments of attention to kept it going and going properly.

Financial matters of the publication side as a whole, is not beyond worries. Publication cost is on the increase due to increase of cost of paper etc. It is felt that a few more pages of advertisement in V. K. could go a long way in making the journal self-supporting. We hope our members will cooperate in the efforts in this direction also.

Observations on the working of the ASWI

(*a*) *Membership*—The strength of the Association in terms of its membership is very poor in relation to the number of scientific workers in the country. In the context of planned development of the country, there is a strong need for strengthening the Association by increase in membership and making the Association more representative in character. Every effort has to be made and that too quickly to organise the scientific workers in the teaching institutions, in the private industry and in the Plan Projects areas, which have not been tapped so far. The active personnel protential at the branch level have to be strongly exhorted towards these efforts and the increase in the membership has to be brought about on a planned basis, regional wise.

Development of Science—The Association which is a unique organisation endowed with the possibility for assuming the responsibilities both in relation to the development of science/scientific efforts as also the scientific work, has not touched even the fringe of the problems. A basic re-appraisal of its position as on date is essential. For instance, such important problems as :—

(i) the need for decentralisation of the administrative machinery of the Government in Government and Quasi-Government Scientific institutions for good scientific progress,

(ii) the need for building up a strong and independent tradition of scientific criticism and evaluation and

(iii) a critical appraisal of the type of structure for building up the fabric of science in an under developed country like ours which will promote the progress of science and scientific efforts are all that demand immediate attention by the scientific workers themselves. The tradition to look forward to an administrative structuce for planning of science and scientific efforts in this country should be broken and emphatic views of the scientific workers themselves on such important issues should be categorically placed before the Government and the scientific workers themselves.

(*c*) *Working and Service Conditions*—In regard to the working and service conditions of the scientific workers in the country, a number of problems such as the categorisation of scientific work and workers, the pro-

blem of demand and supply of scientists, training and educational programme for scientists and technologists, the desirability of service system for scientists, the type and variety of grades and categories in relation to rates of promotion for the scientists, and need for decentralising recruitment, the need for assessing scientific work on an All India standard, the possibility of assessment of scientists for promotion by All India Committee or Commission of scientists, the desirability of promoting free movement of scientists within the same category from institution to another etc. are a few amongst the large number of problems which have to find their place in the programme of activities of the Association in the coming years. These problems again have to be discussed, reviewed and critically examined by the scientific workers themselves and proposals evolved which would be in the context of promoting scientific progress and the advancement of science and here again the Branches/Units of the Association have a very important part to play.

(*d*) *Publication Activities*—The V. K. which is the official organ of the Association offers an effective medium for discussions and exchange of views and for publicising of the activities of the scientific workers and scientific institutions and unfortunately a proper and correct utilisation of this forum is not being made. The scientific workers are alone to blame for this. Every effort should be made by the Branches/Units/Affiliated Organization to make use of this forum as a medium for exchange of views, ideas and for giving effective publicity. In this context the branches have also got an important part to play in relation to the financing of this important forum. There is a strong need for the branches to make efforts towards lessening the financial burden of the Publication Division by contributing or raising funds by way of advertisements if not by any other means possible. The need for the forum of the scientific workers to be independent of grants and aids, need no emphasis !

Recognition of the Association

A proper appreciation of the activities of the Association and the unique role it plays in organising science, scientific efforts and the scientific workers in the country is not being made by those administratively concerned in Government or Quasi-Government agencies. There has been a tendency to dub the Association at par with a typical trade union of workers which would emphasise on the economic and service conditions alone ! The Association had to face this problem of a negative attitude from the Heads of Departments either in regard to the recognition of the association and its activities, or in relation to its organizational activities in forming branches or affiliating other organizations of scientific workers in the country. Unless this serious obstacles viz : of a negative approach towards recognising this Association is removed in a positive way during a year or two by every means possible, the future of the Association will be a none too happy one.

Conclusion

In the light of the above report, the situation may be apparently bleak for the progress in the efforts towards creating favourable conditions ; only the internal weakness have to be overcome by a seriousness of purpose and integrity in thought and action. It is here that the individual scientific worker in the country and particularly the member in the Association today, who has to play a very major role, if this Association has to function towards fulfilment of the aims and objectives for which it was formed 12 years back.

APPENDIX 'B'

Treasurer's Report 1959

Friends,

I have placed before you the audited statement of accounts for the period 1-4-58 to to 31-3-59 along with the audit observations made on these accounts. In addition, I have presented to you a statement indicating the actuals of income and expenditure for the period 1-4 59 to 31-12-59 and estimates for the period 1-1-60 to 31-3-60. I have also tentatively drawn up the budget proposals for the period 1-4-60 to 31-3-61 for your consideration.

The salient feature in both the audited statement of accounts for the period 1-4-58 to 31-3-59 and the actuals of income and expenditure for the period 1-4-59 to 31-12-59. is that both have excess of expenditure over income. Our chief item of expenditure has again been publication of Vijnan Karmee. Inspite of our increased revenue from Advertisements inserted in V. K. and Grants from Government of India and NISI, it has been difficult to keep pace with the rising costs of publication. During the last 9 months, we have incurred an expenditure of Rs. 6562. 35nP on V. K. publication, when the total income derived from Advertisements and Grants was only Rs. 4660. 76nP. The order of deficit calls for yours serious thinking and consideration. We should find methods to economize the publication costs and above all attempts should be made to promote sale of V. K. on commercial lines. It should not be difficult to get at least 100 subscribers in the shape of Libraries alone. If attempts in these directions do not bear result, it should be considered; whether the monthly publication of V. K. should be reduced to a bimonthly or quarterly basis.

Our book-keeping methods at Calcutta publication office have not been very satisfactory and as such have invited certain audit observations this year from Auditors. This has been mainly due to the frequent changes in the office-bearers at Publication Office, for reasons beyond our control. We have given full thought to these audit observations at the last C. E. C. Meeting and I have already issued detailed instructions on maintainence of accounts at Publication Office and these if allowed will avoid such audit objections.

Organizationally, we have 9 Branches, 6 Units and 3 Affiliated Organizations, besides some unattached members. Their respective strength is given on next page :—

The cooperation received from several Branches/Units in the receipt of returns of membership, income and expenditure accounts, and Centre's share of money has not been satisfactory, inspite of repeated communications to them. This has not only caused difficulties in the proper functioning of Central Office but invited audit objections from the Auditors. I have again issued detailed instructions to Branches/Units in this connection and am also moving a specific resolution incorporating these instructions. All these, however, are to prove useless if Branches/Units do not respond. I propose that such Branches/Units which do not respond for 4 successive quarters should be considered as defunct.

Finally, I will like to thank my colleagues in the C. S. I. R. and the various office-bearers at Branches/Units/Affiliated Organizations who have very kindly extended their help and made my task easier.

J. N. Misra,
Treasurer, ASWI

	Membership strength	*Remarks*
(a) Aligarh	50	(Based on return sent in June '58
(b) CFRI, Dhanbad	—	Returns not received
(c) Lucknow	88	—
(d) Bahadrabad	70	—
(e) Calcutta	87	—
(f) Hyderabad	82	—
(g) Bangalore	33	—
(h) Mysore	30	—
(i) Roorkee	52	—
(j) Izatnagar	17	(Based on return sent in March '58 No return since then)
(k) CSIR Delhi	23	—
(l) CLRI, Madras	29	—
(m) CTRI, Rajahmundry	26	—
(n) Federation of Defence Scientific Workers	710	—
(o) Surveyor' Assocn.	75	Returns not received in 1959
(p) Southern Rly. Chem. Assocn.	16	—
(q) Direct members	12	—

Income and Expenditure Account for the Year Ended 31st March, 1959

Expenditure

		Rs.	nP.
To	Salaries	345	00
,,	Rent	480	00
,,	Stationary & Printing ...	322	90
,,	Travelling and Conveyance ...	453	43
,,	Postage and Telegrams ...	63	48
;,	Vijnan Karmee Publications and distribution expenses ...	7,921	64
,,	Miscellaneous expenses ...	40	85
,,	Bank Charges	39	97
,,	Balances Written off... ...	90	00
,,	Depreciation on Assets ...	56	00
,,	Audit Fees (2 Years) ...	100	00
	Total: ...	9,913	27

Income

		Rs.	nP.	Rs.	nP.
By	Subscription :				
	From Members	50	50		
	Centres share from Branches	1220	09	1,270	59
,,	Vijnan Karmee Publication Grant-in-aid from :				
	Government of India	5000	00		
	National Institute of Sciences, India	500	00	5,500	00
,,	Advertisement Income (Vijnan Karmee)			1,524	44
,,	Sale of Vijnan Karmee ...			40	00
,,	Interest from Bank ...			6	00
,,	Profit on sale of Type Writer ...			67	50
,,	Excess of Expenditure over Income carried to General Fund...			1,504	74
	Total : ...			9,913	27

REPORT OF THE AUDITORS

In connection with the audit of accounts of your Association's accounts for the year ended 31st March, 1959, we beg to make the following observations by way of our separate report, a reference to which appears at the foot of the Balance Sheet as at 31st March, 1959.

No details and/or proper supportings were available for :—

I. Postage spent amounting Rs. 63.48 and

II. Postage expenss of Rs. 516.22 included under the head "Vijnan Karmee" Publication & Distribution expenses".

No details for advertisements published in "Vijnan Karmee" were available. The income under this head has been taken on actual cash basis.

"Vijnan Karmee" Publication and Distribution Expenses" include expenses for January 1958 to December 1958 issues only. The General Secretary informs us that further provision upto March 1959 issues has not been made in the accounts due to nonavailability of information regarding publication and Bills etc.

Income of Subscriptions from members, branches, units and affiliated organisations has been adjusted on actual receipt basis. No account is available for subscription due from the aforesaid but not received. The accounts of Branches and Units have not been incorporated in these accounts.

Kanpur :
August 27, 1959.

Sd : GUPTA & Co.
Chartered Accountants.

BALANCE SHEET AS AT 31st DECEMBER, 1959

LIABILITIES	Rs. nP.	Rs. nP.	ASSETS	Rs. nP.	Rs. nP.
General Fund :			**Metal Box :**		
Excess of Expenditure over Income as per account abovesetforth	...1,504.74		Balance as per last Balance Sheet ...	9.00	
Last Balance Sheet ...	797.55		additions during the year ...	5.50	
	707.19			14.50	
Less transferred to debit side as per contra ...	707.19	NIL	Less depreciation for the year ...	1.50	13.00
Liabilities :			**Office Equipment :**		
Deposit on acconnt of Indian Regional Centre of World Federation of Scientific Workers ...		2,662.04	Additions during the year ...	18.50	
For Expenses (including expenses on Vijnan Karmee Publication upto December, 1958 only) ...		2,912.09	Less depreciation for the year ...	2.00	16.50
			Duplex Machine :		
			Balance as per last Balance Sheet ...	472.12	
			Less depreciation for the year ...	52.50	419.62
			Typewriter :		
			Balance as per last Balance Sheet ...	82.50	
			Less Sale Proceeds ...	150.00	
				67.50	
			Less transferred to Income & Expenditure account ...	67.50	NIL
			Advance :		
			To Dr. D. K. Roy against expenses of Vijnan Karmee publication ...	—	2,095.88
			Cash & Bank Balances :		
			Cash in Hand as per Cash Book ...	385.61	
			Punjab National Bank Ltd., Kanpur ...	1,576.69	
			Palai Central Bank Ltd. N. Delhi ...	359.64	2,321.94
			General Fund Account :		
			Debit Balance in account as per contra ...	—	707.19
Total Rs.		5,574.13	Total Rs.		5,574.13

Sd. P. C. MAHALANOBIS *President* — Sd. D. V. VARMA *Vice-President* — Sd. M. R. RAMAN *General Secy.* — Sd. J. N. MISRA *Treasurer*

AUDITOR'S REPORT

The abovesetforth Income and Expenditure account for the year ended 31st March, 1959, and the abovesetforth Balance Sheet as at 31st March, 1959, of the Association of Scientific Workers of India, 8/60, Aryanagar, Kanpur has been examined by us from the books of account produced. Subject to our separate report of even date, the abovesetforth Income & Expenditure Account and the abovesetforth Balance Sheet gives a true and correct state of affairs of the Association, as per information and explanations given to us and as shown by the books of the Association.

Kanpur :
27th August. 1959.

Sd : GUPTA & Co.
Chartered Accountant

Estimates of Income and Expenditure for the period 1-1-60 to 31-3-60

Expenditure	Rs.	nP
Deficit B/F	187	35
Allowances and expenses to officers	500	00
Establishment expenses	128	00
Bank charges	15	00
Stationary, Printing and Postage	300	00
Miscellaneous expenses	50	00
V. K. Publication	3000	00
Excess of income over expenditure	349	65
Total :	4530	00

Income	Rs.	nP	Rs.	nP
Subscription				
Direct	30	00		
FromBranches/Units	500	00	530	00
Income from advertisement			500	00
Grant from Government			3000	00
Grant from NISI			500	00
Total :			4530	00

Budget Proposals for the period 1-4-60 to 31-3-61

Income			Rs.	nP
Opening balance			350	00
Subscription :				
Direct	100	00		
From Branches/Units	2100	00	2100	00
Advertisement revenue			2000	00
Grant and Donation			7000	00
Sale of Journal			100	00
Total :			11550	00

Expenditure	Rs.	nP
Allowances and expenses to officers	800	00
Estt. expenses	450	00
Audit Fee	75	00
Affiliation Fee	100	00
Stationary, Printing and Postage	700	00
Miscellaneous expenses	100	00
V. K. Publication	9000	00
Closing balance	325	00
Total :	11550	00

Income and Expenditure statement for the period 1-4-59 to 31-12-1959

Expenditure	R.	nP.
Allowances and expenses to officers	1240	19
Establishment expenses	322	00
Audit Fee	50	00
Bank charges	51	85
Stationary, Printing and Postage	525	37
Miscellaneous expenses	41	80
V. K. Publication	6562	35
Donations	200	00
Money handed back to Indian Regional Centre	1833	01
Money held in trust for Indian Regional Centre	829	03
Total	11655	60

Income		Rs.	nP.
Opening blaance			
Cash	385 61		
Bank	1936 33	2321	94
Membership Fee			
Direct	57 00		
From Branches/ Units	1733 66	1800	66
Grant from Govt.		2500	00
Grant from NISI		500	00
Advertisement revenue		1660	76
Money received for Ind. Regional Centre		2662	04
Sale of V. K.		10	85
Miscellaneous income		12	00
Sundry creditors	2162 43		
Less closing balance			
Bank	1433 54		
Cash—Treasurer	49 69		
" Gen. Secy.	480 61		
" (Pub.)			
" Gen. Secy. (Org).	186 87		
	2150 71		
Deficit carried forward		187	35
Total		11655	60

APPENDIX 'C'

Reorganisation of Association of Scientific Workers of India

Introduction

In the world of today events are primarily guided by scientific thought and action. It is imperative for the scientific workers who are the contributors to this thought and action to organise and express themselves collectively. This would enable them to secure for themselves conditions suitable to their tasks and in return to guarantee to mankind, at large, progress and prosperity. The necessity for this had been realized as long ago as in 1947 when for the first time in India, an association of scientific workers viz: The Association of Scientific Workerkers of India, was formed and registered as a trade union with Shri Jawaharlal Nehru as its founder President. Although, the Association of Scientific Workers of India has now been in existence for 13 years, the trade unionism among scientific workers has not gained that momentum which is essential to increase the stature of the association to a fully developed and mature organisation.

Strength of an Association

The primary factors which go to make an association strong and effective are—

(a) numerical strength of its membership
(b) its financial stability and
(c) a record of its achievement in—

(i) the efforts for obtaining for its membership (a) security in respect of service and (b) working conditions conductive to the efficient discharge of their responsibilities,

(ii) solving problems of impact of science on society and the organisation of science and technology,

(iii) efforts for popularisation of science and scientific thought.

Growth and Progress

The progressive growth of an association would eventually depend upon its taking up urgent specific problems facing the scientific workers and planning its programmes and schemes in detail to bring about desirable changes. A clear perspective and definite programme of work beneficial to the scientific workers and to the society can alone bring scientific workers into the fold of an association and arouse in them the necessary impulse for taking an active part in the national development.

Present Membership of the Association

At present membership of the association mainly consists of (a) ordinary members who are directly enrolled and (b) affiliated members who are ordinary members of such other trade unions and associations of scientific workers which are affiliated to ASWI. Thus, the membership of the Association is drawn from the Universities, Central Govt. Institutions, State Govt. Institutions, Quasi-Govt. Institutions and the Industries. Units are constituted where a minimum of 10 members are available in any institutions and Branches are formed in towns where a number of such Units exist or the membership in any institution is 50 or more. In the case of Affiiliated Bodies, the scientific workers in a particular institution form themselves into an association and the association is then affiliated to ASWI.

Drawbacks of the Present System of Membership

The membership of the ASWI, being heterogenic in composition, has brought in its wake certain drawbacks from which the organisation suffers. Some of these draw-backs are summarised below :—

(a) there is "lack of enthusiasm" among the members constituting the branches as they have no common grounds in respect of their working and service conditions; for instance the scientific workers belonging to different institution and with varying interest, conditions of work and service are in many cases brought under one branch. In such cases, they have to look up to other organisations for resolving their own grievances and for obtaining conditions conductive to efficient performance of their scientific work,

(b) inspite of the fact that an average scientific worker has a some what different "subjective make-up" when compared to workers of other categories (non-scientists) he is essentially a wage earner and is in constant need of a collective organisation which could successfully work for bringing about changes for the betterment of the conditions of work and service,

(c) the branches are wholly dependent on the Centre and, apart from activities of an academic nature, have no other activities which would contribute to the well-being of the average scientific workers,

(d) there is lack of cooperation between the branches and the Centre and the branches have no locus standi to negotiate with the employers of their members. Consequently, where the branch attempts to negotiate with an employer, he pays no need to the representation. The voice of the branch being ineffective, the enthusiasm of the members goes down which in turn adversely reflects on the organisational strength of the association as a whole.

Existing Organisational Structure

The organisational structure of the ASWI at present is dependent on the Council which in turn comprises of the representative nominated by the Branches/Units/Affiliated Associations on a pro-rata or agreed basis. The Council annually elects a Central Executive Committee. The Executive Authority for the day to day running of the association activities vests in this CEC.

Draw-backs of the Existing Structure

As a National Trade Union embracing scientific workers from all sectors from an idealogical point of view, there is a broad based homogenity in the association. But in the class and type of members and the way in which this membership is distributed and organised, there is a heterogenity. This heterogenity has brought in its wake certain draw-backs viz :—

(a) the Central Executive of the association is unable to cope up with the magnitude of activities which it is theoretically expected to carry on,

(b) there is a regrettable paucity of funds both with the Branches and

the Centre. The reasons are two fold—the Branches fail to discharge their normal obligations towards their membership who in turn do not pay subscription; and the Centre being unable to work to the expectation of the Branches fails to obtain its share of funds from the Branches.

The need for a Re-Organization

Properly organised efforts are not coming forth at the ground level i. e. the Units or Branch. The Central Authority is called upon to activise and to attend to all the work pertaining to the Branches/Units etc. also. The Central Authority is unable to cope-up with the magnititude of the activities which it is called upon to undertake. In addition, the lack of a proper directional flow of the strength (i. e. from the Branch/Unit to the Centre instead of the other way round) is lacking. There is an overall centralisation which is not conductive for the healthy growth of the Association. There is thus a need for change in the organisational structure of the ASWI.

History

The question of re-organisation of the structure has been considered since January 1955, practically at every Annual Meeting. There can be no two opinions about the urgent necessity for finding but and implementing measures for an immediate check of the progressive decline that is facing the association. A major change in the structure is an immediate necessity to arrest this picture of decline in activities, falling membership and difficult financial situation.

The present unitary structure of the association has to be converted into a Federal one. Suitable modifications have got to be brought about in the Constitution of the ASWI if necessary to permit only affiliated bodies to remain within its fold. The existing constituents units on a direct membership basis have to be re-organised on a unitary structure of their own i. e. as homogenous and autonomous associations. These associations at the 'ground level' should be federated directly to form the Central Organisation of ASWI at the first stage. At a later stage, 'middle level' organisations which could be federations or regional organisations could be formed by grouping together associations of a common pattern or representing a common area. The strength of this 'middle level' organisation would be based on their affiliated associations but the guidance would come forth from the Central Federation i. e. ASWI.

Proposed Organisational Structure

A major change in the basic structure is necessary. The Association has to be re-organised on a federal pattern. Suitable relevent modifications, if necessary, have to be made for changing the Constitution of the ASWI. The constituent units should be made stronger in their activities and in funds and thereby removing the organisational maladies.

The ASWI as the Central Federation will thus draw its strength from the Federating Units only and will bring in its fold all the scientific workers irrespective of their field of vocation but organised in a manner that would allow the maximum autonomy for the scientific workers in any particular area in the organisational set up. The scientific workers at the ground level would look up to their own unitary organisations for solving most of their immediate problems which would in turn entail activities for and

by the respective members themselves leading to greater enthusiasm, closer contacts and mutual understanding. There will be thus provision for the maximum display of their enthusiasm and initiative, within a broad based pattern in federal structure.

Benefits of Federal Pattern

ASWI as a Federation will only affiliate autonomous bodies of scientific workers. ASWI as the Central Federation will thus draw its strength from all the Federating Units and bring in its fold all scientific workers irrespective of their field of vocation. They will be, however, organised in such a manner that the fullest scope exists for exercise of the maximum autonomy of a scientific worker in a particular field. He has the freedom to work for himself and guard himself and is also given the scope for a maximum display of his enthusiasm and initiative.

The 'ground level' associations will be in a position to undertake the responsibility for activising their unit organisation and to attend to the collective academic, social, cultural and economic needs of their membership. The basic unit will be thus better organised and strengthened in that the strength will not flow from the top to the bottom but will progressively be reflected from the bottom to the top as the case should be. The strength of the federal structure depends ultimately on the individual strength of the links that constitute the structure.

The routine organisational work pertaining to collection of subscription, maintenance of accounts and report of activities would essentially devolve on the ground units and federal centre would be called upon only to tackle problems of such a nature which are of a coordinating type, or are of national importance, or affect policy and individual questions when and where these are referred to by the constituting units.

With a large number of new scientific and technological institutions coming up e. g. the Steel Factories, Fertilisers Factories, the Drugs/Antibiotics Factories and the Research Centres under Govt. and Quasi-Govt. set up and many Research, Development and Production Units employing scientific workers under the private sector, the organisational machinery of the association has to be geared to meet the situation by an imaginative and practical vitalisation. If the efforts of the scientific workers to meet the objectives of the association are not to be frittered away by formation of small organisations which work at cross purposes with lack of coordination.

Change over to the proposed Federal Structure

To consider the problem on a concrete basis at the moment the existing Units, Branches and general membership branch drawing their membership on a composite basis have to be re-organised :—

(i) CSIR—The scientific workers of the CSIR Laboratories/Institutions have to be grouped together. For the purpose either the CSIR Scientific Workers could organise themselves into one association i.e. SWA CSIR or they could form their own respective associations Laboratories/Institution wise. To be explicit, our existing members belonging to the CSIR from the Mysore Branch, CLRI Unit, Hyderabad Branch, Roorkee Branch, Delhi Unit, CFRI Jealgora and Calcutta Branches.

could straightaway constitute themselves into CSIR, SWA with branches at the places mentioned above or the following associations could be constituted by them separately :—

ASW CLRI, ASW CDRI, ASW CBRI, ASW CSIR Central Office ASW CFRI.

(ii) Bahadrabad Branch—The members of this branch could form ASW IRI U. P.

(iii) Bangalore Branch—They could be organised as ASW (Institute of Science).

(iv) Izatnagar Unit could constitute the ASW IVRI.

(v) Aligarh Branch could constitute the ASW Aligarh University.

(vi) Railway Research Centre, Lucknow could constitute ASW Railway Research Centre, Lucknow.

(vii) The members of Lucknow University belonging to the Lucknow Branch of ASWI could constitute ASW (Lucknow University).

(viii) Individual members where they do not fit into the particular pattern as mentioned above could continue to be direct members of the General Branch or as an associate members of the ground level associations till such time the re-organisation pattern is complete.

NOTE :- The existing affiliated Organisations such as FDSW, Surveyor's Assocn., Dehra Dun, Southern Rly. Chemists & Metallurgists Staff Assocn., Madras, UP PWD Research Institute, Scientific Workers Association, Lucknow and the Association of Scienific Workers, Pimpri do not require any change in regard to their relationship with the ASWI.

The individual associations should consequent on their formation and adoption of their own constitution get themselves registered as a Trade Union with the Registrar of Trade Unions of the area concerned and simultaneously seek recognition from their employers.

Target Date

The above re-organization should be brought about by the 31st March, 1960 at the latest and the new Executive should be charged with the responsibility of bringing about the re-organization to its completion by this target date. The new increase in membership should be brought about on the lines of the Association pattern only and existing Branches should be charged with the responsibility of coordinating in the efforts towards creating the nucleus conducive for the formation of an association at our Centre or Research Institutions etc. on the association pattern.

ASWI In Retrospect

The Association of Scientific Workers of India was sponsored by the Indian Science Congress in its plenary session in January, 1947. It had the good fortune to have Shri Jawaharlal Nehru as the Founder President. In subsequent years also the Association has had the privilege of guidance and advice from the Prime-Minister during its Annual Sessions. The Association functions as a Trade Union and differs from other national scientific bodies in its pre-occupation with the improvement in the economic conditions

of scientific workers and bring about an effective application of science and scientific methods to the welfare of the community as a whole. It stands in the field today in pursuit of these aims and in a way that other bodies cannot and will not fulfil. Its constitution is democratic; a group of scientific workers in any institution or in a field of science and technology can constitute themselves into an active group participating towards the fulfilment of the objectives of the Association. The message of the Prime Minister Shri Jawaharlal Nehru on the occasion of inauguration of the Association in 1947 :—

> "I consider it a privilege to be associated with the Indian Association of Scientific Workers. Such an association was urgently needed in India and the Indian Science Congress has given shape to it at the right moment. It is meant to protect these workers and to help them. It is meant also for the advancement of science and the service of the [community. I hope that scientific workers all over the country will join this association and make it an active and vital Organisation".

will speak for itself.

By his close association with scientific association and related societies, Prime Minister Nehru has indeed given a great lead for a proper appreciation of the importance of science and scientific work in our country. There can be no better appreciation than the fact that a charter for the scientific workers in India was drawn up by the Government when the Parliament of the country passed the 'Scientific Policy Resolution' on March 13, 1958. The role and status of science and scientific workers has been fully realised and their importance for progress and development in the country has been recognised. For the first time, the Government has accorded recognition to the fact that science and technology are very important contributary social factors which govern the evolution and progress of society in modern times. It has been also recognised that the level of development of science is a significant measure to determine the cultural advancement and social progress of a nation.

For scientific workers there are certain obligation which they have to render towards the country and the people. In the programme of national development, scientific workers will play no inconsequential part since every programme of expansion involves progress in scientific and technological research. Hundreds and thousands of scientific workers will be required to carry-out the numerous programmes of research and development as provided and to be provided in the Plans. An organised group of scientific workers can help in this direction by personal examples of scientific advancement and popularising scientific outlook in day to day life. Trade unionism amongst the scientific and technical workers can help in creating a better psychological atmosphere and improved human relationship.

Unfortunately, the administrative pattern of our Government is highly centralised. Decentralisation has to be implemented. The time taken by bureaucratic machinery in comparative rigidity are continuing to hamper the economic progress which in turn, is largely dependent on science. The status accorded to the scientific workers in our country is not very satisfactory. The attitude of the administration vested in bureaucrats

towards points of view put forward by the scientific workers or their associations on important and complicated problems facing the country lacks proper perspective and understanding. On many matters of purely scientific and technical nature or those related to the professional, social and economic status of the scientific workers decisions are taken by people having no scientific training or knowledge which hampers real scientific advancement. There is an urgent need for enunciating the practical steps, by which the scientific policy of the Govt. is to be implemented so that the objectives of the scientific charter are achieved. It is essential that scientists should have an initiative and freedom of action in matters which concern science and technology with a view :—

(a) to work for the most effective use of science and scientific methods for the uplift and the welfare of the society as a whole,

(b) to improve and safeguard the economic conditions of life, profession and social status of all scientific workers in India for obtaining the very best from them,

(c) to participate in and undertake such other activities as may be conducive and relevant to the above.

The growth of a healthy trade union movement amongst the scientific workers belong to the intelligentia and from whom an enlightened and constructive appreach to their problems can be rightly expected, is very essential. In the developing economy of our country a proper appreciation of the need or an association like the ASWI should be recognised at all levels and the initiative taken by the men who matter at the top, particularly in the Government and its bureaucratic set up, to encourage the efforts towards the fulfilment of the objectives of the association. It has to be realised that besides negotiations concerning terms and conditions of service, a trade union like the ASWI plays an active role in promoting education, training and cultural amenities for its members. In addition on questions of social and economic interest an association like ASWI takes the leading part in considering them in a dispassionate manner and suggesting firm and practical directives.

This Meeting of the ASWI calls upon the scientific workers all over the country to join the association and make it an active and vital orgrnisation. This Meeting also requests the Prime Minister and all concerned with the Government and other employers of the scientific workers to look upon the association as a well knit organisation which could be called upon to shoulder the responsibility for the progress of the country and to speak on behalf of the scientific workers for the fullest utilisation of science, discrimination of scientific knowledge and its social implications for creating public interest in science.

The need for Categorising Scientists and Scientific Work

The term scientist is a very comprehensive one. In addition to the individuals connected with pure science, the term also includes Engineers, Technologists, Medical personnel and Agronomists personnel. Whereas the distinction between the scientist or scientific professon from that of many others like the Lawyers, Artists etc. is well recognised ; there is a strong need for categorising the scientists themselves on the basis of the type of work performed by them.

Without considering the various questions relating to the conditions of work or service of the scientist, it is very much desirable to group him on his professional basis and provide him with the necessary facilities that are suitable to that particular group. This is evident from the fact that the teacher in a University is different from technologist in a production unit, the technologist in a production unit from another in a Development Organisation an an Engineer in a Development Project from the one in a Maintenance Department and so on. It would, therefore, be very desirable for this Association to consider the feasibility of categorising the scientists under certain broad groups and to define conditions and facilities separately for each group which would be conducive to the furtherance of the cause of the individuals in their respective scientific aims. Grouping as an example which can be amplified to include diverse activities will be as follows :—

(i) Operating scientists, for example, will include the Technologists in production units, Engineer in Production and Maintenance Units and General Scientific Workers engaged in day to day work on agriculture, irrigation, power, meteorology, geology etc.

(ii) Second group can comprise of Science Teachers in Schools, Colleges and Universities.

(iii) Research Scientists engaged both Development and Fundamental aspects and

(iv) auxiliary technical staff.

Income & Expenditure Accounts of Branches/Units

Since it is felt that the method of maintaining income and expenditure accounts at Branches/Units level in several cases is not satisfactory, it is felt that necessary directives should be issued to guide them. These directives are being incorporated in the form of a resolution. In case there are certain difficulties experienced by Branches/Units in following these or some clarifications/elucidations required, the Branches/Units should contact the Treasurer ASWI for necessary help and guidance.

Resolution

It is hereby resolved that Branches/Units will follow the procedure outlined below for maintaining their income and expenditure accounts and sending returns to Centre.

(a) The amount received from the members as subscription and admission fees should be maintained in a Account Note-Book as per proforma given below:—

(b) The Cash Book has got to be maintained which would show the monthly income and the monthly expenditure under different heads indicating the dates, (the income and expenditure have incurred).

(c) Relevant to the income i.e. subscription, admission fees etc. and relevant to the expenditure such as postage, stationary. T. A. and such other items incurred, Ledger Folios should be opened in a Ledger Note-Book and based on the entries made

Sl. No.	Name of Member	Place where working	Amount received —	Period pertaining to which payment made	Arrears of subscription due, if any	Receipt No.

in the Cash Book, suitable entries should be made in the Ledger also.

(d) For all incomes, receipts should be issued and the receipt No. should be indicated in the Cash Book. For all expenditures, bills and vouchers should be obtained from the parties concerned. For the postage register, a Stamped register should be maintained giving the entries pertaining to the date, address, amount and particulars of the postal transactions; a certificate should be given by the Secretary every month in regard to the amount spent during the month towards the postage. It will be observed that no expenditure should be incurred which is not suitably supported by a bill/voucher and a receipt or certificate. For amount exceeding Rs. 20/-, a revenue stamp should be affixed. Where the amount is sent to the Centre as its share, an entry to this effect should be made in the Cash Book and Ledger and on receipt of the receipt from the Treasurer, ASWI (Central Office), this should be taken up with the voucher and the transaction completed on the Account Books.

(e) Every quarter a statement of accounts giving the actuals of income and expenditure and the arrears of subscription due along with the up-to-date list of members should be sent to the Treasurer. For this purpose, statement of accounts of actuals of income and expenditure submitted by the Treasurer, Central Office as incorporated in the minutes of the CEC should be taken for guidance.

Since, the entire accounts of the Association, between the period 1st April to 31st March, are audited every year and these should include accounts of Branches/Units too, the Branches/Units will every year send by 15th April to the Treasurer, Central Office, the following Books/Registers along with any other relevant papers pertaining to accounts for auditing. These will be returned back to respective Branches/Units after audit is complete:

1. Cash Book, 2. Ledger, 3. Vouchers 4. Receipt Books 5. Membership Register 6. Stamps (Postage) Register 7. Bank Pass Book.

Proposed by : J. N. Misra
Seconded by : M.R. Raman

Restriction On Scientific Personnel From Applying Outside

That U. P. Govenment vide their G.O.No. 3697 dt. 28th Feb., 1959 have restricted the services of all scientific personnel (Assistant Research Officer/Assistant Chemist/Junior Assistant Chemist/Laboratory Assistant from going outside on deputation or for foreign service on their own initiative, for bettering their prospects thus depriving them the concessions and priveleges granted to all Uttar Pradesh Govt. servants vide their G. O. No. A-2911/IIA dated 2nd December, 1957.

Resolved that Government may be moved to withdraw this order No. 3697/EBR dated 28th February, 1959, as it amounts to invidiuous discrimination against the Scientific personnel especially in view of the fact that—

(1) the other Research workers (Overseer, Assistant Engineer, Executive Engineer) employed in this very Institute are being allowed to apply and seek employment elsewhere for betterring their prospects even when they have Sufficient field of promotion and large number of higher posts within the department.

(2) the posts of Scientfic personnel are blocked one having no prospects and avenues of promotion within the department and in all cadres persons having even an experience of more than ten years are still holding the same posts without giving them insentive and impetus to work by way of encouragement in the shape of promotion within the department, even in face of their long and mature experience, although due to the nature of their services and applied Engineering and technical knowledge, in future expansion schemes, this section of the staff, could have been and can even now be provided with suitable promotions viz,

(i) the present Assistant Research Officer be upgraded to Research Officer in-charge of all laboratories,

(ii) all the present 5 Assistant Chemist/A. G's upgraded to that of Assistant Research Officer (Chemists) as incharge of each of 5 laboratories, replacing the Assistant Engineers, who can be entrusted with field work,

(iii) laboratory Assistants be given chances of being absorbed as Junior Assistant Chemists, in view of their long experience and more technical and applied knowledge and deep insight into their subjects, than raw Junior Assistant Chemists who take time to learn and pick up things,

(iv) Promotions to the post of Research Officer and Assistant Research Officer be reserved from amongst suitable qualified and experienced staff of this very Institute.

Appendix 'D'

CEC FOR THE YEAR 1960

The CEC was constituted as under :

1.	Professor M.S. Thacker	.. President
2.	Professor P. C. Mahalanabois	.. Vice-President
3.	Dr. S. Husain Zaheer	.. —do—
4.	Dr. D. S. Kothari	.. —do—
5.	Dr. B. Mukerji	.. —do—
6.	Sri M. R. Raman	.. General Secy. (Org.)
7.	„ S. Ramabhadran	.. General Secy. (Pub.)
8.	„ D. V. Varma	.. Jt. Secy. (Org.)
9.	„ Y. H. Rao	.. Jt. Secy. (Pub.)

10.	„ J. N. Misra	..	Treasurer
11.	Maj. Gen. S.S. Sokhey (Delhi)	..	Member
12.	Sri A. Rahman (Roorkee)	..	„
13.	„ Gopal Krishnan (Hyderabad)	..	„
14.	Dr. D.K. Roy (Calcutta)	..	„
15.	Dr. S. Ganguly „	..	„
16.	Dr. M.S. Iyenger (Jealgora)	..	„
17.	Secretary, Calcutta Branch	..	„
18.	„ Hyderabad Branch	..	„
19.	„ Lucknow Branch	..	„
20.	„ Roorkee Branch	..	„
21.	„ Jealgora Branch	..	„
22.	„ Bangalore Branch	..	„
23.	„ Aligarh Branch	..	„
24.	„ Mysore Branch	..	„
25.	„ Bahadrabad Branch	..	„
26.	„ Izatnagar Unit	..	„
27.	„ CSIR Unit Delhi	..	„
28.	„ CLRI Unit Madras	..	„
29.	„ CTRI Unit Rajahmundry	..	„
30.	„ F.D.S.W.	..	„
31.	„ ASW Kanpur	..	„
32.	„ ASW Kirkee	..	„
33.	„ ASW Khamaria	..	„
34.	„ ASW Pimpri	..	„
35.	„ U.P. PWD Research Institute (Lucknow)	..	„
36.	„ Surveyor's Assocn., D. Dun	..	„
37.	„ Southern Rly. Chemists & Metallurgists Staff Assocn. Madras	..	„

Editorial & Advisory Board.

1. Professor M. S. Thacker
2. Professor P. C. Mahalanobis
3. Dr. S. Husain Zaheer
4. Shri M. R. Raman
5. Dr. Rais Ahmed
6. Dr. D. K. Roy
7. Sri G. C. Joshi
8. Sri Baldev Singh
9. Dr. S. Ganguly
10. Sri M. L. Vaidya
11. Sri R. Iyer
12. Sri S. Ramabadran (Editor)

1. Dr. D. S. Kothari
2. Dr. A. C. Ukil
3. Dr. B. Mukerji
4. Dr. D. N. Wadia
5. Dr. S. Bhagavantam
6. Dr. M. S. Randhawa
7. Dr. D. M. Bose
8. Dr. B. C. Guha
9. Maj. Gen. S. S. Sokhey
10. Dr. S. Husain Zaheer

W. F. S. W. NEWS

The World Federation of Scientific Workers has been especially concerned with the grave threat to humanity brought about by the development of nuclear weapons.

The progress made in discussions which have taken place at Geneva, first among the Technical Experts in July and August, 1958, and later, after November 1958, among members of the Committee, have raised the hopes of hundreds of millions of people, all over the world, that a way might be found of rescuing mankind from its dangerous and exposed position in the face of the ever growing hazard of nuclear war. It is of great importance that during this time there have been no new nuclear test-explosions. Further, and most significantly, nobody seems seriously to have doubted that the agreement to suspend tests has been scrupulously respected, in spite of the absence of a control scheme.

At the present time, however, the progress achieved by many months of negotiation appears to be in danger of being brought to nought by the difficulty in achieving agreement on the problem of detecting underground tests.

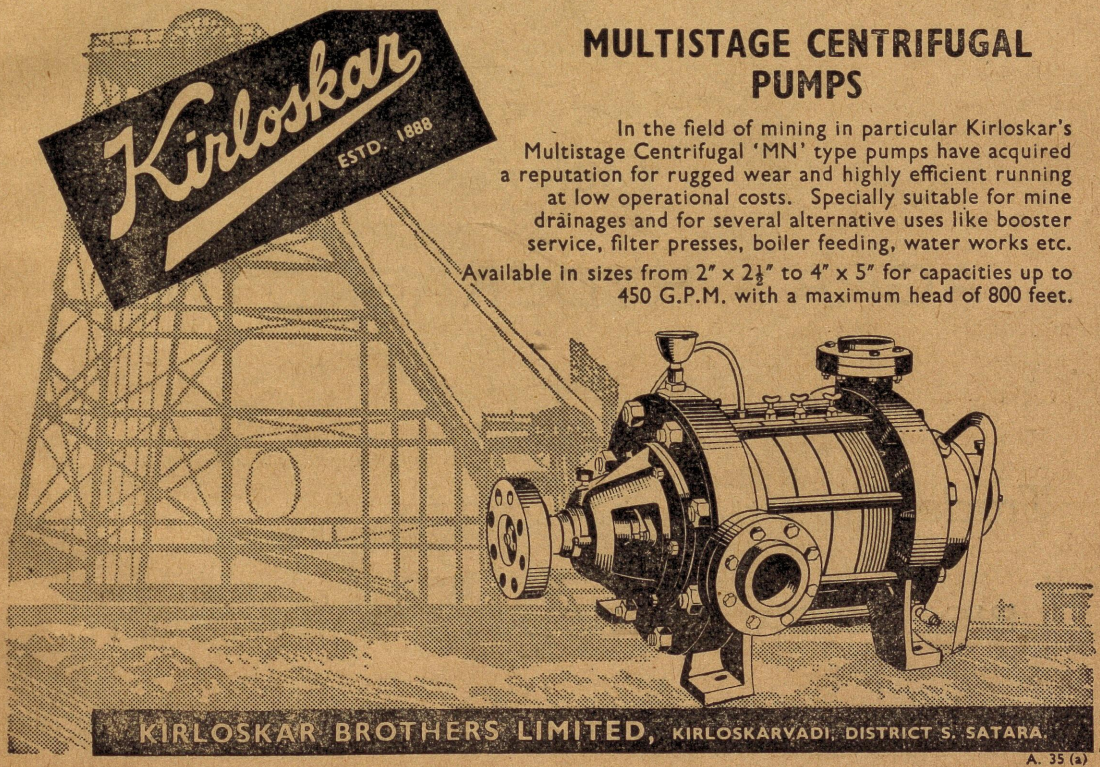
It will be a most ominous portent for the prospects of human society if disagreement on this technical matter should lead to a breakdown of the present negotiations and the resumption of the nuclear arms-race; the need for a rapid and successful conclusion to the Conference is therefore more urgent than ever. A success would greatly increase internationl confidence and would contribute to a further diminution of international tension. Further, experience in the operation of a system for the control of the cessation of nuclear tests would be of great value in helping to devise means of controlling more widespread measures of disarmament.

On the other hand, failure to agree would greatly intensify international tension, would lead to a resumption of testing and the nuclear arms race, would promote the spread of nuclear weapons to other countries, would postpone to the distant future the possibility of agreement on wider measures of general disarmament, and, most serious, would greatly increase the dangers of the outbreak of nuclear war from accidental and other causes.

It is essential that any scheme of control should be as effective as present scentific knowledge and human ingenuity can make it. Nevertheless no control scheme can ever be perfect. Undoubtedly nuclear weapons of such a small yield could be exploded that they would be likely to escape detection by any control scheme. The particular measures proposed in August 1958 by the Conference of technical Experts were aimed at identifying, with virtual certainty, underground nuclear explosions of yield equivalent to 5,000 tons of TNT and greater. Recently doubts have been expressed about the capability of this control scheme, and American scientists have taken the view that the minimum size of a nuclear explosion which could be detected with certainty by the Geneva control scheme is greater than 5,000 tons, while Soviet scientists have drawn different conclusions.

The recently published report of Technical Working Group 2 of the Conference on the Discontinuation of Nuclear Tests, while recording failure to agree on the above question, at the same time reported a considerable progress on other matters, including a programme of research that could lead to a substantial improvement in the effectiveness of a control scheme.

Why then should it not be possible to establish the control scheme proposed by the 1958 Geneva Conference of Technical Experts, together with the recommendation for the improvement of techniques and instrumentation made by Technical Working Group 2 ? At the same time, would it not be possible to establish a permanent international research committee with the task of continually improving and developing months of identifying underground nuclear explosions ?



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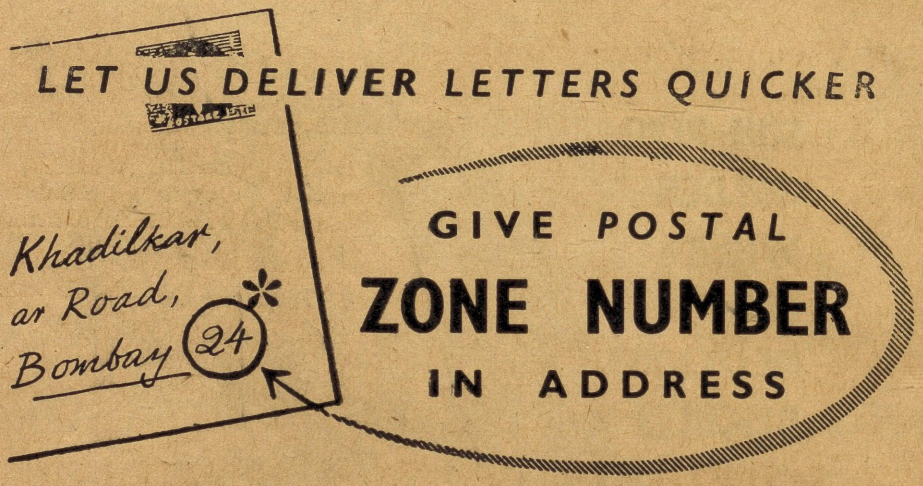

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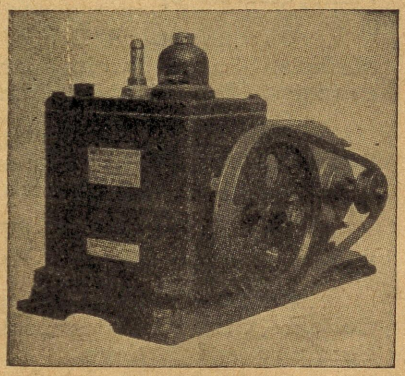

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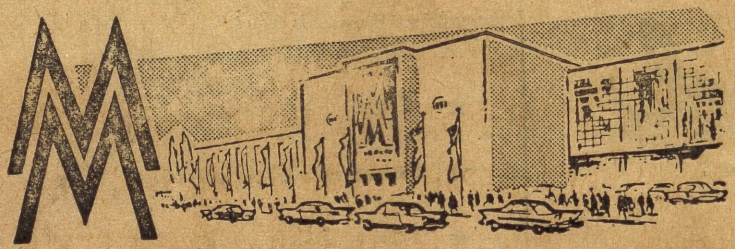

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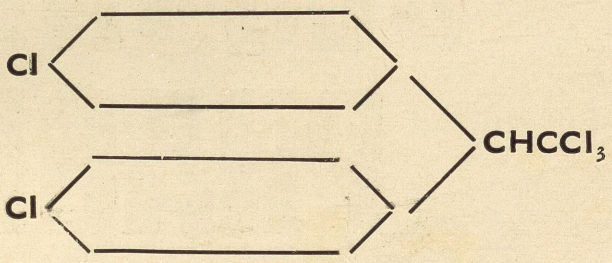

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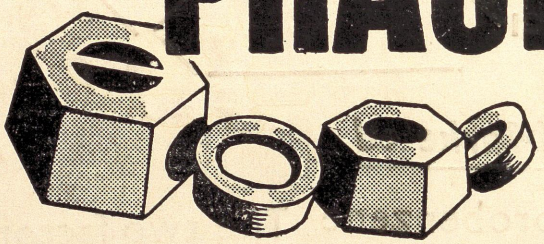

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VIJNAN KARMEE

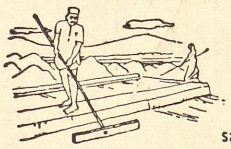
journal of the association of scientific workers of India

Vol. XII

APRIL, 1960

No. 4

What salt means to you!



How long ago man discovered salt is lost in antiquity, but he learnt that it came from the rocks and the sea As he realised the value of salt, he made it an article of currency and commerce.

Science has gone far since then, and today it has learned to make many and varied uses of salt. Can you imagine your common salt being turned into a number of heavy chemicals, such as soda ash, caustic soda, bicarbonate of soda, magnesium chloride, bleaching powder and bromides? Can you imagine getting along without salt in the twentieth-century?

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EDITORIAL

Scientists and Objectivity

From the very early stage, man has been patterned to subjective feelings. The impressions which he got from the environment and nature, have always been interpreted from his own angle. This can be easily seen from the works of art and literature during the various ages. Great artists, poets and sculptors have been able to transform mundane things into immemorial articles of transcendent beauties. If one goes through the works of Shakspeare, the paintings of Leonardo de Virici and the Hellenic sculpture of Greece, he will be struck by the subjective beauty from the individual poet, artist and the sculptor. Literature, art and painting do still attract every human being today though subjective to a large extent. This is aesthetics.

The evaluation of a scientist has, however, been on a different footing, in that his primary function has always been to rationalise what he sees and not assume what others see, write and talk about. A normal man appreciates the beauty of a rose, which blooms in the morning sun but a scientist does not care so much about its pleasing appearance and beauty but tries to work out how a rose blooms, what are the constituent colours which go to make up the hues of the petals, what is the aromatic fragrance from the flower and the chemical structure of the various components which make it look alive and cause it to wither away during the breakdown of their complicated structure into smaller molecules.

During the course of civilisation, in social behaviour man also has been accustomed to subjective feelings in his every day life. Nay, it has been alive to the extent of judging his neighbour, his wife, his children and his servant by subjective feelings rather than by objectivity. This has also permeated into the professional set up. An employer of professional workers has also been influenced in the same manner regarding assessment of work and productivity. Nepotism and bureaucracy have developed out of this unfortunate subjective methods of assessment. While the scientists have developed methods and measure in a number of fields of science to advance science in a rapid manner, it has not been possible for objective methods to be developed for the assessment of scientists. Judgement of merits, capacity for work, personality and intelligence of a person cannot still be evaluated in terms of objective methods.

As an organization, ASWI would like to see their members judged in their profession by concretised objective methods for such purposes. It does not mean, however, that as scientists we should entirely separate ourselves from subjective feelings. In other words, we should be humanistic in our approach. The scientist should be able to appreciate Art, Beauty, Music and every other form of fine Arts. He should be able to build a mean between subjective and objective feelings. He should be in a position to appreciate the beauty of a rose and at the same time able to identify chromophoric groups contributing to the colour effect of the rose and the aromatic groups which give rise to fragrance.

A balanced mind comprised of both subjective and objective feelings should be the aim and will go a long way in bettering human relationship. If objective methods are brought to bear upon social behaviour, the scientists would have contributed something of value to existing society.

EDITORIAL NEWS

SCIENTIFIC EDUCATION IN THE COUNTRY

During the past 10 years, leading educationalists in this country have been mentioning that the standard of education in the Universities and Schools has gone down considerably and there is an urgent need for changing the curriculum for both the boys and girls in Schools/ Colleges. With the rapid advancement of industrialisation, it is necessary to have more bias on the scientific education to be given to the younger generation of the country. This has also been realised in every part of the World that a basic education of science is absolutely essential and in addition art and literature should also be given for one and all so that every human being can be a composite literateur and a scientist. In a series of lectures given before All India Radio, Dr. Khosla has also stressed the necessity for the education of our Engineering graduates in the basic sciences such as Mathematics, Physics and Chemistry. The present Engineering graduates trained at the various Universities / Colleges / Engineering Colleges are quite capable of joining manufacturing and production firms but unfortunately very few are available for the creative and research type of engineering.

Our Education Minister has announced in the Lok Sabha that a Science Commission has been appointed with experts in the field from UK and Continental countries. The Commission will be visiting this country with a view to have a study tour round the Universities and Colleges and suggest suitable modifications to the existing curriculum. It may be also known that the Education Ministry has appointed an Expert Committee under the Chairmanship of Prof. K. S. Krishnan, Director National Physics Laboratories and this Committee has been entrusted the job of scrutinising the syllabuses for the basic science degrees in the various colleges. We understand that considerable work has already been done by this Committee for evaluation of the proper type of syllabus to be prescribed for Physics. The work is proceeding on the other scientific fields and we hope that in the near future the Universities and Colleges will have a uniform curriculum for the benefit of the younger generation.

It is pertinent to point out about the education system in the USSR. During the last 30 years, a great amount of work has been done by the leading scientists of the country and the younger scientists in the USSR are being trained for the role of science from the sixth standard onwards which is equivalent to our eighth standard. During the vacation, the younger boys of the schools who are trained in science are also allowed to go out for training in the various factories so that the application of science may be learned by them even at such an early age. In addition, examinations which are conducted for these boys and girls give more weightage to the questions on the application of science rather than the memorised part of text books (which is the system prevalent in this country). It is also worthwhile to mention that a number of scientific problems which have not been

solved by great scientists of the country are presented as questions to the graduates and the post-graduates students of the Russian Universities. It has been found that in a number of cases because of the fresh outlook and the creative mind of the younger scientists a number of problems which could not be solved by scientists earlier has been satisfactorily solved by the younger scientists.

May we hope, therefore, that the education policy of the Government will take into consideration the principle enunciated above so that the education in India becomes akin to the advanced countries of the World.

Science Commission

While replying to the debate in the Lok Sabha on the demands for grants for the Education Ministry, Dr. Shrimali more or less casually revealed the Government's intention to appoint a high-power science commission. Leading scientists from foreign countries would be associated with the commission and it would be asked, he said, to survey the whole field of scientific education from the school stage onwards. The Education Minister nodoubt means well, and no one will quarrel with the objective of promoting scientific education. But it is by no means certain that the appointment of a science commission is at all necessary at the moment. So far as scientific education beyond the school level is concerned, the University Grants Commission has already begun a series of inquiries, It has appointed review committees with very wide terms of reference. They are expected to investigate and report on the state of development attained in a particular scientific field under reference, make a quantitative and qualitative appraisal of the researches in progress, recommend steps for expansion of training and research facilities, indicate modifications in syllabuses and examinations at different levels and recommend model syllabuses, and finally suggest ways and means of co-ordination between universities and other centres of teaching and research. The review committees on physics, zoology, botany, mathematics and bio-chemistry have already begun their inquiries—and the committees include some of the most distinguished scientists in the country. The Review Committee on Physics (headed by Dr. K. S. Krishnan) has in fact set up sub-committees to study in detail various aspects of teaching in physics. A science commission of the type envisaged by the Union Education Minister could hardly do as thorough a job as the various review committees set up by the U. G. C. are expected to do.

What then remains is the question of scientific education at the school-level. That the facilities for the teaching of science subjects are shockingly poor is already known. As to teaching standards, the authorities concerned know only too well that they are deplorably low. The methods of teaching used in our schools are so unimaginative that in the majority of cases a student's interest in studies is swiftly and permanently killed. Things are learnt by rote with the sole purpose of passing examinations—examinations which mainly test the student's memory but which almost never test his ability to think for himself and analyse a given set of data. The known defects suggest their own remedies. The schools need to be better equipped and not only in terms of laboratories. The teaching staff has to be strengthened both in numbers and in quality. The examination system needs to be drastically altered so that it ceases to kill the will to learn. It is absurd to imagine

that the appointment of a science commission will in any way decrease the difficulties which so far have hampered improvement of teaching standards. Even a high-power commission can only point out the defects which are notorious and the remedies which are well known. It cannot give education higher priority in our national plans. The fact of the matter is that the standard of scientific education, particularly at the school level, can be raised only by improving the quality of secondary education as a whole. The teaching of science subjects cannot be improved by treating it as an isolated matter. What is remarkable is the Education Minister's rather glib assumption that it can be done. This is not to suggest that the authorities should be content to leave things where they are. On the contrary, the objection to the setting up of one commission after another is that all too often the appointment of a commission is merely an excuse for postponing effective action.

Research And Development

Can the effectiveness of research and development be measured? More precisely given a certain amount of research effort, in a given field, can the rate at which useful results will emerge be predicted? These are some of the questions asked during a recent intensive study, "Basic Research in the Navy," carried out for the Naval Research Advisory Committee by Arthur D. Little, Inc. (Industrial Bulletin of Arthur D. Little, Inc., 369, Nov. 1959). In its report to the Secretary of the Navy, the Committee recommended further "research on research"; one approach is through a mathematical model describing the mechanisms of discovery and application.

The model describes a two-stage process; in the first stage, knowledge is discovered, and brought from the realm of the unknown into the known. In the second stage, combinations of the known facts are fitted together and applied. Formulation of the inventive process in this way emphasizes one important point: for every invention there is a key fact, or relation, or principle the last to be discovered of all those necessary before the invention could be made. From this it follows that the date of discovery of this key fact is the earliest date upon which the invention could be made at all—although, of course, many inventions are not made until long after the discovery of the key fact.

There is a body of available knowledge, containing a certain number of key facts, corresponding to an equal number of possible inventions. If no new knowledge is added by research, these represent all the inventions which can be made. But the more research effort is applied, the more new facts come to light. It is also proportional to the size of the pool of (undiscovered) knowledge. The consequences of this ratio are interesting; the equation describing the rate of depletion of basic knowledge—the unknown subject—is an exponential decay (curve like that used to describe the rate of decay) of a radioactive substance. This is the model for the first stage of the research process.

The second stage concerns the application of discovered facts through invention. Here again the rate of progress is proportional to the amount of effort expended and to the size of the pool of knowledge—in this case, the number of discovered, but unapplied, facts. Yet a fact may be applied many times, in different combinations with other facts. It is not the unit of knowledge

that is important—rather, it is the conclusions drawn from a number of units. To determine a rate for the second stage properly, one must invoke the techniques of modern algebra.

There is, also, the question of the time-lag between discovery and application; for the second stage, as well as the first, one can draw an analogy with the process of radioactive decay. The body of known but unapplied facts is considered, on this model, to have a well-defined half-life, but the expected time for any one fact to be applied may range from very short to extremely long. The expected half-life itself is a variable quantity which depends on the amount of effort expended on development work.

By putting these various factors together, for the second stage an S-shaped curve is obtained indicating first a slow rate of application, then a more rapid increase, and finally a plateau; curves of this type are familiar to economists for describing the development of a market or a new product. This is the model for the inventive process, and it is confirmed by observation.

Perhaps the most interesting feature of the model is that an optimum ratio for the effort to be applied to the two stages of discovery and application of knowledge can be derived. That is, one can in theory answer the question: For maximum productivity of a research programme, what percentage of the budget should be devoted to basic research, and what part to applied research? The model suggests that to develop one large and complex field, basic research should not fall below about 20 percent of the total research budget.

SCIENCE NEWS

Heat Resistant Fibre

Choice for a versatile material that can withstand high temperatures, can act as an insulant and some property of acquiring pliability for manipulations or better and easy coverage has rested so far on materials like grades of asbestos, spun glass wool, or a few resins. All of these have their limitations both in subsidiary properties as well as working temperature range.

A perfectly new synthetic fibre has recently been announced which has high refractive index, small diameters, and can form light weight felts which can be used at temperatures upto 2200°F (1204°C). In addition, this fibre has high infra-red reflectivity and diffusibility which marks it as a likely choice for varied field for applications.

The material is wholly synthetic. As a chemical substance, it is potassium titanate and has the composition K_2O, $(TiO_2)n$, where n=4 to 7. A detailed account of its physical and chemical properties has appeared in Industrial and Engineering Chemistry (International addition), Vol. 52, No. 2, February, 1960. Alone or in conjunction with reinforced thermostable polymers it has been found suitable for several uses, most of which are listed in the reference.

Food From Grass

Scientists are confronted with the Problem of finding new sources of food for the new mouths that are appearing rather at an alarming rate. Of the major components of food, proteins have presented a chronic problem in this regard.

In the search of alternative and new sources of potentially utilisable proteins, Prof. N. W. Pirie and his group at Rothemsted Experimental Station, Harpenden, have been active for the past several years. Recently, this group has been considering the possibility of utilising proteins from grasses and other chlorophyll containing plants for edible purposes. Processing of proteins from leaves and grasses involves several complicated steps in Bio-chemical Engineering. One of the processes that have been used by M/s British Glues & Chemicals Ltd. for treatment of leaves to obtain proteins is CHAYEN impulse process. The principle of this process is to subject the potential protein source to high frequency impulses as is done in depth charge technique by submarines, or shock-fishery. Of the materials that have been successfully subjected to this process are bones and oil-seeds, groundnuts and grasses. In the treatment of grasses, for example, 100 tons of fresh grass (containing 80% wortes) yields 2¼ tons of edible protein, 7 tons of fibres which can be used for construction of hard board etc., and 0.6% chlorophyll syrup from which soluble vitamins, pigments and steroids are obtained.

These advances in Biochemical Engineering hold promise for food deficient areas which are facing the problem of growing population.

Is 'G' Constant

An interesting speculation about Earth's constant is whether its value is stationary or is it changing. In 1937 Dirae pointed out that Gravitational Constant of earth, G, is de-

creasing proportional to t^{-1} where t=age of universe, at—that time taken to be 2×10^9 years. Dicke' subsequently showed that such a situation would lead to an increase in the circumference of the earth. Estimates based on $t=6.5\times10$ and 12×10^9 (presently accepted figures) show that in the past circumference of earth would have changed at an average rate of 0.5 mm a year. By a different estimate an expansion of 3.8 mm a year has been found.

During the recent I.G.Y. activities some new and interesting data have been collected regarding the surface geology of earth which give a new light to the phenomena of expansion of Earth's circumference. Prof. J. TuZo Wilson has, in a recent article in Nature,* analysed these evidences, particularly the data regarding (i) mid oceanic seismically active belts (ii) oceanic heat flow measurements (iii) and concentration of volcanically associated isotopic lead ore. He points out that the expansion could have occurred due (to phage changes in the Earths' interior, or due) to differentiation of the core and mantle. But the decrease in gravitational constant is quite a fascinating hypothesis and can lead to results of the order observed on the basis of factors mentioned earlier.

'Super Conductivity'

The Phenomena of super conductivity is a comparatively recent discovery in the field of low temperature physics. When temperatures nearing absolute zero are attained, common materials like metals start behaving in a peculiar manner. For instance, metals cooled to about 3 or 4 degree absolute show very peculiar properties of electrical conductivity, they become 'super conductive' or in other words the electrical resistance totally disappears. This phenomena, although discovered by the Dutch physicist, Kammerlingh Ounes in 1911, has been explained only in recent years.

While theoretical interpretations have reached satisfactory solution, possibilities of immence significance have arisen in the application of super conductivity. As an illustration, metal wires of extremely thin dimensions can be constructed which will take a large current load without introducing the problem of resistance. This can result in extremely compact electronic circuits which have theoretically no current loss. Motors can be designed with very high efficiency, and minimum current loss, computor circuits and magnetic lenses can be designed to an ideal perfection and a nearest approach to a perpetual motion machine can be made.

Another interesting feature of super conductivity is related with the design of analogue computors and 'memory' machines. If an initial current is fed in an insulated metal block, maintained near absolute zero, the current goes on revolving round and round as there is no current loss due to inherent friction of the metel. Eddies produced in the metal can be used for secondary reference feeding for the working of the memory machine. Thus a new source of storing 'memory' in electronic circuits have been discovered based on the phenomena of super conductivity. In terms of instrument design this presents a very interesting possibility of constructing ideal 'memory' machines with extremely large retention capacity!

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ARTICLES

RADIATION FROM PARTICLES EXCEEDING THE VELOCITY OF LIGHT AND SEVERAL APPLICATIONS OF IT IN EXPERIMENTAL PHYSICS

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Experimental studies on the remarkable properties of radiation emitted by fast charged particles moving within matter have been carried out during the last 25 years. Even as early as in 1934, S. I. Vavilov and myself communicated two papers to the Dokladi Academy of Science[1,2], USSR, in which it was shown that γ-rays from radium immersed in fluorescent solutions, impart a weak luminiscence to the whole solvent. In those papers were described the universality of this radiation, its unusual property and we came to the conclusion, on the basis of the properties studied, that the luminiscence could not be fluorescence. Further experiments established the fact that this radiation is produced by γ rays and by fast electrons created by them during Compton scattering. Attempts to generate under the action of X-rays (hv max-30 K. E. V.), a radiation having such properties were unsuccessful.

It was shown that the weakly luminiscent property of the liquids could not be of any special importance, because this luminiscence, not only of the solid body but also of the liquids — subject to very different causative agents — was a widely encountered phenomenon. Besides the well-known classical examples of luminiscence, we may mention the weak luminiscence of (practically) very 'pure' liquids observed under irradiation with *ultra violet* rays[3]; many liquid substances turned luminiscent under the action of X-rays[4]; luminiscence of liquids also appears under the action of ultrasonic waves[5]. Numerous facts on luminiscence of fluids as well as of solids caused by radioactive emanations were known even in the days of the original works of Pierre and Marie Curie[6].

Luminiscence of this nature is indeed generally fluorescence and in case of the so-called 'pure' fluids, it is due to the presence of very small (infinitesimal) quantitities of impurity capable of luminiscence. Hence, it was naturally assumed that the luminiscence caused by γ-rays was also a phenomenon of the same nature. Such was the conclusion of Pierre and Marie Curie who, undoubtedly, first observed this phenomenon, although under conditions when it was very much veiled by ordinary luminiscence. Other observers had also studied it afterwards. One of them Mallet[7] had not only observed but also photographed its spectrum.

A comprehensive study of this radiation revealed a number of noticeable properties which showed undoubtedly that it was no ordinary luminiscence but a phenomenon of a completely new type. It seemed to be of great interest both as regard to the theoretical principle and the possibilities of practical applications.

It would, however, be wrong to presume that the characteristic phenomenon had not been explored much earlier through an accidental 'oversight'. The unusual nature of the phenomenon detected could be established only as a result of the quantitative measurements of the most important characteristic properties of radiation (explaining its dependence on definite conditions altered within the experimental process). At present, when we have at our disposal powerful sources of charged particles and very sensitive registering instruments, such measurements are not particularly difficult. But several decades ago, the physicists were in no such favourable situation. They could use only natural radioactive preparation as sources of charged particles. The intensity of such sources was very low. Hence the brightness of the luminiscent fluid*, obtained by such means, was so very weak that it could be detected by an observer only after he stayed for some time in complete darkness. It is obvious that under these conditions, the usual methods of photometry for quantitative measurements cannot at all be used. A newer and much more sensitive method was necessary for such measurements.

In the Institute of Physics of the Academy of Sciences, USSR, where this phenomenon was discovered, such method was known. This method of visual photometry by means of threshold vision — in other worlds, the 'method of extinction' — had been worked out not long ago by E. M. Bromberg, and S. I. Vavilov for quantitative measurements of the quantum fluctuation of light[8]. In this method, the human eye was used as an apparatus for registering the light. Because of the fact that the photo-sensitivity of the eye adapted to darkness in the extreme case is ten thousand times higher than the sensitivity during diurnal vision, this method was superior to other methods (because of its high sensitivity). Irrespective of the subjectiveness and comparatively large errors of measurements, at that time, this method was the only one suitable for quantitative measurements of such extremely weak radiation. It is essential to appreciate that quantitative measurements permitted the explanation of the unusual properties of the obsered radiation and at the same time to establish its peculiar origin.

It has already been noticed above that the first very probable hypothesis regarding the nature of the radiation was the assumption of luminiscence. The correctness of such an assumption could be verified only by means of experimental clarification of the presence (or absence) of the radiation observed and its characteristic luminiscence. There exists, however, a very large number of different types of luminiscent phenomenon differing amongst themselves as regards the nature of excitation, the range of radiation, character of spectra, the properties of luminiscent substances and other indicators. It is obvious that in the given cases the important thing is the presence or absence of all the various

* The study of this effect was chiefly carried out with fluids because they could easily be purified and thus separated from luminiscent impurities. While working with them, parameters such as viscosity, refractive index, density etc., change more easily. Besides, in this case the experiments on the 'extinction' of luminiscence become remarkably simple. Let us remember that photo-magnification had not been developed at that time. On the 'method of extinction' which is of historical interest are based of the following properties of Corpuscular (this means vision in semi-darkness— Translator's note) human vision : (a) the presence of a threshold of vision, (b) the constant value of threshold vision for one and the same observer (for standard observers).

general indication of luminiscence which would indicate its nature.

One of these indicators of luminiscence as was noticed by S. I. Vavilov is the finite life-time (greater than 10^{-10} sec). of the excited state. This property of luminiscence permits us to exert an external influence on the process of radiation. One man, for example, significantly weaken the brightness or as it is said, 'extinguish' the luminiscence either by heating the luminiscent solution or by dissolving in it other substances capable of extinguishing the luminiscence. In both the cases, the weakening of the luminiscence occurs as a result of conversion of energy from the excited particles into heat.

Accurately speaking, we can thus alter the polarization of the luminiscence by changing the mobility of the particles, for example, by heating. Significant experiments indicated, however, that the radiation from the fluid does not change its brightness either by heating it or by dissolving in it such active exinguishers of fluorescence, as potassium iodide, silver nitrate and others. Hence it was shown that the polarization of this radiation which has been discovered does not undergo any change. It is necessary to note that experiments with quenching agents of difinitely fluorescent solutions (for example, the solution of esculin in water) carried out under similar conditions led in all cases to the detection of a remarkable extinguishing effect.

These results were an evidence to the practically non-mechanical process of the radiation and thus excluded the hypothesis of luminiscence. This conclusion found confirmation likewise in the unusual character of polarization of this radiation. A suitable direction of the vector of electric oscillation indicated a non-perpendicular excitation of the light beam which must have been the case for the polarisation of the fluorescence. On the contrary here it was in a parallel direction.

Thus the totality of the data obtained in the first step of the investigation permitted us to conclude that the radiation originating in the fluids due to γ-radiation is not trivial. However, these data turned out to be insufficient for propounding a theory of the phenomenon based on them. The solution of the problem came out only later after which, in the year 1936, very noticeable novel properties of the radiation were discovered. This is the directional property[9,10].

It was shown that the radiation has a sharply defined spatial symmetry. It moves forward only along a direction forming a certain angle with the direction of the beam of γ-rays. The determination of this fundamental property of radiation turned out to be decisive for the explanation of its true physical nature and for propounding a theory of the phenomenon. A very meritorius work on this has been done by I. M. Frank and I. E. Tamm[11].

In this theory, the observed radiation is interesting as a radiation of electrons moving uniformly within substances and having a velocity exceeding that of light (phase velocity) in this medium. It is interesting to observe that even as early as in 1901 Lord Kelvin[12] discussed the possibility of radiation emitted by particles moving with a velocity greater than that of light. Somewhat later in 1904-1905, simultaneously with the appearance of the theory of relativity, Sommerfeld considered theoretically a hypothetical case of motion of electrons in vacuum with a velocity exceeding that of light[13]. However, the

appearance of the theory of relativity, according to which material bodies cannot move with a velocity equal to or greater than that of light, discouraged the conclusions of Sommerfeld. It is true that this state of affairs, to a certain extent, served as the reason why the problem of the motion of charged particles in substances with a velocity exceeding that of light was generally not considered, because it would have contradicted the theory of relativity. The motion within substances of a particle exceeding the velocity of light need not, however, in any way contradict the theory of relativity. This is because of the fact that within a substance the velocity of propagation of light waves differs from the velocity of light c in vacuum and is $\frac{c}{n}$, where n is the refractive index of the medium in which the motion takes place. For visible light, n is greater than unity; therefore the velocity of such particles within a substance may be greater than the velocity of light $\frac{c}{n}$ within this substance, remaining at the same time less than c, in complete accordance with the theory of relativity. Thus the motion of the particles with the velocity exceeding that of light is not only possible in principle, but can also be realized experimentally.

Assuming that the velocity of the electrons moving within a medium is greater than the velocity of the light, one can also determine the conditions under which the radiation originates and find out several very important properties starting from a simple qualitative consideration. Actually the path of the electron is unifrom in the medium along the direction of the axis Z with a velocity V greater than $\frac{c}{n}$. At every point through which the electron passes, it will be subjected to electro-magnetic perturbations. Such perturbations propagate from the points as retarded waves. On considering the components of a definite frequency w for the wave emanated from the different points of the trajectory of the electron in a certain direction θ, one can easily convince oneself that in every direction, save that for which

$$Vt \cos\theta = \frac{c}{n}\, t \text{ that is } \cos\theta = \frac{1}{\beta n} \quad (1)$$ where

$\beta = \frac{v}{c}$ the waves aree xtinguished as a result of interference. In the direction satisfied by condition (1), waves reach the observer with an optical difference of phase equal to zero and consequently in this direction the radiation will propagate. In acoustics we have got the analogous case, namely, the so-called ballistic waves formed by projectiles or aeroplanes flying at a rate greater than the velocity of sound (Mach waves). The wake waves of the ship provide us with a very well-known 2-dimensional analogue.

From equation (1) which forms one of the most important results of the theory of Tamm & Frank, it follows that the radiation is possible only for the condition $\beta n > 1$ i. e., if the vellocity of the particles V is greater than the velocity of light $\frac{C}{n}$. For βn less than 1 or β less than $1/n$ the radiation does not propagate. Thus, the equation $\beta n = 1$ determines the energy threshould of the radiation.

The value of the energy E of this threshold depends on the refractive index n. Now it is obvious that the energy E must also depend on the mass of the particles because in the condition determining the threshould, we find not the energy E (directly) but the velocity βc of the particles. As an illustration, we are giving

a table below indicating the threshould values of E of electrons, π-masons and protons for three values of n.

The theoretical relation between θ, β and n expressed by equation (1) was experimentally verified. The results obtained were found to be in beautiful accordance with the theoretical conclusions. The scheme of the corresponding experiments for determining this relation had been worked out. The beam of γ-rays falls on the thin-walled vessel with the fluid. The radiation generated in this fluid while coming out strikes on conical mirror and is reflected back along the direction of the objective of photo apparatus. Now, luminiscence not having any asymmetric property assumes the form of a thick ring. But radiation emitted by particles having a velocity exceeding that of light, yields a form resemling two streaks inclined at an angle of 2θ.

Table I

Nature of particles	The values of threshold energies in mev.		
	n—1.2 β—0.796	n—1.5, —0.667	n—2, 0.5
Electrons	0.29	0.2	0.078
π Mesons	79	47	21.5
Protons	520	320	143

The angle θ can easily be determined. The value of this angle increases with the increasing value of n (refractive index) in such a manner as is expected from the theory. For the same fluid, the value of θ obtained in the experiments with γ-rays from Th C″, is greater than that obtained with γ-rays from Ra. This difference in the measurements of the angles in the case of Th C″ and Ra. permits us to make use of equation (1) for determining the effective velocities (Beff) of Compton electrons generating the radiation. These velocities turned out to be equal, to 0.896 and 0.847 respectively. This result is in complete agreement with the very high energy of γ-radiation from Th C″. The radiation must be propagated on the surface of a cone, the axis of which forms the trajectory of the charged particles and forming an angle θ with this axis. By means of a photo-plate, placed perpendicularly to the beam of rapid particles we must obtain, besides the image of the position of the beam, also the photograph of the radiation in the form of a beam.

Up till now, we consideted several definite values of the frequency ω. As a matter of fact, the radiation has a continuous spectrum. As the medium is dispersive, that is, the refractive index n depends on frequency, it means that light of different wave lengths must be propagated at angles θ, differing somewhat amongst themselves, even if the velocity of the particles remains perfectly constant. It seems therefore as if the radiation had a discrete spectrum. The surface of the cone of radiation shall, therefore, possess a certain thickness. Because of this, in case of media having normal properties, the red-end of the spectrum shall be situated at the inner part (of the surface) and the violet end at the outer part. This is actually the case.

Thus, the mechanism of radiation given by Tamm and Frank, even for a quantitative consideration, makes those very important properties comprehensible, namely the properties of direction, small range of glow, the presence of a threshold, and universality. A rigorous quantitative theory gives also the expression for the energy W, lost by the electron during the emission of the radiation. This expression assumes the form

$$W = \frac{e^2 l}{c^2} \int_{\beta n > 1} \omega \left(1 - \frac{1}{\beta^2 n^2}\right) d\omega \quad .. \quad 2$$

where 1 is the length of the path of the electron.

From this expression, it follows that the energy in the spectrum of radiation is proportional to 1/3, that is, it increases quickly at the shorter side of the wave length. However, in the domain of X-rays radiation must not occur because in this domain n is less than 1. The theory indicates finally that the light is polarized in such a manner as was found even in the first experiments. The vector of the electric oscillation lies in the plane passing through the rays and in the direction of motion of the particles.

All this shows that the theory considered now fully explains all the properties of the new radiation known up till now. This was obtained by a large number of investigations with respect to the discovery, all sided experimental study and the working of the theoretical basis-opening up a new direction in physics, the optics of radiators moving with a velocity greater than that of light.

Because of the absence of sufficiently sensitive and convenient means of registration, the new radiation at first seemed to be only of immense theoretical interest. While containing, however, a very great potential possibility of practical utilization, it remained quite useless specially in experimental physics. However, in recent years, in connextion with development of photo-magnification, radiation from rapid charged particles attained an important significance particularly in the domain of investigations on high energy particle physics.

In spite of the infinitesimally small intensity of the flash of radiation yielded by an individual particle, this intensity is now sufficient enough to be measurable. From formula (2), it follows that the number of photons emanated by the charged particles moving in the medium having $n \simeq 1.5$ and occurring at the visible part of the spectrum, attains "200 to 300 photons per centimetre." For correct choice of the form and position of the radiator (these are called the media in which the radiation of charged particles are generated and moves through) would be such that a significant part of this light can be directed to a photo-cathode of the photoelectron multiplier. As a result of manifold magnification at the anodes of the photo-multiplier there is generated an impulse of current which exceeds the initial current by millions of times. This impulse can be noted by means of a suitable electronic instrument and the particle becomes registered. Such a construction is the counter in which for the registration of the particles, the radiation emitted by them is immediately utilized (as a means of registration).

A counter of this type very much resembles the so-called scientillation counter in which for the registration of charged particles detected thus by means of a photo-multiplier, the luminiscence due to absorption of the energy of particles is utilized. However, in comparison with that it has the following number of essential advantages :—

1. Small range of time of radiation permits determination of the counter with a very high efficiency.
2. The presence of threshold radiation makes counters of this type insensitive for soft "up to threshold"

radiation. This property of the counters is particularly valuable for their use under conditions when there exists a significant background from soft γ-radiation.

3. As a result of the asymmetry of the radiation, it is possible by means of these counters, to register only such particles as move in the radiator along the direction towards the cathode of photo-multiplier. Particles moving in the reverse direction are not registered by the counter. In other words, the counter of the type considered has a property of directional action. This peculiarity of the counter was utilized by Winckler[14] for detecting cosmic rays in the upper layer of the atmosphere.

At present in the works of Jelly[15], Marshall and other authors a large number of original constructions of counters of the type mentioned has been described. The different type of properties of the radiation (often in combination with other methods) considerably expand the possibilities of physical experiments.

It is known, for example, that the determination of one of these important parameters of the particles — their masses—can be computed by means of measurements of their (momentum) impulse and velocity. Usual experimental difficulties are encountered while measuring the velocities. It is obvious that for the cases of the velocities of the particles when β (satisfying the condition $\beta n > 1$) already differ sufficiently from unity, the velocity of particles can easily be found from the equation (1) by measurement of the value of θ and known refractive index n.

In case, the type of particles is known, then the measurement of the velocities immediately permits the determination of their energy. This method gives particularly good results for the determination of energy of photon at accelerators, in the domain of energy of the order of several hundred Mev (Table 1) where the accuracy of the measurements of energy is upto 0.25 percent. It was already observed above that the presence of radiation of energetic threshold in the radiation makes of counter insensitive to particles of small energy.

Choosing a radiator with a suitable value of n, one can alter the threshold energy E. It is obvious that two counters with different values of threshold energy E_1 and E_2 chosen beforehand and included in series in the anti-coincident scheme, will register only such particles the velocities of which lie within limits determined by the thresholds E_1 and E_2. A similar method was successfully used by Segre *et all* in their remarkable work leading to the discovery of the anti-proton.

Another interesting use of this property (of radiation) was found in studying the wide showers of cosmic rays. While studying these with usual counters we find that at a certain height, only the particles formed by distant 'current' of the primary particles are registered. All other particles in the preliminary stages of shower formation and vanishing due to this set up, are not registered. However, as the shower particles have high energies, they are capable of producing in air, a radiation of the observed type, moving practically along the same direction. Under favourable conditions, this radiation may reach up to the earth and can be registered by a photomultiplier. This method gives a very complete picture of shower and enables

us to gain valuable information on the process of its origin.

For cosmology, the explanation of the following fact is of great importance. The composition of primary cosmic rays inside the atmosphere of the earth contains nuclei which are much heavier than the hydrogen nuclei. Suitable experiments on this line are now carried out in the sputniks. In these experiments was utilized the fact that the intensity of the radiation of particles exceeding the velocity of light is proportional to the charge of the particles. Hence the registration (by means of counters) of the impulses from particles of the same charge must differ in amplitude. The analysis of amplitude distribution permits us to obtain data on the distribution of heavy particles in cosmic rays as a function of their atomic number.

The latter—and I would like to linger on this point—is due to making use of the radiation of fast particles for determining their energy when this energy is very great. In this case, the measurement of energy of the particles by means of deflection in the magnetic field is no longer possible. One can, however, attempt to determine it by measuring the complete energy which the particle expands in the form of radiation of the type observed by us. For this purpose, it is necessary to use a very transparent dense radiator with a thickness sufficient for a complete development of shower. Water seems to be most suitable as a radiator for the purpose mentioned above. In the physics institute of the Academy of Sciences of the USSR the measurement of energy of cosmic particles by this method is being tried out.

The examples considered up till now show how important is the significance of the radiation from particles exceeding the velocity of light in experimental physics. However, even this is far from being an exhaustive list of all the possibilities of the practical uses of this radiation. In future, undoubtedly, the field of its application will quickly expand.

References

1. P. A. Cerenkov, Dekladi Acad. Sci. 2, 451, 1934.
2. S. I. Vavilov, ibid, 2, 457, 1934.
3. S. I. Wawilow and L. A. Tummermann, Z. S. F. Phys. 54, 270, 1929.
4. Z. S. Newcomer, Jour. Amer. Chem. Soc., 42, 1997, 1920.
5. Z. U. Frenzel and Z. Schultes, Z. S. F. Physics, Chem. 27, 421, 1934.
6. Madam Curie, Eve Curie, 1941 (London)
7. M. L. Mallet, C. R.; 183, 274, 1926; 187, 222, 1928; 188, 445, 1929.
8. E. M. Bromberg and S. I. Vavilov, IZV. AN. OMEN Series, cp., y II, 919, 1933.
9. P. A. Cerenkov, Dekladi Acad. Sci. 3, 413, 1936.
10. Idem, ibid, 4, 99, 1937.
11. I. E. Tamm and I. M. Frank, ibid, 4, 107, 1937.
12. Lord Kelvin, Nineteenth Century, Clouds over Dynamical Theory of Heat and Light Phil., Mag., July, 1920.
13. A Sommerfeld, Gotting, Nachricht. 99, 363, 1904; 201, 1905.
14. J. Winckler, Phys. Rev., 85, 1085, 1952,
15. J. V. Jelly, Cerenkov Radiation, 1958.
16. R. L. Mather, Phys. Rev., 84, 181, 1951.

SCIENCE AND CULTURAL VALUES IN INDIA A HISTORICAL ANALYSIS

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Abstract

Science represents the cutting edge for the human advance into an unknown future, technology its widening and concretisation, while culture represents the stabilisation of the two, in a dynamic equilibrium, in a particular period of human evolution. The nature of the advance made is not independent of the other two, in fact is directly dependant upon them, the other two in turn are equally dependant upon each other as well as upon new ideas, however utopian they might be.

Science and technology in India was introduced by the British alongwith their political domination and consequently it had some of the characteristic social features, i.e. including technological as well as cultural, of British life and thought. The impact on Indian mind was of three types :

(1) British were enslavers, they and everything they introduced must be opposed by every patriot.

(2) British represents a superior culture and they must be copied.

(3) The basis of British civilization represents a new approach to life and therein lies the hope for the future emancipation of India.

The third type represents an appreciation of science and technology, by about the middle of 19th Century and later around Delhi, and is evident from the poems of *Ghalib* and his younger contemporary *Hali.* They advocate a new intellectual approach to problems of every day life. It is not an insignificant fact that *Ghalib's* visit to Calcutta was perhaps, the beginning of this impact, as it was there that he saw the nature of western civilization and the impact it had created in over hundred years.

The complete Association of science and technology with beaucracy, on the one hand and the patriotic sentiments soon reduced this awareness to nothing or very considerably limited it socially. The consequent development of science and technology in India suggests its continued separation from the movement of social change, as against the western tradition, and hence cultural values. We in India have an antiquated philosophical outlook and a caricature of cultural values on the one hand and instruments of mass dissemination which we use without knowing the purpose and the end for which these should be used. The intellectual and cultural chaos is the result and is effecting every aspect of our life.

The paper discusses the historical development which have lead to the present and are peculiar to India.

The breath-taking changes brought about by science and technology in our own times have bewildered many. Their tempo and character has created awe in those, who, used to imperceptible and slow changes, took for granted much which they had inherited. "Everything," including human society, to borrow the words of the 5th century B. C. Greek philosopher *Heraklitos*, "is in a state of flux", or to express it more poetically as

has been done by a Turkish poet, *Nazim Hikmat* :

"The wind flows and passes

The same cherry branch never swings twice in the same wind"

We now know that it is not the same cherry branch either !

Science by challenging the commonly accepted views and values, by attempting to modify them, through critical analysis and to bring them in line with the present scene, has frightened many and created in them a certain antegonism towards it. This antagonism is either due to fear of change and resistance to it, or because of a real concern with human ideals. The former is due to containment of science and its outlook to a small group of its votaries, leaving the vast majority to think in terms of obsolete knowledge and be guided by those traditions, which codify it. The growth of specialised knowledge, and the limited effort made to popularise it, has further reinforced the reliance on tradition. People unable to comprehend the changes taking place around them, and the forces bringing them about, have no alternative but to rely upon the obsolete but 'sure' standards which they have inherited and which had guided the lives of their forefathers. Surely, they seem to think, what had been good for their forefathers could not entirely be had for them. Consequently unable to overpower the circumstances, and lacking the confidence to meet the changes they see in them only an attack on their 'sure' and established mode of life. Their fear and resistance is comprehendible.

Those who are concerned with human perspective and ideals look at science with consternation for the following reasons :

1. The high degree of specialisation has produced a narrow outlook amongst scientists which has laid them and their knowledge open to much abuse by adventurers. The non-immediate and wider issues of human life have suffered in consequence.
2. Science by investigating 'material things' has given man weapons which have intensified his lust and greed. This in incidently is not new. Pliny, for instance, remarking the possibility of the journey from Red-sea to the coast of Malabar and back in less then a year through the discovery of monsoon by Hipparchus, says that so close has "India been brought by greed "!
3. Science by its researches has given unlimited power to man to cause harm to himself and much destruction. This has increased rapidly since the 14th century, when "that horryble instrument of Gonnes" was invented by Bertholus Schawartz, to our times when nucluear weapons, capable of destroying the whole world, have been developed.
4. Science by its discoveries in the sphere of human welfare has not solved any basic problem, but by its purely material solution has intensified the very problems it was supposed to solve, and created a few more in the bargain.

It is, therefore, argued by some that unless science is tempered by cultural and moral values it is bound to lead mankind to destruction. In justification of their view they point to the developments in Renaissance, when Scientists imbued with christian teach-

ings of evil and good, thought man to be "sinful" and actively withheld from him "Secret invention" which they thought would give him power to cause more evil*. There appears to be some truth in these arguments and some justification for them can be found from historical data.

An analysis of these arguments, however, suggests that, firstly their protoganists consider the division of science and cultural values to be fundamental. The limitation of science to the pursuit of purely materials wants, which these people consider as fundamental to science, on the other hand is a product of the wider acceptance of the theory of utilitarianism. There has been, for instance a movement in France which sought to combine Artistic attainments with the new industrial products or military requirements. Budget (1622-1694) for instance, as has been pointed out by Nef, refused to drop artistic decorations from naval warships when suggested on basis of utility or costs. In fact on the continent, particularly France, this effort to make industrial product artistic was a part of a general movement, and its failure was not due to science and technology but to other factors.

Secondly such arguments also overlook an important limitation of science in our times, that of its contrainment to a small group of educated class. It has serious consequences, on the scope of science, its character and structure as well as on its outlook. It has reduced science and its role as a social movement to a mere profession. The early scientists working in their humble, workshops were social revolutioners, technical experts, industrialists and promoters of art and literature, but slowly each of the field separated and scientists and inventors became mere appendages to investors or politicians. It affected science in such a manner that with the increase in its social role and importance the circle of those who could comprehend it shank, till it became a respectable academic discipline with only limited efforts to popularise it. Consequently, what started as, and essentially is, a part of the general cultural movement came to be looked upon as separate from it as having evil consequences upon it.

The contention in this paper is that science and culture are, not only a part of the same process but also strive towards the same end. They both increase our awareness of human potentiality, assert human dignity, courage and faith to face circumstances, guide us to change them, and control the change in the direction we desire. The dynamic equilibrium of science and culture is a complex which gives a historical period its characteristics. Science, in this complex, represents the cutting edge of human advance, technology its widening and concretisation and culture its deepening, refinement and stabilisation.

The main reason for this contention is the historical fact, often overlooked, that the periods of scientific developments have also been the periods of great literary, artistic, social and ethical developments in early civilizations of Egypt, Mesopotamia, India, China, in ancient Greece and Renaissance in Arab countries and in Europe. This could not have been otherwise, because human vision and human energy as it regrouped round a new idea or concept is unshackled and liberated cannot be contained in narrow spheres. The unity of outlook and endeavour in each

* John U. Nef Wor and Human Bigrest Harward Unio Press, 1950.

of these periods as reflected in literature, poetry, drama, arts, painting and sculpture, social movements of reform and utopian dreams, scientific and technological attainments and in ethical and moral quests, is part of the same promise of realising human potentialities. To quote in support of this contention an early and zealous advocate of Science, Francis Bacon.

"The true rule of religion, that a man should show his faith by his works, holds good in natural philosophy also. Science too must be known by works. It is the witness of works rather than by logic or even observation, that truth is revealed and established. Whence it follows that the improvement of man's mind and the improvement of his lot are one and the same thing". (Cognita et visa).

And it is this pursuit that gives power to man over nature and confidence to conquer it, extend this control and victory to an ever increasing number of people and make it more deep as a part of human experience.

In looking at historical data in this way, we should neither exaggerate the aberrations nor be dismayed by the fact that the highest and finest of human visions have not been realised in their entirity and purity. Their incompleteness, or debasement, if one likes to put it that way, reflects a human process, calling for renewed effort to attain them, for their reshaping and restatement in terms of the changing social scene. An objective or ideal as it is being achieved, is left behand, human life itself advances beyond it, making it obsolete in the process of achieving it. As a 19th century Urdu poet Hali has said:

(After reaching the good we search for the better. Let us see where the human vision will now take us)

In this search we need not be deterred in our endeavour of making value judgements by the short term nature of our results and the transient character of scientific theory or the truth arrived at.

Who can say that is ultimate good or evil. We mortals can see only a little ahead, just a little ahead, and based on this dim perception of the future make a choice, from amongst the alternatives before us for our course of action. The main feature of the choice lies in the vision of the future and a critical evaluation and essessment of our capabilities and potentialities. Science does offer mankind a tool of unprecedented value in this critical analysis. The value of the tool lies in the specification of the conditions under which it arrives at a solution and the technique adopted, thus laying the conclusions open for others to confirm, modify or refute. There is nothing sacrosanct in science, the humblest of the worker can challange the mightiest. Everything can be doubted and this spirit of doubt and skepticism, which breeds heretics, is the fountain and source of science.

This attitude has also placed the entire responsibility of human decisions, their consequences and actions, on man himself. In doing this it has developed a spirit of judicious appraisal in man. Weiss has pointed out recently that the power of Science arises out of strict mental discipline and critical detachment, and practising of this code can be satisfying. It gives purpose and content to a span of life, and a "responsibile and judicious self-direction as a design for living, and in this choice, the scientific approach can help him to avoid predictable disastrous turns and mishaps.(1)". The vision of future may vary from individual to individual and society to

1. Prof. P. weiss, Message of Science, vide Nature 184 (1959) 295

society but it is often limited by what man has achieved. Science by refinement of life, and added power it has given to human faculties, has made man a visionary of a new order, has brought new experience to him and has also made it possible for every man to feel this experience. From the time of ancient Greece, when slavery was a part of social and cultural life, even through Greek culture represented noblest of the human values, to our own times, when slavery has been abolished the concept of equality of man realised and the dignity of all men asserted in practice, the change has been, marked and achievement considerable inspite of all limitations. This has been made possible primarily through scientific and technologic inventions which did away with the social necessity of a lower caste of men to give time and leisure to the higher caste for pursuit of contemplation and creative effort. But science by itself would not have been able to achieve, had it not been a part of the complex to which we have referred earlier. Perhaps it was this realisation of the role of science that made *Omar Khayyam* say in a period when mysticism had much sway:

"Of my base metal may be filed a key
That shall unlock the Door he (the
Dervish) howls without."

The division between science and cultural values in the form in which it has come down to us is a part of Victorian heritage. The roots of course go back in history. Donne, the seventeenth century poet, for instance, gave expression to his reaction to the early advance of science which resulted in the displacement of the *Four Element Theory* and the *Ptolemaic geocentric system* in the following words :

"And new philosophy calls out in doubt;
The element of fire is quite put out,
The sun is lost, and the earth, and no
man's wit.
Can well direct him where to look for
it."

The reaction of Tennyson to the Darwinism theory is :

"Not only cunning casts in clay,
Let science prove we are, and then
What matters science unto men,
At least to me ? I would not stay
Let him, the wiser man who springs
Hereafter, up from childhood shape
His actions like the greater ape
But I was born to other things "

The reason for this reaction had social roots and has already been referred to earlier. The dichotomy between science and culture, which we have inherited, as a basis of our outlook was a consequence of this reaction.

The division is artificial can be seen from an analysis of cultural values and what they assert in the human context. Cultural values of any period, besides science and technology, comprise of literary and artistic social and ethical values. In all the three fields, as a recent art critic Berger has pointed out, for the artistic sphere, the expression is "part of a promise and an increase in the awareness of our potentiality implying action and desire to change." It could be an expression of physical dignity as in Greek sculpture, moral courage as in Rembrandt or sensual awareness as in Matisse. Commenting on the work of El-Greco, Rembrandt, Watteau, Delacroix & Van Gogh, he says, "These artists suggest that man in one way or other is larger than his circumstances and so could change them."[1]

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(1) John Berger, This Century, New Statesman 11th July, 1959.

The assertation of physical dignity by Greek artists, for instance would not have been possible, in the way it was made, without Greek achievements in geometry and it is so thoroughly imbued with their geometrical ideas and outlook, that even where it seems to break away from it, it does so only in their context. What is true of this field is also true of the social and ethical spheres also. Seen from this broader perspective we find that social and ethical problems of a culture seek a solution in terms of the scientific developments of the period. The scientific developments, on their part, represent a part of the human assertion to control the environment.

This unity of science and cultural values has been the theme since earliest times. It is the theme of the Latin poet *Lucretius*, and in India of one Urdu poet *Hali*. There is an essential similarity between two poets as to the times they lived. *Lucretius's* time was turbulent, there was a disastrous plague in Athens (430 B. C.) and was a period of mad ambition and class war. The times of *Hali* was a time of national defeat in cultural and moral terms as well as on an individual and social plane. *Hali* was a witness to the events of 1857 at Delhi and suffered personally. Like *Lucretius* he sees the salvation in science. Science for him is not the truncated purely material science, but one which implies the unity of human aspirations. To quote the words of Munro for Lucretius ;

> "The aim of the poet through out is not so much purely seientific as practical and moral. His main object as he tells us again and again, is to free men's minds from the yoke of superstitious fears by displaying to them the aspect and the laws of nature, and this is why he argues with such earnestness against the immortality of the soul and denies the interference of the gods in human affairs."

Hali incidently, had also the same difficulty in Urdu for expressing the scientific ideas, which Lucretius had in Latin, and he uses English words such as mechanics, original, chemistry, public, republic etc.

Before we discuss *Hali* in greater detail it must be necessary to mention that we cannot understand him fully without reference to *Sir Syed* and *Raja Ram Mohan Roy*, and his elder contemporary poet *Ghalib*.

Ghalib went to Calcutta and saw there the impact of British over a period of a century, and this had a considerable effect on him. He was known for brevity and difficult expression but gave ample evidence of the conclusions he drew. In a poem written for *Akbar Nama*, at the instance of *Sir Syed*, he describes the achievement of Western civilization in which steam and mineral coal as a source of fire and power have a special significance. Elsewhere, with his characteristic poetic beauty he says :

> "Fire may change once again our fortune for the better
>
> Otherwise our civilization is like the *thron* the bane of the garden"

This is a clear indication of the direction in which he looked for future salvation. And, perhaps, having faith and confidence in his judgement, inspite of his old age and the personel suffering that he had undergone in the wake of 1857, he prophesies :

> "The dark night is the pointer to a bright morning
>
> The candle as it burns to its end is a pointer to the bright sun which is to rise soon "

What *Ghalib* said in a few verses *Hali* seems to explain it at length.

Hali (1837-1914) made a detailed analysis of the decay that had set in the civilization in *Musaddas* and presents his diagnosis in the appendix to his long poem. He says ;

Learning had decayed to such an extent that the guesses of the ancients have now become sacred texts. They hardly know anything but a few scraps that have reached them from generation to generation. Their teaching is hardly anything but teaching to a parrot a few words they know and also make the next generation like themselves. The followers of the philosophies of *Shafa* and *Mujasta*, or Aristotle or plato, are like the *Teli ka bail* which goes round and round without making any progress.

Being a devout muslim he seems to be pained at the adherence to Greek learing in preference to sacred texts and talks of stagnation of learning in the following words:

The Bible, old and New Testament and the Koran all put together can be discarded or forgotten, but not a comma of the laws laid by Greeks can be, and as long as this world is in existence not even a dot of these would change.

But unfortunately the results of Western Science and learning, which are before us in India for the last hundred years cannot be understood due to prejudice, which prevents us from seeing the truth. We are so ensnared by Aristotle's methods that we have no faith in our own vision.

Talking of the effects of the decay of this knowldege on social and economic life he says: That even if they were to stitch a cap for themselves then they have to go to west for cloth and the needle. They are dependant upon others on everything, in the wake of mechanics they are uprooted.

If the goods from West do not reach them the craftsmen and trader alike would have nothing to do. They are all dependant for their livelihood on others.

And in Memorable lines for anytime he describes the role and power of science thus:

It was a precious jewel but none had tested it so far, all its functions were thus a matter of belief, none knew the powers it had. But now the ocean and the earth are all proving that science has the power of the hand of God.*

It has levelled the mountains, made oceans a market place, the stationary stars have been turned into planets. It has used the steam as a source of power and given dolls the power of man.

It has enabled us to use mineral coal as fuel for the planes to travel on earth, imprisoned sounds into moulds, forced earth to bring out its treasures. This has made lightening the messenger of man and enabled man to fly without wings.

It is the builder of civilisation, spearhead of progress, instrument in the hands of craftsmen and a weapon in the hands of fighters. It has humbled the brave and lionhearted.

He ends up by saying that a nation which eschews labour, considers professions and crafts as low trade a difficult proposition, and who seek easy comforts as well as respect will meet their doom today if not yesterday. And finally, that it is the lesson of the sacred book that humanity is one and the help and

*According to muslim mythology God created the world with a movement of his hand.

sympathy of one man for another is alone the faith, religion and prayer and service of God.

We have given these extensive quotations from *Musaddas* to place before you the breadth of his vision to emphasise the unity of science and culture to which we have been referring. This was just about hundred years ago, and at a time when India was conquered by aliens. As contrasted with the attitude of Tennyson it is a great thing to see through the national prejudices and realise the core of a new civilization and requires great moral courage to state it in the way *Hali* stated it. And it is beautiful poetry,

This intellectual realisation was in fact a part of a general cultural reappraisal following in the wake of defeat and the impact of European thought on India. One aspect of it was the thirst for knowledge which lead to extensive translations, and the formation of societies for discussing science. The societies were established in Agra, Bareilly, Badaun, Aligarh, Delhi, Roorkee and other-places. The centre at Roorkee was called *Native Masters Association* and was responsible, like other centres, for a number of translation from English, of Scientific and engineering books, into Urdu, from amongst others, by its zealous kayasth teachers under the guidance of Ustad Behari Lal. *Hali* himself acquired much of his outlook at Lahore where he was employed to correct Urdu translations of English books.

The other aspect of the impact was through the efforts of English engineers who in the course of digging canals, setting up of workshops, laying railway tracks, erecting electric installations and carrying out other types of constructions came up against problems which necessitated research and application of research. The result is recorded in Indian Engineer's, Professional Papers, which makes interesting reading even now.*

The two streams, viz., the British scientific and technologic efforts and the ferment it produced on Indian mind had they coalesed into one would have produced a general cultural revival, and would have made science a social movement as was the case in the West. As it was, that was not to be. The result was a sharp division which in our opinion is the basis of the gulf between science and cultural values in our own times, resulting in the dichotomy of our outlook with disastrous consequences to science as well as culture. The reasons for this division are mainly :

1. Association of Science with the conqueror and the uncritical opposition to every thing brought by them.
2. Containment of science to only those problems which helped the British in their domination of India.
3. Introduction of English as a language of science.

The first created a hostile attitude towards science, which was looked upon as a part of instrument of oppression and in opposition to the older learning in India, in content, philosophy and values. Science by virtue of its method of investigation, its doubt of everything old and established, and its attack on medieval outlook and philosophies, aroused special distrust and became the

*It is rather unfortunate that most of these translations and Professional papers are being destroyed through neglect at Roorkee University, Library.

main target of attack, of revivalists and social reformers. In the twenties of this century when national sentiments had asserted themselves and some thought was given to education, when boycott of everything British, including education was organised, science did not find any significant place in the national scheme of things. The nationalist centres of education, like *Jamia Millia* at Delhi, became centres of revivalism rather than centres of a new outlook in which science had a prominent part to play.

The containment of Science by the ruling power prevented it from becoming a part of social movement for change as it was in the west. The British guided by their economic interests and political exigencies actively opposed the establishment of industries by the Indians, such as those by the Tatas and others. This meant that science and technology could not get a broad based support, and limited it as a discipline in few centres of education under their direct control. The liberating role of science and technology could not be felt by the people through the growth of industries and the consequent attack on age old problems of India. The Indian people suffered terribly through competition supported politically by the conquerors, ruin of Indian craftsmen in the wake of machanics as *Hali* put it is a sad reading and in contrast to Europe there was no relief through the establishment of new industries. In addition to this new suffering the age old problems of draught, floods, pestilence epidemics—the so called natural calamities continued to add to the cup of suffering. Nothing gave the Indians hope, but many preached the virtues of prayer to gods or to suffering in silence or patience, and to wait for the day of deliverance. This strengthened the outlook of man being a victim, a prey of natural phenomena and circumstance, as against the role of science in trying to stress that man is larger than his circumstances and can direct and control his future. Indians, therefore, not having the confidence in the present did not look forward to future but to the past, which, the farther it receded the rosier it became.

The introduction of English as a language of Science completed the process of isolation. English came in the way of the illeterate craftsmen, who knew technically a lot about their craf s, from taking advantage of the new literature about their crafts and thus work for their improvement. It stopped the movement of translation which was becoming widespread and consequently uprooted the new ferment and the affect it was making on the minds of the people. Lastly it laid open the field for a free ride to the revivalist attitudes which appealed to old values, outlook and philosophy and helped them to retain a wider following. In our own times the lack of development of regional language as a medium of scientific expression on the one hand and the difference between English journalism and that in regional languages, both in expression and outlook, reflects the results of this policy.

The net result of these policies and development has been that science could not attain a wider base, and become a social movement of cultural change as was the case in west. It was restricted as an academic discipline in colleges. The vast majority of the people remained ignorent of its development and the benefits that could accrue through its promotion. Its introduction, in the manner it was, also broke the continuity

of the national movement of the growth of science and technology. The earlier developments were looked upon as precious and their modern refinements and further progress with distruct. Those who studied science were specially looked down upon as "natury i. e. followers of nature, as antigods and athiests, besides compromising the national sentiments by having Western education for serving the aliens. Sir Syed, Hali and their followers were all "*naturies*" and there was a vigorous and vicious campaign launched against them. The admirers of Science and technology could not fight back as they had no broad based support, nor there was any economic movement to back them as was the case in West. Further in the West the attack on science was directed only by the church, whereas in India it was a mixture of national and patriotic sentiments appealing to religion and cultural traditions of the country. The advantage with the opponents of science was also that the barrier of language prevented the protagonists of science to take their message to people, whereas they could fully utilise the regional languages with all their emotive force in their service.

The net result was that science in India came to rely upon the administrative machinery of the foreign rulers for its support and sustenance and further isolated itself in the process. As some of the features following this set up have been discussed elsewhere, these need not be discussed here[1]. This antagonism against science and technology got the upper hand in the national movement for liberation with Gandhiji's leadership and the evolution of Gandhian outlook and philosophy. Gandhian movement was essentially a reaction against the inhuman aspects of industrialisation under capitalism. It was an effort to discover a solution of the ills of modern society in the human context as well as in terms of Indian traditions and values. It erred in associating science and technology with the social features which capitalism had imposed upon it, and hence sought to impose limits on it. The net result of these developments was deepened the widening of the gulf between the social and cultural values and science and technology. The association of patriotic sentiments with revivalist tendencies went a long way to cloud the issues and role of science and technology in social and cultural regeneration. In the wake of scientific and technologic developments and the benefits to man accuring from them it was grudgingly accepted with the limitation of its role to providing benefits and curbing its evils through a reassertion of ancient Indian cultural values. What these values were and how they were to control the evil influence of science none worked out. The message of *Hali* was forgotten. The other effect of this division has been admirably expressed by Bernal :*

"It is inevitable that in science as other aspects of life the Indians should feel the need for self assertion, but this attitude is always an uneasy one and has led to a mixture of submissiveness and arrogance that between them inevitably affect the quality of scientific work. Indian science is noted at the same time for the originality of many of its conception and experimental processes, and for the extreme unreliability and lack of critical faculty in carrying out the work itself".

(1) Government and Science in India, Vijnan Karmee Oct. 1958

* J. D. Bernel, Social function of science, p. 208

In the broader field it has resulted in the vascillation between uncritical acceptance of Western tradition of science, without discarding the social frills, and in the same way an uncritical assertion of revivalist ideas. The wholesale borrowing of ideas of organisation, commercialism and other superficial and transeint features has done harm to science as well as other cultural aspects. The assertion of revivalists, ideas as a reaction to this expresses itself sometimes in a very amusing way such as the division of art as modern and oriental and the efforts to promote both. Such an expression, to say the least, represents the superficial understanding of the role of art. Perhaps some day we could have Indian Science also like the christian science.

The first serious effort to link science with the regeneration of social and cultural life came under the leadership of Pandit Jawaharlal Nehru, when he formed the National Planning Committee(N. P. C.). It was a new pattern of thinking and was opposed by the old guard in the congress as it meant the utilisation of the techniques of science in social life. This represented the first break through of science in social life, and an effort to put an end to its isolation. The break through, however, was from top and not as a result of the intellectual or technological developments of the country, as was the case in the West. This suggested to begin with, that science in India would not have to fight the intellectual battles for creating a new outlook and new culture as was the case in the West. But to arrive at such a conclusion would be a hasty step particularly in view of the strong Gandhian under eurrent, prevailence of illetracy and continuance of obsolete ideas and concepts as guides to action. In addition to this there are two more factors which have to be taken into account. Firstly science as it taught in the University, which have shown a decline in standards in recent years, is not a mode of thought but as a profession to equip people for a career. Consequently many of the scientists are scientists only in the laboratory, outside which they are guided by an obsolete philosophical outlook and cultural tradition. Secondly the emotional association of the vast majority of the people is with pseudo religions theories, dogmas and the cornified tradition, with the result that they could be mobilised at the slighest pretext, against a well meaning move to secure the future, by the vested interests. The present developments of industries or agricultural schemes have broken the crust of the ossified tradition and is developing a new awareness but there is much skepticism and it may take some time for this to be a part of cultural tradition and basis of a new outlook. The indications are that India is moving towards a reappraisal of its values and concepts and perhaps in the turmoil of the reappraisal, the intellectual battles would be refought in India as they were in West, or perhaps the international pressures and the force of national developments would be so great that the torrent of Science and technology would just wash away the crumbling walls of the century old traditions without leaving a trace. But that has to be seen.

In the meantime this division of science and culture on the one hand and the lack of critical reassessment of one traditions has created a situation whose chief features are :

i. The national cultural regeneration has become the vehicles of revivalism.

A revivalism which emphasises only a form but looses sight of content.

ii. The prevention of science, through isolation, from a critical appraisal of the past to be the basis of value judgments and the guide to action.

iii. The instruments made available through scientific research have become the propagators of nothingness, or at least they are not the vehicle of of disseminating the outlook and methods for which science stands for.

iv. Science is not utilised to give direction to society and culture, i. e. is not the basis of organisation, it is left to anyone and everyone to utilise it for whatever purpose they like.

Looking at these features critically one finds in them an escape from the necessity of critical reappraisal and organisation based on this appraisal. This short coming could be due to just a lack of appreciation, or lack of confidence in science and its sweep, or perhaps a fear of revolutionary consequences of such an appraisal and action based on it. Perhaps it is due to all the three factors. It must however be remembered that the strength of science lies in the sweeping changes it has been able to make at times with full confidence in its method and technique. Its truth and beauty lies not in the knowledge of facts it has made available but in the organisation which it has been able to affect with the available facts. In the solution of our day to day problems, such as health and disease, shortages of goods, in meeting man made or natural calamities we look to science, why then should we limit it so. Why can we not extend it further to all those fields of which it is a part? The causes are historical. We hope we have been able to show the essential unity of science and culture as a product of human progress and causes of such a division in India.

"Remember", to quote the 19th Century scientist, W. K. Clifford, "then, that (scientific thought) is the guide of action; that the truth which it arrives at is not that which we can ideally contemplate without error, but that which we can ideally contemplate without error, but that which we may act upon without fear; and you cannot fail to see that scientific thought is not an accompaniment or condition of human progress, but human progress itself".

THE MYSTERY OF COSMIC RAYS

By A. Koltsov

A New Theory of Origin

Nine centuries ago the chroniclers of Japan and China recorded the flare of a star in Taurus Constellation. It shone so brightly that it was visible even in day time. Yet now a days a telescope trained at the spot where the bright star of Taurus once flared will only show a nebulous luminescance. Why has the star disappeared? An answer to this question has become possible only in our time when powerful means of observation of heavenly bodies such as radiotelescopes have been developed and when huge laboratories have been rocketed into outer space.

At the beginning of the 20th century, it was discovered that streams of invisible, mysterious rays from the depths of the universe penetrate our atmosphere, travelling at a speed nearly equal to that of light. A considerable part of these rays is absorbed by the upper strata of the atmosphere, but their energy is so great that some of them reach down to the earth's surface. Scientists had long racked their brains over the nature of these rays before they established a direct connection between these rays and the Chinese and Japanese records about the extraordinary flare in Taurus.

Radiotelescopes have revealed that the nebula which originated in place of the star is radiating a powerful stream of particles with energies amounting to billions of billions electron volt.

A number of hypotheses were put forward to explain this unique phenomenon. Two Soviet scientists, vitally Ginsburg and Iosif Shklovsky, Corresponding Members of the Academy of Sciences of the USSR, have developed a theory about the origin of these mysterious rays, which has been borne out by the measurements carried out by artificial satellites and space rockets.

Supernew Stars

According to the Soviet scientists, these rays originate in the explosions of new and supernew stars. These are stars of a special type which flare up, approximately once in three hundred years, dispersing the stellar mass over the universe. During this process the envelope of the supernew star swells out on all sides at an enormous speed—something like a thousand kilometres per second. New and supernew stars eject electrons into space, they emit radiowaves and may therefore be studied and measured with radio-astronomic instruments.

Having measured the number and energy of these electrons, Ginsburg and Shklovsky predicted certain properties of this radiation such as polarisation. Their prediction was fully confirmed by the instruments installed in space rockets. They counted up the energy of all cosmic rays. This was a decisive step towards disclosing the properties of cosmic rays.

But how do cosmic rays acquire such enormous energies?

When cyclotrons, proton synchrotrons and other particle accelerators were built to accelerate particles to vast speeds and consequently to impart higher energies to them, the scientists thought if the acceleration of cosmic particles as well did not take place

basically in the same way. The Italian physicist Fermi put forward an extremely interesting idea according to which the elementary particles in this "heavenly cyclotron" are accelerated by colliding with chaotically moving magnetized clounds of inter-stellar gas.

Radiation Belt Round Earth

Life on earth would probably look somewhat different if the stream of these high-energy particles were not dammed by the upper strata of the atmosphere. Bombarding the nuclei of gases in the upper strata, cosmic rays produce secondary cosmic rays: particles of the nuclei of gases, travelling at terrific speed, reach the earth's surface. That is why it is so important to study the cosmic rays from artificial satellites and rockets at high altitudes where these rays are to be found in their primary state and are not distorted.

The results of these investigations were unexpected : a rather intense radiation consisting of low-energy particles was discovered at high altitudes along with the primary cosmic rays.

When the statellites flew close to 55° of geomagnetic latitude, their instruments registered a fifty percent increase in the intensity of radiation. Yet ground stations detected no increase in radiation at that moment. It was clear thus that this radiation did not reach the surface of the earth but was confined within a certain zone around our planet and oscillated along the lines of force of the earth' s magnetic field. In this process the energy of protons within the inner part of the zone (at an altitude of 1,000 km.) becomes quite impressive : something like 100 million electron volt. Perhaps, it is precisely these streams of protons along the lines of force of the earth's magnetic field that cause the polar light s.

Now, what is the origin of this halo of charged particles around the globe ?

This problem holds the attention of scientists everywhere. But since too little time has passed since the discovery of this new phenomenon i' has not been posssible to come to a final conclusion about the origin of this halo. It can be said nevertheless that cosmic rays give rise to it : it is under their influence that the earth, like any other heavenly body, emanates neutrons. The latter shoot up as a result of the bombardment by cosmic rays of the atomic nuclei of the gases in the atmosphere. Possessing no electric charges, neutron pass through the earth's magnetic field and fly off into space, unimpeded.

Close to the earth, on the other hand, a portion of neutrons break up into electrically charged particles, electrons and protons, as a result of collision with the atomic nuclei of the atmosphere. Possessing comparatively low energies, these particles get "trapped" in the magnetic field of the earth.

On the strength of this, it is possible to venture a prediction of great moment to astrophysics : the same halo of particle envelopes every heavenly body which has a magnetic field. The properties of the cosmos essentially change, therefore, in the neighbourhood of planets, at distances many times greater than the diameter of a heavenly body's atmosphere.

Cosmic Radiation and Dinosaurs

There is another aspect of cosmic radiation that has great interest for us. In certain conditions, cosmic radiation can be

so powerful as to have a cataclysmic effect on the life on the earth. If, for example, a supernew star were to burst out relatively close to our solar system it would have a powerful impact on the Earth.

The envelope of the bursting and expanding star, gas, would gradually encompass the entire solar system, including the Earth. This gas would not deform our planet since it would be extremly rarefied; but as the gas would be highly radioactive, it could change life on the Earth in a radical manner.

Calculations show that such cosmic catalysms would have occured close to our solar system approximately once in a few hundred million years.

Some genetioists tend to believe that dinosaurs, whose skeletons can now be seen in museums, died out a few hundred million years ago because of a vast cosmic irradiation of the earth.

This is only an example of the fact that the study of cosmic radiation can lead to startling conclusions about phenomena on the Earth. The study of cosmic radiation has not only helped to solve the mystery of the disnosaurs, it is giving us deeper insight into the mystery of the structure of substances. Today, it would be risky even to try to predict the consequences of this penetration of science into the depths of matter.



DIESEL ELECTRIC LOCOMOTIVES FROM U. K. FOR DURGAPUR

One of the British-built diesel electric locomotives for use at the new iron and steel works in Durgapur being towed through the streets of Lincoln, England, at the start of its journey. These 30-ton shunters, of 230 horse power, are sturdily designed for hard work on the 5 ft. 6 ins. Indian gauge and will haul up to 1,193 tons on level tracks. Similar locomotives built by the same company are already handling tough haulage jobs at the £100 million Britist-built steelworks at Durgapur, as well as on works and docks in countries ranging from the Arctic circle to the tropics.

Science in the Nuclear Age:

IRRADIATION CHEMISTRY

By L. S. Polak,

Chief, Laboratory of Irradiation Chemistry, Institute of Petrochemical Processing, USSR Academy of Science

Irradiation chemistry is the latest development in chemical science. This new trend involves the use of nuclear radiations to stipulate chemical processes, to produce hitherto non-existent polymers and also to change their properties.

Though this fresh branch has not yet advanced beyond the stage of laboratory experiments in the Soviet Union, the results obtained to-date at the Institute of Petrochemical Processing, the USSR Academy of Science, are of unquestionable practical value. This very fact gives some ground to make some forecasts regarding its future application in the refining industry.

The time is not far distant when irradiation chemistry will occupy a prominent place in the chemical processing of raw materials. In a great measure it applies to petrochemical manufacture. The modern refining industry can supply only source materials for petrochemical processing. The present indications are that irradiation chemistry will furnish a means of processing oil directly into synthetic substances; plastics, drugs, alcohols, synthetic rubber, etc., so that the numerous stages of the existing refining technology can be eleminated.

New Polymers

Petrochemical processing already produces hundreds and even thousands of synthetic materials. But through irradiation technique there are possibilities of producing tens or hundreds of hither to unknown polymers with—what is most important—pre-determined properties.

Until quite recently polymers are considered as insulators having nothing to do with semi-conductors. However, results of experiments carried out at this Institute under the guidance of Academicians A. V. Topchiev and V. Kargin and the author have provided enough proof to repudiate this point of view. After they had been subjected to powerful radiations and additionally heat-treated, some polymers acquired the properties of semi-conductors.

Semi-conductors from oil gas. All attempts to produce controlled synthesis of polymeric semi-conductors which would supplant natural germanium, silicon and selenium, have met with failure. However, the laboratory of Irradiation chemistry has obtained a plymeric semi-conductor now. It is believed to be less "unpredictable" than, say, germanium. It is much easier to shape and more convenient in service. It has been decided to subject the new semi-conductor to engineering tests right in the laboratory. It will be made into thermo-electric cells for an infra-red spectrometer.

Irradiation Cracking

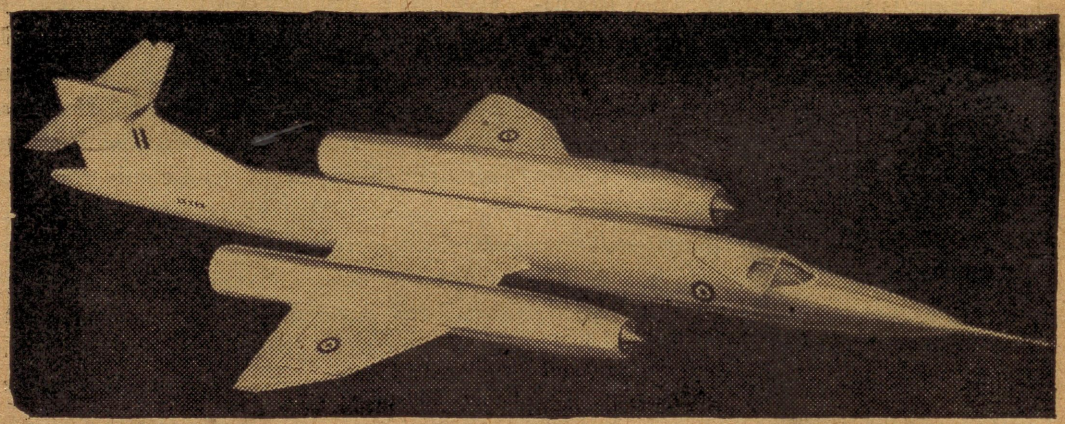
The laboratory is the youngest at the Institute. Among other projects, the research staff is engaged in studies in the irradiation thermal cracking process. This

is a fundamentally new process of oil refining and obtaining source materials for petrochemical manufacture.

The cracking industry is a huge manufacturing sector in the national economy involving millions of tons of oil annually. Therefore, even a small increase in the yield of products per ton of oil has a tremendous economic effect.

All conventional cracking processes rely for their success on high temperatures and often on catalysts. Irradiation thermal cracking needs a much lower temperature. This is a valuable factor in itself. However, what is more important is that irradiation thermal cracking yields four to five times more products at the same temperature, compared with conventional processes. These products are excellent source materials for petrochemical manufacture. Also important is the fact that irradiation breaks up oil hydrocarbons without the help of catalysts.

The high rate of the radiation-induced chemical reaction holds a great promise for the new method. But a very serious problem has yet to be solved—an efficient method will have to be worked out for the separation of the products obtained in the irradiation thermal cracking process. The Institute is confident that it shall be able to solve the problem and give the chemical industry the raw materials which will be much easier to separate. This will be a major victory for irradiation chemistry —the chemistry of the Nuclear Age.



NEW BRITISH STAINLESS STEEL RESEARCH PLANE

An artist's impression of the Bristol Type 188, a new British high-speed research plane capable of flying at more than 1,500 miles an hour, now under construction at Bristol, England, and which is scheduled to begin its first flying tests later this year. The aircraft, being built to the order of the Ministry of Aviation, is a mid-wing monoplane powered by two De Havilland Gyron Junior reheated turbojet engines mounted in wing nacelles. Built of welded stainless steel, it is intended for investigations into problems of extremely high speed flight. Entirely new techniques had to be evolved for the construction of the body to meet heating problems.

THE BANDS OF THE EARTH

Outstanding works in science and engineering are annually awarded with Lenin Prizes in the Soviet Union.

The works nominated for these awards are now being discussed in the Soviet press.

The following is an article by Prof. A. Lebedinsky dealing with the work of a group of Soviet scientists in investigating the radiation bands around the Earth discovered by artificial earth satellites.

Among the research ventures proposed for Lenin Prize awards is "The Investigation of Cosmic Radiation and the Magnetic Fields of the Earth and the Moon" by a group of scientists—S. N. Vernov, A. E. Chudakov, V. I. Krasovsky, I. S. Shklovsky and S. S. Dolghinov. These studies, carried out with the aid of the instruments installed in artificial earth satellites and space rockets led to the discovery of the so-called radiation bands of the Earth. The Earth has been found to be surrounded by a kind of halo or cloud of charged high-energy particles held by its magnetic field. This cloud is distinctly divided into outer and inner bands of radiation.

The equatorial diameter of the outer band is about 100,000 km. Inside it, there is a cavity about 40,000 km across. The band is symmetrical in relation to the Earth's magnetic axis, while its meridional cross section is crescent-shaped with its clipped-off tips reaching the upper fringes of the atmosphere in the geomagnetic latitudes of 50-60 degrees.

It is within the cavity of the outer band that the inner one lies. It extends in breadth for about forty degrees on both sides of the geomagnetic equator and in height—from several hundred to five or six thousand kilometres above the surface of the Earth.

The bands differ by the nature of the constituent particles in the outer band the instrument-recorded electrons have the energies of scores or hundreds of thousands of electron-volts, while in the inner band the protons have energies of scores and even millions of electron-volts.

Soviet scientists are credited both with having been the first to discover the outer band and with playing an essential role in investigating the inner band.

The first signs of the existence of the outer band were detected during the flight of the second Soviet artificial earth satellite, launched on Nov. 3, 1957. Radiations of increased intensity, beyond the recording power limit of earth-based instruments, were detected when Sputnik 2 passed over high geographic latitudes. These results were subsequently confirmed by the findings of the third Soviet Artificial Earth Satellite, launched on May 15, 1958.

Sputnik 3 carried the so-called luminescent counter. It effectively recorded not only the high-energy particles, but also the electrons of comparatively low energies, and determined the total ionisation produced by all the particles reaching it.

The major achievement of Sputnik 3 was the discovery and investigation of the outer

radiation band. The findings of the observation of some three hundred transits over the territory of the Soviet Union have made it possible to trace an inclined boundary surface. After crossing it on its way from the equator to the pole, Sputnik enters a zone filled with electrons of comparatively low energies—scores or hundreds of thousands of electrons-volts. Sputnik's re-emergence from the electron zone into the particle-free space over the pole has also been observed as it passed over the Antarctic stations. The discovery of a particle-free zone at the poles can be of importance for astronavigation since it offers the possibility of future space-bound-ships avoiding the radiation hazards at both poles when leaving the Earth.

The detection of a high-latitude zone has furnished evidence of the existence of an outer band and the presence of a cavity inside it. Along with Sputnik 3 observations, it was assumed that the charged particles of the radiation bands are locked up, as it were within the Earth's magnetic field, and race about along the magnetic lines of forces growing in numbers due to neutron disintegration and, possibly, to the capture of solar corpuscules.

The inner band was first detected by the American scientist *Van Allan* and his colleagues with the aid of the readings of the charged particle counters installed in the first and third American satellites launched on Jan. 31 and March 26, 1958. Those counters did not differ in their essentials from those of the second Soviet Sputnik, but had long breaks in their operation which could have been due to the instrument malfunction or to the extremely great intensity of the radiation which was to be measured.

In those days Van Allan did not, nor could he, identify the newly-discovered radiation as a "band". To do so, it was necessary not only to detect the great intensity of cosmic rays over the equator, but also to establish its absence in the middle latitudes. But this is just what Van Allan could not do, because the American satellites did not reach any latitudes beyond 35 degrees, that is they did not travel beyond the inner band limits. It was the instrument readings of third Soviet satellite, launched on May 15, 1958, that made it possible to define the bounds of the inner band, measure the energy of its constituent particles and discover a longitudinal asymmetry due to the fact that the Earth's magnetic axis does not pass through its centre.

The space rocket launchings were the next important stage in the investigation of the radiation bands. The Soviet space rockets carried instruments which took an even wider range of measurements than those of Sputnik 3. These instruments supplied a vast variety of radiation characteristics of the outer radiation band. The distribution of particles according to energies was determined and their nature identified. The space rockets made it possible, for the first time, to investigate cosmic radiation in interplanetary space outside the Earth's magnetic field, and determine its composition.

Closely associated with the study of the radiation bands is the exploration of the magnetic field of the Earth. The rocket-borne instruments detected a marked difference of the Earth's real magnetic field from the theoretically calculated one. This is due to the presence of intense electric currents scores of thousands of kilometres

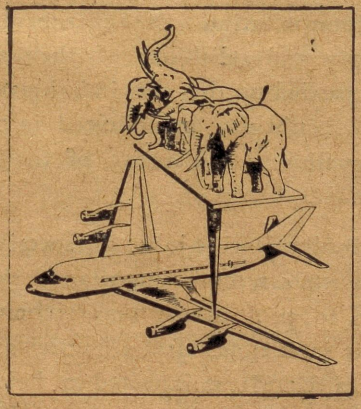
away from the Earth's centre, i. e. far beyond the ionosphere, but still within the radiation bands. Of particular interest is the minimum of intensity of the magnetic field at a distance of 20,000 km from the Earth's centre, which was detected during the first space rocket's flight.

The space rockets made it possible to establish that the Moon has no magnetic field of any detectable intensity, nor any radiation belts, i. e. charged particles held within a magnetic field.

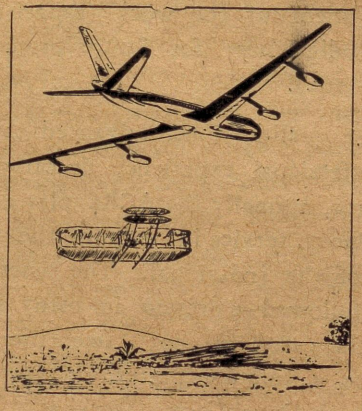
There is no theory of terrestrial magnetism as yet. The actual absence of a lunar magnetic field gives reason to believe that the Earth's intense magnetic field is due to its comparatively swift rotation.

The research work of the Soviet space explorers considerably widens the scope of our knowledge of the realms of space surroundings us and is, certainly, worthy of a Lenin Prize award.

DO YOU KNOW?



The wing of one of today's high-speed passenger planes must be strong enough to withstand a stress of 18 tons per square inch. This is equal to the weight of four elephants on every square inch of wing surface.



In 1903 the first successful airplane, developed by the Wright Brothers of the U. S., flew only 120 feet. Today a modern airliner can fly 10,000 miles non-stop, nearly halfway around the world.

WORKERS' FORUM

ASSESSMENT OF WORK VIS-A-VIS PROMOTIONS— ANNUAL CONFIDENTIAL REPORT

The Problem

For the purposes of promotion, generally the criteria considered by Government and Quasi-Government employing agencies are :—

(i) Qualifications (University Degrees/ Diplomae, Technological Degrees/ Diplomae).

(ii) Professional experience (in the field of science and technology relevant to the area and type of work).

(iii) Length of service vis-a-vis seniority in a grade.

(iv) Annual Confidential Reports (the annual reporting giving an assessment of the work, capacity and eligibility for future promotions etc.).

While qualifications, advanced training and professional experience do carry some weightage, normally the ACRs play a vital role in Govt. service in shaping the future career of the individual. The assessment system followed at present in many Establishments carrying out scientific work relate to a common pattern or type for all Govt. and Quasi-Govt. servants. There is a particular need for revising the existing criteria pertaining to ACR with a view to enable a proper assessment in the case of scientific and technical personnel.

Suggestions for solution :

In any assessment system, it would be necessary to formulate the various categories of requirements pertaining to the assessees. Broadly speaking, in addition to (a) personal and (b) executive abilities of an individal, his (c) technical skill and (d) professional qualities also require an objective assessment. Depending upon the nature and type of jobs characteristic of a particular employing agency, various details in respect of the above four categories could be worked out ; but in any type of scientific work, the professional and technical/manipulative skill plays an important part. It is essential to assess for this purpose, factors such as the scientific or technical knowledge, the capacity for application of such knowledge, ability in regard to interpretation of experimental data, accuracy and reliability of the scientific work carried out by the individual. Some ideas should also be indicated in regard to the quality and quantity of the scientific work.

For all scientific jobs, irrespective of the grade or class, more importance should be given to professional and technical skill. At the same time, after a particular 'level', when a scientist is expected to hold a particular rank as senior teacher in University (guiding research) or as a Senior Officer (in a Research Department planning, guiding and arranging for the execution of research programmes or as an applied scientist (working on development projects), certain personal qualities in addition to his professional and manipulative skill are required, such as

leadership, initiative, personal relationship, direct/orderliness of methods, quality of expression, judgement and commonsense. It would evident that such qualities play an important role in the out-turn of scientific work in the 'higher' or the 'senior' scientific posts.

Mode of Report

It would, therefore, be appropriate to categorise the various requirements in the ACRs broadly under two headings viz :

(i) those which relate to 'personal' qualities and

(ii) those of professional importance.

During the year under review, in the case of scientific worker, the quality and quantity of output relevant to scientific efforts in his professional career should be emphasised in as much details as possible. Reporting on personal qualities should be confined to an age limit of 30.* Beyond 30, the reporting on personal qualities should not give any scope for any violent variation from year to year. Perhaps, with advancing age, some of these qualities like 'initiative' and 'capacity for cooperation' may be on the decline but this is normally taken for granted in any service career.

In the system of reporting obtaining at present, it is only one immediate superior who gives an assessment report of an individual junior to him. This no doubt followed by remarks of the next higher official and the Head of the Estt. Any remarks by the latter two should be taken as 'indirect' assessment and not as 'direct one. Therefore, there is a definite need for assessment of every scientific worker in a direct and objective manner by more than one individual in a superior grade to the one to which he belongs. This may lead to an objective assessment and subjective factor could be minimised if not eliminated. Further, such a system would also in turn enable an assessment to be made of the reporting officers and their nature viz : whether they are subjective or objective in their method of assessment. In fact, the assessment report should be more 'factual' as for as possible and less prone to 'opinions'.

Introspection

It would perhaps be interesting to provide for some scope in the assessment report for the individuals also to report on themselves in regard to their performance during the year. A suitable criteria could be drawn up for the purpose ; every one of the individuals could be asked to fill-up, a profoma during the year, wherein he could, not only be given scope for stating the facts in regard to his scientific knowledge and out-turn of scientific work but also the reasons for any lacunae. A report on himself by the individual at periodical intervals (viz. one year) could itself enable him or her to make an assessment in regard to his turn-over of work during the year and thus remove any doubts in his mind. The mediocore will automatically fall in line in their own respective places

* It would, however, be seen that most of the personal qualities are generally of the non-remedial type, inherent or inborn and after the University career, very rarely acquired by external training or circumstances. It would, therefore, be necessary to look for the scientists of tomorrow, who would be required to hold posts of responsibilities when they are young. It may perhaps be necessary even to catch them young at the University or training stage whereas the professional qualifications or advanced training in respect of technical work can be acquired, given the circumstances for the same. The personal qualities can very rarely be improved after a particular age and once an individual has entered his service career.

and would perhaps reconcile themselves to the situation if they are not in a position to provide a factual statement of case, to prove that the output can be termed as 'outstanding' or 'above average'.

In this confidential report by the individual, it would also be interesting to provide for certain columns where their opinions in regard to their colleagues immediately concerning them (in the next higher or lower categories) could be given by him/her. This practice will also enable both the individuals 'being assessed' by others and the 'assessors', to be more temperate, factual and less opiniorated or subjective. If this report by the individual is treated as strictly confidential and the information is made available only to the Head of the Estt., quite often some of the administrative difficulties facing the Director or the Head of the branch may be resolved in an amicable and democratic manner.

Conclusion :

Thus not only is there a definite need for modifying the existing system of reporting for purposes of assessment but also to improve the same by giving particular emphasis on the professional and technical qualities in respect of scientific personnel.

Scientists and Classification

Industrial vis-a-vis Non-Industrial

It is the accepted practice for all employing agencies, whether Governmental or Non-Governmental, to define the employees as Industrial and Non-Industrial. The Industrial worker is given certain statutary protections whereas the Non-Industrial type are generally not eligible for equivalent privileges. The work with an administrative bias relevant to clerical, executive or the managerial type could be classified as administrative. Consequently, the employees belonging to the administrative structure were required to undertake responsibilities on behalf of the employers and so were classified as supervisory. The industrial worker on the other hand was treated as apart from the management or the employer and hence was treated as a 'separate party' as far as the employing agencies were concerned. When going into the various aspects of the merits and demerits of the above classification, it is relevant for our purpose to only state that the advent of scientific or technological worker as a class makes it essential for some changes to be made in the classification. The fitting up of the scientific technological work, therefore, becomes an important aspect, both from the employers as well as the employees concept. One of the factors that affect the above is the question of classification in relation to remuneration.

The employee-vis-a-vis remuneration

Undoubtedly, the remuneration for an employee is not related to the quality and quantity of his work but is also related by the common rules of economics viz: the law and supply in demand. It has been the endeavour generally in all countries to see that certain statutary provisions are made to provide for an immediate wage structure and to relate the emoluments to the quality and quantity of the work by a system of classification or gradation.

In the case of the industrial worker, manipulative skill is the predominant factor; experience goes towards an increase in the performance ratings. Therefore, the remuneration could be directly proportion-

ate to the performance output with a bias on the quality of the out-turn. They could, therefore, be classified broadly as unskilled, semi-skilled and skilled and their remuneration relate to this type of gradation.

The worker belonging to the administrative type viz: a clerical, executive or managerial, could be expected to have certain amount of capacity to apply his intelligence supported by his education. The capacity and the performance rating in this case would be related not only to the out-turn of work but also to certain personal factors relating to the "quality of work and responsibility". Manipulative skill as related to certain routine type of performance does not play a major part. The capacity to understand, ability to express precisely, ability to take decisions, power of observation and inherent capacity to give recommendations and take direct responsibility, will all play a major role on the performance output. Naturally, depending on the extent to which these factors affect the nature of duty, classification becomes essential; that is why in the case of administrative cadre, classification is generally resorted to so that efficiency is given due regard and a proper utilisation of man power is made.

When we come to scientific worker, the nature of work itself does not admit of any difference from worker to worker. However, the type of work could vary from one extreme viz: the routine repetitive type to the other extreme requiring extra-ordinary skill, experience and genious. However, the common yards stick would be experience in manipulative techniques, scientific approach, capacity for observations and interpretation of data. The other qualities which are generally expected in the case of administrative type of work such as man management, ability to take decision, etc. play only a secondary role. The scientific work does not admit of levels. Levels, if any, arise only in a 'recognised' manner depending on the 'contribution' of the worker to the 'cause of science'. His position and status in the case of scientific worker cannot be governed only by a post or grade but by his capacity to justify himself in his approach to the scientific work. An example, it may be stated that a scientific worker by virtue of holding a post belonging to a higher grade cannot automatically become a guide for his so called juniors. It is only his experience in the scientific work and his inherent capacity to guide depending on his knowledge of experimental techniques, his experience in the field of science etc. which will play an important part. Therefore, it is not proper to introduce a system of classification in the case of scientific workers on the lines similar to that for the industrial workers or administrative employees.

The classification for scientists

However, it can only be said that the scientific worker as an employee has to be provided with certain privileges if necessary with statutory provisions as in the case of the industrial worker but the type of statutary protection need not be the same. For this purpose, the scientific worker can be treated as a worker or employee and distinct from the administrative employees who are supposed to represent the employer.

Since this class of workers viz: scientific and technological workers are increasingly finding their place in the modern society and since they have a major role to play in our society today, they require a special type of treatment. It is very essential for us to

take certain concrete and definite decisions in respect of the statutary provisions that would be required for their protection, safety etc. concerning their service and working conditions. Perhaps, the scientific workers should be brought under statutary provisions like the Factory's Act, Trade Unlon Act etc. But with suitable provisions defining their own status, functions and work, the present practice of treating them as Non-Industrial and at par with the administrative workers is incorrect. At the same time, it would not be just enough to treat them at par with the Industrial workers in the context of the definition of an Industrial worker under statutary provisions existing today. A wholesome view of the problem has to be taken and as a consequence of the same, it would be essential to define employees today under the following categories :—

(a) the administrative employees

(b) the scientific technological workers depending upon the type and nature of work performed by the scientific and technological worker. It is essential for us to provide for certain statutary provisions as in the case of the Industrial workers.

(c) The Industrial workers.

Trade Union Vis-A-Vis Association Pattern

The ASWI was sponsored by the Indian Science Congress in January, 1947. It has been registered as a Trade Union. The aims and objects of the Association are given in Clause 3 of the Objects & Constitution. The Association differs from other national scientific bodies in that its primary role is for the improvement of the economic conditions of scientific workers and bringing-about an effective application of science and scientific methods for the welfare of the community as a whole. The Association is meant to protect the scientific workers and to help them. It is also meant for the advancement of science and the service of the community. As a Trade Uuion, it differs from other trade unions in the country in that the ASWI has unique and useful role to play for promoting the use of science and technology for development of the country. It has the responsibility to create conciousness for the purpose amongst the scientists. Thus it has to essentialy believe in creating the proper conditions for a collective bargaining not only for the economic uplift of the scientific workers but also for the most effective use of science in the uplift and welfare of the society as a Whole. It is similar to other trade unions only in providing a forum platform for the scientific workers to get together irrespective of any status which they hold. It cannot essentially believe in either sologans, shouting, demonstration or strike etc. But it has to depend in creating a proper and enlighten approach so that it can shoulder the responsibility for the progress of the country in an effective manner and to speak on behalf of the scientific workers on utilisation of science, a dissemination of scientific knowledge and for creating public interest in science.

Functions as a Trade Union

Articles (A) (i) to A (ix) of the Constitution clearly lay down the primary responsibility of the ASWI as a Trade Union. However, certain special rights vests with the members in belonging to this organiza-

tion. They also get certain protections when taking part in the activities for instance Clause 42, 42(a) and 42(b) and particularly A (ix). As a Trade Union, can the ASWI take recourse to statutary provisions for giving effect to some of the problems pertaining to economic conditions of the scientific workers. As a Trade Union, collective bargaining and the right to 'demand' are primarily accepted and recognised. Victamisation of the office-bearers or members taking part in promoting the activities of the Association cannot normally take place.

Functions as an Association

As an Association registered under the Society's Act, the aims and objects could be same but the right to effectively implement this need not be so. Statutary provisions for protection of the office-bearers or active workers of the ASWI will not exist. Possibly, the right of collective bargaining will not vest in the ASWI. However, in lieu thereof, the privilege of 'recommending' or 'suggesting' may be recognised. This could be clearly enunciated by pointing out that the ASWI as a Trade Union will have the right to 'demand' whereas as an Association, it can only 'submit'. Trade disputes could not be negotiated.

The Need for a decision in status of scientific workers

Scientific workers cannot be classified as equivalent to administrators in the executive or clerical line. At the same time, they may not be recognised as equivalant to the industrial workers in view of the high order of education, intelligence and capacity to discharge a higher responsibility to society. But primarily it has to be accepted that the scientific workers whether as a Teacher or a Research worker in a laboratory or a technologist in industrial institution etc. are different and distinct from other workers. It is this primary distinction which alone binds him professionally with his other colleagues. In the discharge of his duties, he is called upon frequently to, not only think for his own individual progress but also for the progress of the community and humanity. Thus the right of the scientific workers to get together i. e. to unite to form an association of their own has got to be recognised by the society, the Government and the people.

Inherently, the scientific workers cannot be classified with the other workers whether belonging to the administrative or industrial spheres. If, this need and necessity, for "the professional-get-together is recognised and admitted, the other rights, obligations and duties which follow can be sorted out by pragmatic approach.

It is the lack of clarity in understanding this thread of homogenity that weaves the pattern for the scientific workers on a common platform, that leads quite often to creating confusion. An attempt is made to treat the scientist according to the pay or his status in a manner analogus to other workers in a particular institution.

Points Which Require Clarification

(a) Can the scientific workers irrespective of their status, join together in forming a common organisation i. e. have the scientific workers the right to form a composite organisation wherein effective steps could be taken to improve safeguard, the economic conditions of all scientific workers ?

(b) As an Association, will the members of the Executive Committee, office-bearers/ active workers get suitable statutary protection against being victimised.

(c) Will the ASWI in an aassociation pattern have the right to collective bargaining and negotiation ?

(d) Whereas as a Staff Association, the activities of the ASWI are expected to be confined to staff problems, service conditions etc. alone. Can it undertake activities as outlined under clause (b) and the Aims and Objects i.e. promotion of activities for the effective use of science and scientific workers for the uplift and welfare of the society ?

(e) Can the ASWI at a national level have a cross sectional representation of all types of scientific workers employed by different employing agencies coming under the Government; Quasi-Government/Semi-Government and Private Sectors ?

(f) If homogenous Units of the ASWI are organised relevant to particular employing agencies, can such units federate together at a national level and still have the dejure and defacto recognition of the Govt./ Employer ?

(g) If some of these federating units are on an association pattern and some on Trade Union Pattern, can they still exist together in a composite manner under a federal structure ?

(h) Will the right of the ASWI at a national level be recognised in the light of this composite structure as the main body to negotiate on staff problems and/or on problems pertaining to Clauses (B) of the Constitution.

(i) Can the ASWI be treated for purposes of a dejure of defacto recognition, midway between the Trade Union/Staff Association and a scientific society like the Physical Society, Chemical Society Institution of Engineers etc.

(j) Can the ASWI have a composite structure wherein both the scientific workers coming under the Government service and those under the Non-Govt. service remain together in one common well knit organisation ?

(k) Why should the rights under Clause 2(g) of the Trade Union Act be denied to the scientific workers employed as Govt. servants? If for purposes of the Trade Union/Industrial Dispute, the employees can be categorised in the following two types :—

(i) those who are covered by the Clause 2(g) because they fall within the remuneration limit viz : Rs. 500/- and

(ii) who have a remuneration above Rs. 500/- and therefore classified for this purpose as a representative of this employer,

can these two types of employees be represented by one composite organisation.

Conclusion

In the light of the above, it is evident that some serious thinking and decisive efforts are to be made to activise the ASWI by ractifying some of the lacunae existing at present in its structure, mode of functioning and problems related to its recognition. The Govt./Quasi Govt. employing agencies have to seriously consider the above and come to a definite conclusion regarding an important aspect pertaining to the scientific workers employed by them.

TRADE UNION VIS-A-VIS ASSOCIATION PATTERN

ASWI has been founded on the pattern of Association of Scientific Workers, UK, ASW, U K has been registered as a Trade Union and as the British Institutions generally were the models to the scientists of India, ASWI was formed at the initial stage as a Trade Union.

The AWSI is no way similar to the various learned bodies in the country but has the following aims :—

(i) to encourage the most effective use of science and scientific methods for the benefit of the community as a whole,

(ii) to improve the status and conditions of the scientists,

(iii) to work for a fuller appreciation and recognition of the achievement of science and scientists.

There is a great need for an organisation which is mainly concerned with the welfare of the scientific workers, as problems are sometimes individual in character and at other times, the questions to be dealt with are, common to a number of people.

A question has now arisen whether this Assocn. should continue as a Trade Union or be re-constituted as an association. The fundamental rights and privileges expected by the members from a Trade Union are as follows :—

(a) protection of status as scientists,

(b) suitable environmental conditions for work and

(c) proper assessment of his work and subsequent encouragement for popularisation and thereby giving the scientists his proper place in the community.

For this, either a Trade Union or an Association is needed. However, an Association or a Trade Union will necessarily require strength for negotiation/collective bargaining. There should not be any fear of victimisation for actively negotiating on Trade Union/Association activities.

As far as possible, heads of scientific institutions should be free from subjective feelings for the assessment of a man's ability, work, temperament and status. This has to be impressed upon by Trade Union or Association to counteract nepotism and bureaucracy.

It may be possible that either an Association or a Trade Union would be able to ensure the above aims and objectives for its members. Psychologically, however, since a Trade Union is a registered body under the Trade Union Act of the Govt. of India, the workers are confident and are eligible by statutary rules to have negotiations on any matter of dispute and at the same time if they are not satisfied with the decision of the employers, they can go to the Court of Law to settle disputes. On the other hand, an Association can only undertake peaceful negotiations in matters of dispute. It is not eligible for taking the matter to a Court of Law or undertake strikes, if considered necessary. In addition, for 100 years or so, an Association has been considered to be, more or less, a Club for recreation and pastime. In the modern days, the associations have also been intimately connected with solely organisation of popular lectures, film shows etc.

ASWI is composed of a majority of workers who have always difficulties in their environment. An ideal state is never possible and under the circumstances, the majority of workers feel happy and confident if they can unite under the banner of Trade Union.

The scientists in this country consider it a novel idea to have negotiation on such questions as salaries, working conditions, superannuation etc. Actually, the field of negotiation is becoming so wide that the day is not far distant when the scientists whose conditions are not the subject of negotiation will be the rare exception. It is also well known that Trade Union activities create conditions for political democracy which is expected to develop into economic democracy. All these functions can be discharged by an association, provided there is sufficient strength amongst the scientists and the scientific workers. An Association can be powerful if it can earn a name and also establish the rights to negotiate with different employers.

SCIENTIFIC PERSONNEL

MEDICAL CARE IN INDIA

In India at present there are about 70,000 physicians of whom a little less than a half are trained at the University level and about 37,000 are Licentiates with four years training in junior medical schools. The distribution of Doctors by level and qualification and State of residence in 1954 is given in the Table (facing page). The number of Doctors in India as a whole is about 176 per million of population or one physician for about 5700 persons on an average. The number, however, varies widely from one State to another from over 600 per million (one doctor for 1700 persons) in West Bengal and Delhi to 40 per million (or one for 15,000) in Rajasthan and Manipur. What is, however, much more serious is that most of the doctors reside in urban areas; and the total number of doctors residing in rural areas (with a population of about 330 million) may be below 10,000 that is only one doctor for 30,000 persons or more on an average. In some rural areas it is known that there is only one doctor for 50,000 or 100,000 persons.

Table I

Table I

Distribution of Doctors per million population by level of qualifications and state of residence in 1954.

State	Population in 1954 (million)	Number of Doctors			Doctors per million			Index with W. Bengal 100
		Graduate & Post-Graduate	Licenti-ate	all	Graduate and Post-Graduate	Licentiate	all	
1. Andhra	32.65	2,025	1,908	3,933	62	58	120	19.8
2. Assam	9.59	403	2,281	2,684	42	238	280	46.3
3. Bihar	40.07	1,762	3,302	5,064	44	82	126	20.8
4. Bombay	51.15	6,928	6,044	12,972	135	118	253	41.8
5. J & K	4.54	32	42	74	7	9	16	2.6
6. Kerala	14.51	836	845	1,681	58	58	116	19.2
7. Madhya Pradesh	26.80	731	1,191	1,922	28	44	72	11.9
8. Madras	31.38	2,959	3,083	6,042	95	98	193	31.9
9. Mysore	20.58	1,100	1,846	2,946	53	90	143	23.6
10. Orissa	14.94	448	800	1,248	30	54	84	13.9
11. Punjab	16.63	1,118	1,915	3,033	67	115	182	30.1
12. Rajasthan	16.74	213	454	667	13	27	40	6.6
13. Uttar Pradesh	65.60	3,244	2,989	6,233	49	46	95	15.7
14. West Bengal	27.41	6,157	10,434	16,591	225	381	605	100.0
15. Delhi	1.93	771	468	1,239	399	242	642	106.1
16. Himachal Pradesh	1.13	31	42	73	27	37	65	10.7
17. Manipur	0.60	3	21	24	5	35	40	6.6
18. Tripura	0.69	31	145	176	45	210	255	42.1
All India	376.94	28,792	37,810	66,602	76	100	176	29.1

Source : Perspective Planning Division, Planning Commission, based on Medical Registers.
(Courtesy to : Anniversary address by President, Professor P. C. Mahalanobis to the National Institute of Sciences on 20-1-59.)

SCIENTIFIC INSTITUTIONS

RIVER RESEARCH INSTITUTE, WEST BENGAL

The necessity for a Research Institute to study the river problems of undivided Bengal was a long-and-greatly-felt need as the problems were many, vast and complicated with the partition of the province the need for growing more food added to the urgency of the situation. The State abounded in lands that were lying fallow due to want of water, that were water-logged due to deficiency of drainage and that were unproductive as they were subject to annual floodings. Such lands are generally potential growers of food if their water supply can be properly regulated. The 3,000 square miles of the Sunderbans are protected precariously by earthen embankments that breach at many places every year. The vast fertile plains of North Bengal at the foot-hills of the Himalayas flourish with numerous Tea gardens, paddy and jute fields that are occasionally flooded with water and sand. Such floodings entail considerable loss of food and money; occasionally they are attended with loss of human and animal life and property.

Apart from the question of growing more food crops, the problem of regeneration of dead and dying rivers that threatened the health and prosperity of the country was also of pressing urgency. With the diversion of the river Ganga to the course of the Padma, rapid deterioration had started in the river Bhagirathi—Hooghly and its distributary channels. The river Ganga had mainly flowed through the Bhagirathi channel for centuries before this diversion took place. The low lands, mostly on its left bank, were being gradually raised by the silt-laden flood water. But before the reclamation was completed and the process of delta building had raised the land sufficiently high, particularly in the southern part of the delta, the main course of the Ganga was diverted through the Padma channel and the upland fresh water-supply to the Bhagirathi river system became progressively less, till from the beginning of the present century it has been confined to 2-2½ months of the monsoon season when the high levels of the Ganga permitted some spill water to flow into the Bhagirathi, Jalangi and Mathabhanga, the three main tributaries that flow into the Hooghly Eastuary.

These and various other river problems that the engineers could cope with great difficulty drew the attention of two great sons of Bengal, Prof. Meghnad Saha and Padmashri Satish Chandra Majumdar. These two illustrious alumni of the University of Calcutta felt the necessity of tackling these problems on scientific lines with the help of a Research Institute based on the pattern of similar institutions in the West. With their help and advice the River Research Institute, Calcutta, was set up in 1943.

Damodar Valley Project

After the disastrous floods of the Damodar in July 1943, soon after the establishment of the River Research Institute in January 1943, the Institute was called

upon to take up the work of investigation and devising methods for preventing the recurrence of such floods in the river. An Enquiry Committee was set up by the Government of Bengal in 1944 to advise on permanent measures to control floods in the Damodar river and in particular to advise on the utility of the scheme for flood-regulating reservoirs prepared by Mr. E. L. Glass, Executive Engineer, in the year 1920.

To implement some of the recommendations of the Committee the River Research Institute took up systematic investigations both in the field and the laboratory. A network of river-gauging and meteorological observation station was set up all over the valley. Rainfall, discharge, silt charge, and water levels in the different tributaries and the main river were observed and statistically examined. These have formed the basis of all designs and planning activities of the Damodar Valley Corporation. To help the designers the Institute is carrying out an extensive series of model experiments. Some of these may be mentioned here.

Model experiments have helped to finalise the position and determine all the details of the Durgapur Barrage.

Spillway designs of the Maithon and Panchet Hill Dams have been similarly worked out in detail from model study; and the various designs of Undersluices, Barrels and Gates have been examined and finalised. Not a single design of this multipurpose projet had to be sent to outside laboratories for testing.

Mayurakshi Project

Almost simultaneously with the investigations for the Damodar Flood Prevention Schemes an important series of investigations for the multipurpose development of another river in West Bengali was taken up by the River Research Institute. Statistical investigations as well as examination by model experiments helped in the successful planning of the Project and in the design of the Barrrage at Tilpara near Suri and of the Dam at Meseenjore, now renamed the Canada Dam. The completed project will irrigate about 600,000 acres and generate about 4,000 Kw. of Hydro-electric energy.

Kaliaghai Flood Prevention Scheme

Floods in the Kaliaghai river are a standing menace to the people of Midnapore. Various schemes had been proposed by different authorities in the past. The River Research Institute initiated a series of hydrological observations on the river and its tributaries. After the examination of the data so collected a scheme of flood prevention has been proposed and its details are to be worked out from model experiments.

Revival of Tolly's Nullah

Tolly's Nullah now flows in the old course of the river Ganga and serves as a drainage channel for the countryside south of Calcutta. It has silted up badly, resulting in drainage congestion and stoppage of navigation. This Nullah draws its tidal water-supply from the Hooghly and is used to connect up with Bidyadhari and the Southern Salt Lake. With the death of Bidyadhari and the raising of the entrance channels to the Southern Salt Lake, the Nullah has been deprived of all its spill area. The problem of revival of the Nullah has been under investigation by the River Research Institute.

Preservation of the Kutigong

Next to the Bidyadhari, the Kulti series of rivers forms the only outfall for the

sewage and storm water drainage of the city of Calcutta and its suburbs. With the stoppage of the upland fresh water-supply from the river Ganga, this river system has to depend entirely on its local spill area for preservation and successful continuation of its function. The deterioration of this series of rivers immediately after the death of the Bidyadhari and the diversion of the Calcutta sewage water to Kulti outfall had created a situation that demanded immediate attention. Extensive hydrological observations and other investigations were taken up by the River Research Institute and a programme of model experiments has been drawn up. One model has already been set up at Haringhata to study the problem of preservation of this river system. As lungs are to human life, so are spill areas essential for tidal channels. But excessive spilling may lead to undesirable developments in the river channels. Only with the help of model experiments can we drew up a programme of planned development of the river system.

Other River Valleys

Investigations for the multipurpose development of some other river valleys of West Bengal have also been taken up by the River Research Institute. These are mostly in the preliminary stage. No model experiments have as yet been taken up. In some cases, statistical examinations have been started to help planning. These investigations mostly refer to the rivers Cossye, Teesta, Dwarkeswar and Adjai.

Food Problem

The Floods of 1954 threw up a number of important and urgent problems which the Bengal Institute, among other research institutes in India, has taken up for solution. Besides model studies and hydrological work for North Bengal Rivers, the Institute is co-operating with the Central Water and Power Commission in devising ways and means of counteracting the devastating and erosive action of the Brahmaputra at Dibrugarh and Palasbari. A model of the river Brahmaputra was also set up to study the protective works at the latter place.

Outside Work

Besides these investigations for different projects in which West Bengal is vitally interested, the Institute has been working for projects also. The problem of fixing a suitable site for a railway bridge across the Brahmaputra river at Jogigopa was referred to the Institute for model study. Another problem of equally vital importance, the protection of the railway bridge across the river Torsa near Hasimara on the Assam Rail Link, is now being examined in the River Research Institute.

Fundamental Research

The maintenance and improvement of tidal channels form one of the most important problems of river research in West Bengal. One of the recognised and successful methods for this purpose is the introduction and operation of spill areas. The technique of simulating such operation in models and studying their effects on the regime of tidal rivers has been successfully developed in the River Research Institute. This method has been applied for finding out ways and means of improving Tolly's Nullah and Kultigong rivers and maitaining their rigime. These two channels form the main drainage outlets for Calcutta and the surrounding areas and great emphasis is laid by the Government on their proper maintenance and functioning.

Participation in International Research

During the 1951 Plenary Session of the International Association for Hydraulic Research at Bombay, the Director of the River Research Institute was selected as one of the four group Chairmen to preside over the deliberations of the meetings. During 1952 the Director was invited by the Economic Commission for Asia and Far East, a United Nations Organisation, to work as a Consultant to the Bureau of Flood Control.

Organisational Set up

When the Institute was set up in January 1943, the different components of the Institute were started owing to the difficulties of the war situation, in the laboratories of various organisations in and round about Calcutta. Experiments on hydraulic models were taken up in the Bengal Engineering College, Sibpur. Physical and chemical experiments were undertaken in the Physics and Chemistry laboratories of the University College of Science, Calcutta, and statistical investigations were initiated in the laboratories of the Indian Statistical Institute, Presidency College, Calcutta. Very soon, due to increased volume of work, these branches of the Institute had to be transferred to more spacious surroundings. The hydraulic models were taken out to Galsi a place on the Damodar Canal with facilities of water-supply. The Physical and Chemical Laboratories were set up at Russa along with the Soil Mechanics Laboratory that was organised to analyse soil samples from the Damodar Valley Dams and Mayurakshi Reservoir Project. For better supervision, the statistical work was also concentrated at the Anderson House, Alipore, where the headquarters of the Director of the Institute is located. For the Tidal Models, a new Station was opened in a rented piece of land at Belghoria.

Centralisation :

The Institute continued to function at these different centres for ten years. As the work developed, this arrangement not only added to the difficulties of supervision of the various investigations some of which were of a very urgent nature, but it retarded and prejudiced to a great extent the full development of the spirit of research in an Institution of this kind. It has, therefore, been decided that all the different branches of the Institute should be centralised at Haringhata, about 35 miles from Calcutta, where 350 acres of level land have been acquired and 30 cusec pumping arrangements have been installed, the water supply to come from a vast lake about half a sq. mile surface area. It is expected that in the third phase of development of the Institute all its activities will be concentrated at Haringhata and the research workers will have the benefit of constant guidance and advice of their Director.

(By courtesy : Indian Science Congress Association.)

SCIENCE & INDUSTRY

IRON & STEEL INDUSTRY

I. INTEGRATED STEEL PLANT

The integration of the different sectional units caused a considrable saving in the cost of production of steel.

Flow-sheet of an integrated Steel Plant

The following four different sections constitute an integrated steel Plant:



Every section has distinct functions to perform :

1. *Coke Ovens* : This section deals with the carbonisation of coal. In addition, production of coke which is to be further utilised in blast furnaces for the reduction of iron ore, a gas rich in tar, ammonia and various hydrocarbons, is collected and further processed to give benzene, toluene, xylene, phenols and cresols etc. The stripped off gas is still a rich fuel, which is stored in gas holders to be further utilised in other sections such as, steel melting shop, rolling mill and boilers.

2. *Blast Furnace* : In this section, iron ore is converted to crude iron; coke and lime stone are charged in the blast furnace along with iron ore and a blast of air blown from the bottom. Coke acts both as a reducing agent and a heat supplier. Molten pig iron is tapped at the bottom through a refractory channel, while the blast furnace gas is collected at the top of the furnace and further utilised as low calorific-value fuel in boilers and re-heating furnaces.

These furnaces are tall structures approximating a height of 100 to 150 feet. Their capacity of production ranges from 600 to 1600 tons per day, depending upon their size.

3. *Steel Melting Shop* : This section deals with refining of pig iron. Depending upon the nature of steel making process, this section may consist of either convertors, open-hearth furnaces, or electrical furnaces for refining of pig iron supplied by blast furnaces. By far, the open-hearth furnaces constitute the major melting and refining pots.

Pig iron along with scrap is re-metled and refined by driving off the harmful impurities such as, silicon, phosphorous and sulphur, which after oxidation are collected as slag. The heat required for melting is supplied by either coke oven gas, blast furnace gas, producer gas or oils. Iron ore or mill-scale (iron oxide obtained during rolling of steel) is utilised for oxidation of imuprities while lime or lime stone is used to remove them as slag.

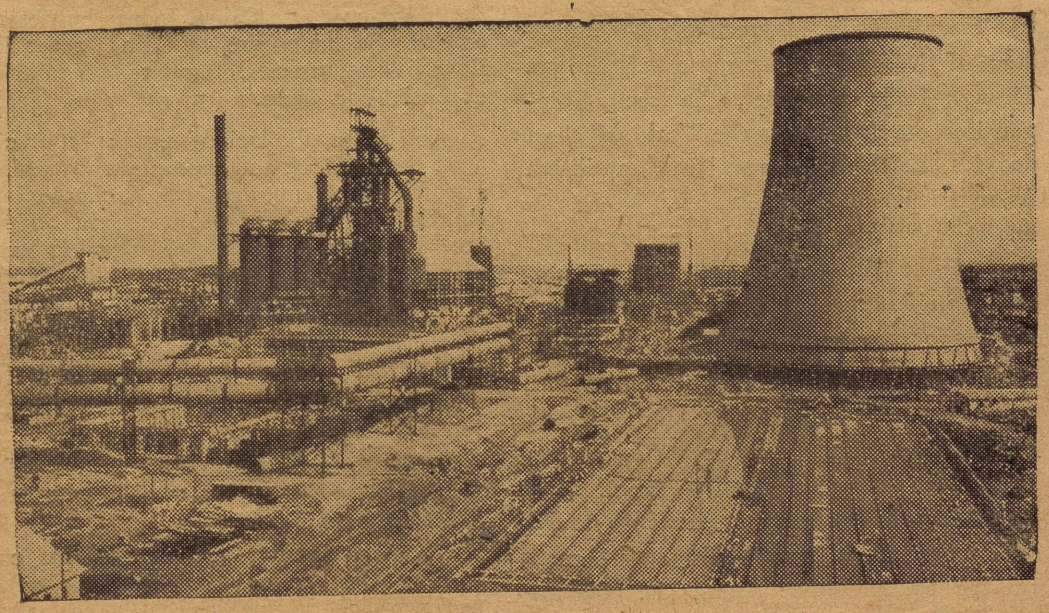
4. *Rolling Mills*: Melting section supplies steel in ingot form. Rolling mills break them down to give them proper shape and size. The process of shaping of steel carried out makes the steel suitable for different uses.

The rolls are designed depending upon the size and shape of the products required to be manufactured. Rolling may comprise of both high and low temperature working.

II. OUR NEW INTEGRTAED PLANTS

1. *At Rourkela*: This plant is being built in colloboration with the two famous German firms, namely, Krupps and Demag. The plant will have an initial capacity of 1.1 million tons pig iron per year and will be employing both open-hearth and Linz Donawitz processes. It will turn out plates, sheets and strips. The by-products from the plant will include benzene, toluene, xylene, phenols, cresols naphthalene, wash oil, anthracene and sulphuric acid; nitrolime stone fertiliser will be manufactured from surplus nitrogen from oxygen plant.

2. *At Bhilai*: This plant is being built in colloboraion with the Russian Government. The plant will have an initial capacity of 1 million tons ingot steel, and will be em-



DURGAPUR STEELWORKS

Since independence, Indo-British co-operation has not only expanded in volume, but has also extended to many new fields, an outstanding example of which is the £100,000,000 "package deal" entered into by the Government of India with a consortium of 13 leading British firms for the construction of the million-ton a year steelworks at Durgapur. Indians and British alike will take pride in the completed Durgapur works, because it will be the result of the closest team work between, on the one hand, 13 U K. firms, 300 British engineers, six U K. banks (which provided a credit of £11,500,000) and the U. K. Government (£15,000,000 loan), and on the other, the Indian Government (which found the initial finance by drawing £26,000,000 from sterling balances), Hindustan Steel Ltd., and several thousand Indian engineers, contractors, and workers. Under the Colombo Plan Technical Co-operation Scheme Britain is also financing the training in the United Kingdom of 350 Indian engineers for its supervisory and operating staff. This picture shows the Blast Furnace area and the Melting Shop Cooling Tower.

ploying open-hearth process. It will produce rails, railway slippers, rounds, flats and billets. The by-products from this plant are similar to those of rhe Rourkela plant except for nitro-lime-stone.

3. *At Durgapur* : This plant is being built with the help of a steel consortium consisting of the famous English firms like Ashmore & Benson, G.E.C. etc. The Plant will have an initial capacity of 1 million ton ingot steel and will be employing open-hearth process. It will be producing medium structural steel, wheel tyres and axles.

III. CONCLUDING REMARKS

The reasons for our having been a little too late, in India, in realising the importance of the Steel Industry, are well known. Though India possesses, the second biggest iron ore deposits in the World, all these decades, the resources were lying unutilised. As an independent nation now, we can be one of the large iron and steel producing countries of the world. We can not only satisfy our internal demands but also have surplus for exports.

The export of the steel goods, however, will have to be done in the face of great competition. This calls for particular care to produce superior quality steels. If we do not lay the necessary emphasis on "quality", we are liable to fail miserably because of the present poor standards. Barring some few attempts, here and there, there is a lack of any organised approach to this vital problem of quality control. Our smelting practice, refining methods, casting techniques and rolling operations need a thorough investigation and continuous watch, for desirable improvements to keep pace with the technological improvements effected by other countries.

The second factor which will influence the exports, is the cost of "our products". Here again, it may be said, a lot of ground remains to be covered in making efforts for reducing cost of production by increasing working efficiency. The scientific approach to this problem, includes two major aspects viz. fuel efficiency and refractory life.

In our attempt to utilise our low grade coals and ore fines, we are trying experiments with the famous Low-Shaft Furnances. In this respect, a word of caution, based on the experiences of other countries, may be given. The quality of products produced in Low-Shaft-Furnaces is of such a low order that there are doubts as to how they can be further utilised in steel-making, without heavy cost of refining. It may be observed that the adventure by China, regarding Low Shaft-Furnaces, has proved to very expensive for them.

And again, the lack of proper appreciation, the need for and training in organised research efforts amongst our Technologists/ Engineers, who are the back bones of the Steel Industry, is quite disheartening; particularly, so, when there is a growing demane for better trained Technologists and Engineers.

A few of the concrete suggestions for organised study of the Steel Industry are denoted below:—

1. Thorough investigation into the factors affecting the quality of pig iron, steel and the rolled products.

2. Investigation into the factors controlling the economy of fuel and refractories, which in turn, affect the cost of the steel produced.

3. Study of furnace designs and changes required to be made in them to attain the best performance in working.

4. Speeding up of the plans for having our own alloy steel making plants.

5. Providing for adequate facilities for training our own technical personnel in the organised research performances covering the Steel Industry.

Table I

Broad Features of the Different New Steel Plants

Plant	Coke Ovens	Blast Furnaces	Steel Shop	Rolling Mills	Power Plant
Rourkela	3 batteries (70 Ovens/battery)	3 Furnances (1000 ton/day)	2 Mixers 3 L. D. Convertors 4 Basic Open-Hearth Furnaces	1 Blooming and slabbing mill 1 Heavy plate mill 1 Continuous strip mill 1 Cold rolling mill with 2 stands	75,000 Kw
Bhilai	3 batteries (65 Ovens/battery)	3 Furnaces (1135 Ton/day)	1 Mixer 6 Basic Open-Hearth furnaces	1 Blooming mill 1 Rail and structural mill 1 Merchant mill 1 Continuous billet mill	24,000 Kw
Durgapur	3 batteries (72 Ovens/battery)	3 Furnaces (1250 Ton/day)	8 Open-hearth furnaces of 200 ton capacity each	1 Blooming mill 1 Intermediate mill 1 Medium structural mill 1 Merchant mill 1 Continuous billet mill 1 Wheel & Tyre & Axle mill	

Table II

Products & By-Products From New Plants

Plant	Main products	Quantity (Tons)	By-Products	Quantity (Tons)
Rourkela	Wide heavy plates thickness 3/8″ and above (maximum width 110″)	170,000	Ammonia	4,000
			Benzene	10,000
			Tolune	2,100
			Xylene	1,100
			Phenol & Cresols	600
	Narrow heavy plates thickness 3/16″ and above (width below 60″)	30,000	Napthalene	7,000
			Wash Oil	10,000
			Solid anthracene	4,000
			Granulated pitch	50,000
			Sulphuric acid	7,000
	Hot rolled sheets and strips, width 60″ and below, Thickness 16, gauge to 3/16%	300,000	Nitrolimestone fertiliser	6,00,000
	Cold rolled sheets and strips, width 60″ and below, thickness 12 to 19 guage.	170,000		
	Tin plates, thickness 30 to 34 gauge.	50,000		
Bhilai	Rails (Std. gauge)	100,000	Ammonium Sulphate	16,300
	Rails (Narrow gauge)	10,000		
	Railway slipper bars	90,000	Benzol	6,240
	Standard and broad flanged beams, channels angles, & other light and heavy sections	284,000	Toluene	1,490
	Round (dia. 7/8×3″) & squares (7/8×3″)	121,000		
	Flats (width 2-5″)	15,000		
	Billets for re-rolling at outside rolling mills from 2×2″ to 3×3″ cross section.	150,000		

ASSOCIATION NEWS

PROF. M. S. THACKER'S VISIT TO THE BANGALORE BRANCH

During Prof. Thacker's recent visit to the Indian Institute of Science an informal meeting of the Bangalore Branch was arranged on 31-3-1960. The ASWI President briefly addressed a gathering of approximately 150 scientific workers at which Dr. S. Bhagavantam, Director, Indian Institute of Science was present. Prof. Thacker appealed to the scientific workers to take an active interest in the organization and to re-vitalize it by pursuing the objectives for which the association was founded. He highlighted the importance of the scientific workers of the country themselves taking an imformed and active interest in the building of a healthy scientific tradition. Referring to the Science Policy Resolution, Prof. Thacker said that while Govt. were anxious to see that scientists were given all support in their work and an thonoured place in society it was actually the scientists themselves who must effectively by their own actions translate the spirit of the resolution into practice. In this the Association of Scientific Workers could and should play an important role. He asked the scientific Workers to examine the reasons why even after over twleve years of existence the ASWI had not been able to grow in the membership and exerted only a marginal influence on national matters concerning science and scientific workers. He said that the ASWI Central Executive Committee had been discussing such questions for some time and some members had expressed the opinion that perhaps among the main contributory reasons were the trade union character of the association and some fear in the minds of many that by joining such an organization they would incur disapproval of the authorities. During the discussion that followed the affiliation of the Association with the WFSW also came up for discussion. The general trend of these discussions was that the most important immediate task of the Association was to mobilize the scientific workers and become a really representative organization of Indian Scientists. Members of the Bangalore Branch placed on record their experience of working at the Indian Institute of Science and affirmed that at least as far as this Branch was concerned the Institute authorities had been quite understanding and cooperative but that even so the Branch membership had continued to decline and there were few scientific workers who took an active interest in the Branch's work. Dr. Bhagavantam, Director of the Indian Institute of Science emphasised the importance of academic freedom and association in Institutions of Scientific Research and learning. He pointed out that the exercise of such freedom carried grave responsibilities with it and scientific workers should be fully conscious of this. He assured the ASWI members that at the Indian Institute of Science their organization and its activities would continue to be regarded sympathetically.

Among other topics briefly discussed during the meeting were the imperative

need to maintain and raise the standards of post-graduate teaching and scientific research. The absence of coordination and purpose in many research institution and schemes in the country was pointed out by some of the members present at the same time, it was noted by others that the existence ot such a state of affairs placed a serious and heavy responsibility on the scientific workers. It was they in the final analysis who would have to set things right. An important task developing on the ASWI was to initiate serious and searching discussions among its members as well as others engaged in scientific activity on the importance of applying objective standards of a criticism and evaluation for their own scientific activity.

Attention was drawn to the language problem in the scientific field and it is needless to reiterate that the Association of Scientific Workers should give serious consideration to this difficult problem. Every attempt should be made to find out a satisfactory and workable solution to this intricate, important and urgent problem.

Assocn. of Scientific Workers (Ord. Estts) Khamaria, Jubbulpore

The Association of Scientific Workers (Ordnance Establishment) was formed in 1949. During the year under review, the association tried its level best to further the aims and objects of the Association. The membership at the beginning of the year was 86. There were 10 E. C. Meetings during the year. The E. C. did its best to slove the problems that faced the members during the year. Two educational visits were arranged by the Association—one to the AOC School & Museum and the other to the Telecommunication Laboratories of the Govt. Engineering College, Jabalpur. A few good books are available in the Library.

U.P., PWD Research Institute Scientific Workers Assocn., Lucknow

No. of member—16

Branch Executive—one

Branch General—one

A reminder was sent to the Secy. for PWD, U.P. Govt. for removal of restriction on applying for outside posts.

A resolution regarding change in designation and grade of pay of Lab. Assistant was adopted. The executive also passed a resolution on the suicide of Dr. Joseph.

THIRD C. E. C. MEETING

Minutes of the 3rd (1960) Meeting of the CEC of the Association of Scientific Workers of India, held on 4th April, 1960 at the Defence Research Laboratory, Kanpur at 15.00 hrs.

Members Present :

1.	Professor M. S. Thacker	..	President
2.	Dr. B. Mukerji	..	Vice-President
3.	Dr. M. S. Iyengar (Jealgora)	..	Member
4.	Maj. Gen. S. S. Sokhey (Delhi)	..	,,
5.	Dr. D. N. Misra (Lucknow)	..	,,
6.	Sri A. Gopalkrishnan (Hyderabad)	..	,,
7.	,, R. N. Bhargava (Roorkee)	..	,,
8.	,, R. N. Chaturvedi (Bahadrabad)	..	,,
9.	,, B. N. Tewari (Kanpur)	..	,,
10.	Dr. T. N. Chojer (Lucknow)	..	,,
11.	Sri Y. H. Rao (Kanpur)	..	Jt. Secy. (Pubn.)
12.	,, J. N. Misra ,,	..	Treasurer
13.	,, S. Ramabadran ,,	..	General Secy. (Pubn.)
14.	,, M. R. Raman ,,	..	General Secy. (Org.)
15.	,, V. C. Vora (Lucknow)	..	Observer
16.	,, J. J. Bagchi (Kanpur)	..	,,
17.	,, R. P. Rastogi (Lucknow)	..	,,
18.	,, S. S. Goel (Kanpur)	..	,,
19.	,, A. N. Dikshit ,,	..	,,
20.	,, J. N. Misra ,,	..	,,
21.	,, R. N. Tandon ,,	..	,,

1. The Meeting took place in two Sessions on the same day. In the first session, the President M. S. Thacker was in the chair and in the second session Dr. B. Mukerji was the Chairman.

2. At the outset, the General Secy (Org.) read out the messages of good wishes and greetings received from Prof. P. C. Mahalanobis, Dr. S. Husain Zaheer and Sri A. Rahman.

3. **Confirmation of the minutes of the 2nd (1960) CEC Meeting held at Hyderabad**

The minutes were confirmed.

4. **Report of the General Secy. (Org.)**
The report submitted by Sri M. R. Raman, General Secy. (Org.) (Appendix 'A') was adopted.

5. **Report of the General Secy. (Pubn.)**
The report submitted by Sri S. Ramabadran, Gen. Secy. (Pubn.) (Appendix 'B') was adopted.

6. **Report of the Treasurer**

The report of the Treasurer as per Appendix 'C' was read out and adopted.

7. **Reports from Branches**

Dr. M. S. Iyengar (Jealgora), Dr. D. N. Misra (Lucknow), Sri R. N. Bhargava (Roorkee), Sri A. Gopalkrishnan (Hyderabad) and Sri R. N. Chaturvedi (Bahadrabad) gave verbal reports of the activities pertaining to the respective Branches (details of these reports will appear in the V. K. "Association News Column").

8. **Procedure for representation of Service Conditions and related Problems pertaining to the various Branches**

After considerable discussion, it was decided that the various problems/issues arising from the Branches should be referred to the General Secy. (Org.). The General Secy. (Org.) will in turn refer and discuss these problems with the Vice-Presidents. In the light of the discussion and depending upon the merit of the case, the same will be either directly pursued with the concerned agencies/authorities or referred and discussed with the President for his concurrence, if necessary. Some of these problems may also be pursued directly by the President.

9. **Bahadrabad Branch**

The Executive Committee heard the latest position in regard to the permission for formation of Branch at the IRI, Bahadrabad from Dr. B. Mukerji. Dr. Mukerji promised to expedite the case with the concerned authorities in the U. P. Government.

10. **Forwarding of applications—U. P. PWD Research Institute Scientific Workers Association, Lucknow case**

Dr. Mukerji who is negotiating with the U. P. Government at Lucknow has promised to expedite the case at a personal level.

11. **Southern Railway Chemists and Metallurgists Staff Assocn. Madras case**

In the light of the advice from the President, it was decided to pursue the problem through one of the Vice-Presidents at a personal level with the Railway Board at Delhi.

12. **Increase in membership and Recognition of ASWI**

Prof. Thacker gave a brief outline of the difficulties facing the ASWI, particularly in the official circles and amongst the scientific workers. It was very essential to create a suitable climate which would be recognise and encouraging for the scientists to join the Association.

In the light of the discussion, it was decided to throughly examine the various aspects pertaining to the ASWI such as Trade Union vis-a-vis Association pattern, the existing Constitution vis-a-vis right of collective bargaining etc. If necessary, the authoritative legal opinion should also be obtained. Based on this, a detailed report may be drawn up which could be utilised for persuing the question of recognition with the Govt. of India, State Govt. and other Quasi-Govt. agencies and also in the appeal to be issued by the President. General Secretaries were directed to give the highest priority to this question and meet the President at Delhi within a fortnight.

13. **Staff Committees/Councils**

After some discussion, the CEC felt that it was very essential to have Staff Councils/Committees in all scientific institutions which employ scientific workers. These Councils would comprise of representatives of the scientific workers and the administration wherein all their grievances and local problems could be settled by direct discus-

sions with the concerned administrative authorities. Statutary provisions should be provided for the purpose. In this connection, the decision of the Govt. of India to have Staff Councils for their employees was noted.

In the light of the above discussion, the General Secy. (Org.) was asked to put up a note in consutlation with Dr. B. Mukerji. Based on which, suitable action will be taken to process this suggestion through the respective employers viz : the Central Govt. Deptt., State Govt. Deptt. and Quasi-Govt. agencies like the CSIR etc.

14. Resolutions

(*a*) *Grant of additional increments to Scientific Staff in Junior Grades* : It was observed that individuals belonging to the Clerical cadre in the junior grades were given additional increments if they pass typing test. In an analogus manner, it would be desirable to provide incentives to scientists in the junior grades by providing them additional increments if they show specific improvements in their Qualifications viz :

(i) obtaining proficiency in analytical testing (ii) passing public analyse examination and (iii) passing AIC etc.

After considering the above resolution passed by the Lucknow Branch on 2nd April, 1960, the CEC decided to take up this question with the CSIR and such other employing agencies.

(*b*) *Scientific Workers' Day* : A suggestion was noted that a specific day should be allocated every year which could be utilised as a sort of stock-taking day all over India with programmes for constructive activities and discussions and problems facing the scientific workers etc. Considering the wide implications and the importance of the suggestion, it was decided to circulate a brief note on the suggestion to all the Branches and to take up this point for discussion in the subsequent meeting of the CEC.

The above suggestion came from the Lucknow Branch.

(*c*) *Service conditions for scientific workers vis-a-vis implementation of Scientific Policy Resolution* : At a meeting of the Lucknow Branch, held on 1st Feb., 1960 to commorate the sad demise of Dr. Joseph, a detailed resolution on the above subject was taken up for consideration by the Lucknow Branch. The resolution in detail form was read out by the Secy., Lucknow Branch for consideration of the Central Executive. (the detailed resolution will appear in the subsequent issue of the (V. K.) The resolution lays down the following principles that should govern the steps to be taken by the Government in the implementation of the Scientific Policy Resolution in regard to service conditions of scientific workers :—

(i) The Pay structure should be such that—

(a) the best talent is not lured away into other professions for merely better emoluments,

(b) freedom from want is ensured and

(c) number of grades is reduced to a minimum.

(ii) There must be uniformity of service conditions in all Universities, Government and Government aided Organisations.

(iii) Movement from one institute to another in the country should not be hampered.

The CEC adopted the above resolution and decided to take up the same with the Government.

15. V. K.

Dr. B. Mukerji congratulated the Editor Sri S. Ramabadran on his endeavours and the initiative taken by him and his other colleagues of the Editorial Board at Kanpur towards improving the V. K. as a forum for the scientific workers. He strongly exhorted the CEC members and through them the members of the various Branches/Units to come forward, co-operate and fully utilise the various sections in the new 'FORMAT' and thus make the V. K. a truly representative and informative Journal for the scientific workers in the country. He assured the Executive that he would personally help the V. K. to the best of his ability.

In regard to the advertisement, both President and the Vice-President assured the Editor of their co-operation in bettering the financial status of the Publication Division.

16. Dr. Joseph Fund

It was decided to expedite all the Branches/Units/Affiliated Organisations regarding the collection of the funds. On receipt of the remittance, the General Secy. and Treasurer were directed to forward the money to the family of late Dr. Joseph.

The meeting came to a close with a vote of thanks to the chair.

APPENDIX 'A'

REPORT OF THE GENERAL SECRETARY (ORGANIZATION)

I. CEC Meeting

The 2nd (1960) CEC Meeting of the ASWI was held at the Regional Research Laboratory, Hyderabad on the 8/9th February, 1960.

II. Organization

(*a*) *Southern Rly. Chemists & Metallurgists Staff Association, Madras* :

(i) The case pertaining to grades of Analytical Asst. in the Southern Rly. was referred to the President for being taken up at the personal level with the Chairman of the Rly. Board.

(ii) The case pertaining to "Selection Class II Cadres" for Asstt. Chemist & Metallurgists in the CMT's Organisation has been referred to the Member Staff Railway Board.

(iii) No reply has been received so far from the General Manager, Southern Rly. regarding receiving a deputation on behalf of the Southern Rly. Association.

(*b*) *Bahadrabad Branch* : A copy of the letter addressed to the President/Secy. of the Bahadrabad Branch from the Director, IRI was received which states that the scientific staff of IRI Bahadrabad cannot form a branch of the ASWI. However, this matter has been referred to the Vice-President Dr. B. Mukerji for being taken up at a personal level with the U. P. Government at Lucknow.

(*c*) *U. P. PWD Research Institute Scientific Workers Assocn. Lucknow* : The problem pertaining to forwarding of applica-

tions concerning this Association has been pursued with the U. P. Govt. and the Vice-President Dr. B. Mukerji is negotiating with the concerned Ministry in the U. P. Govt., Lucknow for a satisfactory solution viz: withdrawl of the G. O. which prohibits members and staff of the U. P., P. W. D. Research Institute from applying for posts elsewhere.

(*d*) *Calcutta Branch*: Dr. D. K. Roy, Dr. S. Ganguly and the Secretary of the Calcutta Branch have informed that active and spade work is going on for revitalising the branch. A General Body Meeting of the Branch had been called and suitable action has been taken to regularise a number of issues such as collections/writing off arrears, enrolment of new members etc.

(*e*) *Graduate Scientific Workers' Association, Calcutta*: The Secretary of the Association has been reminded regarding the question of affiliation and Dr. S. Ganguly has been requested to personally look into the matter.

(*f*) *Mysore Branch*: The Branch has given the following suggestions :—

(i) regarding reduction of subscription since members are finding difficulty to pay the amount,

(ii) proposes to hold discussion/meeting on "Incentives for Research and its Utilisation."

(*g*) *Bangalore Branch*: The Branch has referred the problem pertaining to stoppage of house rent and city compensatory allowances since the Institute is not situated in Corporation area etc. In the light of the Pay Commission recommendations, the Branch has requested for the problem to be taken up with the Government.

(*h*) *ASW Pimpri*: The office bearers of the Association when they had attended the Annual Meetings at Bombay were advised to take action to get their association registered. They were also advised to apply for recognition. No information has since been received in regard to the above from the Association.

(*i*) *C. E. R. I. Karaikudi*: Dr. A. K. N. Reddy of the Institute has been reminded regarding the formation of the branch of ASWI.

III. Action On Resolutions

1. *ASWI in Retrospect*: This resolution was circulated to all the Branch Secretaries with the request that the same may be discussed in detail in the Branches/Units with a view to increasing the membership in the branch or to help in formation of new units and branches.

2. *Re-organisation of ASWI*: The attention of the Branches/Units was drawn to this resolution which was passed at the Bombay Meetings with the request that the same may be discussed with the branches and their comments forwarded. Emphasis was laid on the fact that this change-over of structure should be made as smoothly as possible without upsetting the organisational aspects. However, in the light of the decision taken at the Hyderabad Meeting, no further action has been taken towards implementing the directives of the General Body Meeting.

3. *The need for categorisation of scientists*: The resolution was referred to the Branches/Units and Affiliated Organisations with the request that group discussions, Symposium and Seminar should be held on the subject and details of the deliberations and on recommendations should be forwarded to the Central Office for consideration of the CEC.

4. *Resolution on national instruments factory, Calcutta* : The Association had taken up this question with the Govt. of India in the year 1958-59. It is uderstood since then that the question of final status of the employees of the National Instrument Factory is under consideration possibly the erstwhile Govt. employees will be treated as on foreign service to the National Instrument Factory Ltd.

5. (*a*) *Protection under Article* 311 *of the Constitution for Civilians paid from the Defence Estimates.*

(*b*) *Condonation of ETE Service rendered between Two TE Services vis-a-vis Seniority.*

These two resolutions passed at the General Body Meeting in the year 1959 had been under correspondence and have since been referred to the Minister for Defence.

6. *Definition of Family As Per Service Rules* : Ministry of Defence has since stated that the existing definition in Passage Regulation C. S. R. and Supplementary Rules of faimly for purposes of entitlement of T.A. & Travelling Concession is the same. A detailed analysis has been given to show that there is no difference in the treatment meted out to the civilians in the various Government Departments.

7. *Liberation of Leave Travel Concession* : The Govt. of India, Ministry of Home Affairs have since informed that the matter is still under consideration.

IV. Auditors

The accounts of the Association for the year 1959-60 will be sent for auditing to M/s GUPTA & CO. The attention of the Branches/Units have been drawn to the resolution regarding maintenance of accounts.

V. Grant-In-Aid

The Govt. of India, Ministry of Scientific Research & Cultural Affairs have been approached for a grant-in-aid to cover the deficit in the Publication Division which was to the tune of Rs. 6,500 as on 31st December, 1959 and it was anicipated to increase to Rs. 8,400 as on 31st March, 1960. The Govt. of India had been approached for a grant-in-aid of Rs. 8,000. During the month of March, 1960, the Ministry of Scientific Research & Cultural Affairs have sanctioned a sum of Rs. 3,500 against the request. As this would only partially cover the deficit, it would be necessary to go back for a further grant in due course. The sanctioned grant of Rs. 500 from the NISI has since materialised.

VI. Actions Arising out of the Previous Meeting

(*a*) *Sub-Committee regarding implementation of proposals pertaining to Item* 6 (*c*) *paras* (*b*), (*c*) & *and Item No.* 7 *of the Annual Report* : A small Note on the subject has been drawn up by the General Secy. (Org.) for circulation to other members of the Committee.

(*b*) *World Federation* : Arising out of the discussions at the previous meeting, the issue is to be considered in the light of Dr. Rais Ahmed's letter, at the Kanpur Meeting.

(*c*) *Pay Commission Report* : A detailed note on the subject has been drawn up by the General Sec. (Org.) and will be forwarded to the Vice-President Dr. Zaheer after a preliminary consideration by the CEC Meeting at Kanpur.

(*d*) *Late Dr. JOSEPH's Case* : Branches/Units/Affiliated Organisations were informed of the action taken at the previous CEC Meeting. A copy of the resolution was forwarded to Mrs. Joseph. The Branches who have initiated collection of funds and who have not taken any action to send the money so far, have been requested to send the same to the Central Office, for a uniform action to be taken for dispersing the same.

M. R. Raman
General Secretary (*Org.*)

APPENDIX 'B'

REPORT OF THE GENERAL SECY. PUBLICATION

As reported in the last CEC Meeting held at Hyderabad, the Publication work was taken-over from the General Secy, (Pubn.)—Dr. D. K. Roy on the 22nd January, 1960. The formalities of the Declaration before the District Magistrate and obtaining the Concession from the Post-Master General, Lucknow have taken a considerable lot of time though efforts were made to hasted the processes by personal contacts. The Declaration has recently been given and the necessary papers have been forwarded to the PMG, Lucknow for the concession.

The Publication of V. K. for the months of Nov.-Dec.'59 issue has been combined and one issue has already come out from the Press at Kanpur. The combined issue for the months of Jan.-Feb. '60 will be out on the 4th April and the Journals will be despatched to the various members and Branches by the 2nd week of April. The mattter for printing for the issue of March '60 is ready and will be handedover to the Press on 6th/7th April, 1960. We expect to be up-to-date from the month of May onwards.

The FORMAT of the Journal has recently been changed as under :—

1. Section I—Editorial and Editorial News
2. Section II—Secience News
3. Section III—Scientific Articles
4. Section IV—Scientific Forum
5. Section V—Science in Industry
6. Section VI—Scienctific Personnel
7. Section VII—Scientific Institutions
8. Section VIII—Association and Branch News
9. Section IX—W. F. S. W. News
10. Section X—Book Reviews

The financial position of the V. K. is given in the annexure. Members may note that the advertisements position for the year 1960 is expected to be in the region of Rs. 2250. I would like to appeal to the President, Vice-Presidents and Members of the Committee for procurement of regular advertisements for the V. K. This will help the General Secretary's job in that there will be no necessity for asking grant-in-aid from the Government in future. The printing of two issues of V. K. at Kanpur i. e. Nov.-Dec. and Jan.-Feb. issues have cost roughly Rs. 1100/-only including the paper.

S. RAMABADRAN
General Secy. (Pubn.)

APPENDIX 'C'

TREASURER'S REPORT

Actuals of Income and Expenditure during the period 1-4-59 *to* 31-3-1960.

Income		Rs. nP	Expenditure	Rs. nP
1. Membership Fees —			Travelling allowances	1847.01
(i) Direct		68.50	Stationery & Printing	528.32
(ii) Branches/Units		1995.23	V. K. Publication	11687.40
2. Publication Grant		6500.00	Postage & Telegrams	321.64
3. Advertisement revenue		3373.61	Bank charges	80.35
4. Sale of Journal		40.85	Miscl. expenses	98.10
5. Miscl. Income		12.00	Establishment	438.00
6. Deficit		3300.63	Donations	200.00
(l) Sundry creditors of V. K. Publication:			Audit Fees	50.00
(a) Paper	1102.00			
(b) Press	1091.50			
(c) Estt.	340.00			
(d) Dr. Ray	20.00			
(ii) Excess of expenditure over income	747.13			
Total:		15250.82	Total:	15250.82

W. F. S. W. NEWS

APPEAL FOR THE SIXTH WORLD CONFERENCE AGAINST ATOMIC AND HYDROGEN BOMBS AND FOR TOTAL DISARMAMENT

The Japan Council against Atomic and Hydrogen Bombs is calling the Sixth World Conference against Atomic and Hydrogen Bombs and for Total Disarmament to be held in Japan in August 1960— the 15th Anniversary of the first A Bombs, which destroyed the cities of Hiroshima and Nagasaki.

We are witnessing the results of years of patient planning and activity on the part of the peoples of the world who are seeking peace, and this has contributed much to the present lessening of tension. It is our firm belief that this year it is especially necessary to strengthen every move toward a total ban on nuclear weapons; to make the present cessation of tests the basis of a complete agreement for a permanent ban; to end the arms race and ensure within a limited period general and complete disarmament.

1959 was the year of the thaw. 1960 opens with the Summit planned, and all must be done to intensify our activities and guarantee that the present trend culminates in a complete victory for peace. Every attempt to revive or keep alive cold war hostilities and frictions must be met and defeated and peoples of all nations encouraged to experience the benefits of co-existence.

Lovers of peace throughout the world know the need; we need not stress the benefit to every man that would come from disarmament, especially the positive programme for a better life, economic and cultural, the basic right of all mankind.

It is urgent and necessary that this year, delegation from the nuclear and non-nuclear powers meet in an atmosphere of deep understanding and with common aspirations, together with delegations from former colonies, from newly independent states from the Afro-Asian and Latin American countries.

As in 1959, there will be adequate opportunity for all delegates to meet and discuss all relevant problems; and further, for all overseas delegates to experience the strength of the mass movement of Japan. Japan will stage a Peace March greater than any yet attempted, which will concentrate the energies of the people and focus their attention on the Conference. We will nullify both old and new military alliances—an anachronism in today's world.

In Japan, contrary to the world wide moves for the lessening of tensions, the Government is trying to establish a new military alliance with the USA. We are waging a nationwide campaign against this with a view to preventing the introduction of nuclear weapons to Japan, and the resulting nuclearization of the country. We regard this as a dangerous military alliance and are working for the establishment of a peaceful nation with a policy of positive neutralism. It is in the midst of this campaign that we are making plans to hold the Sixth World Conference against A and H Bombs and for Total Disarmament.

We ask you to begin your planning now, and ensure that in August we may succeed in inspiring and guiding to further successes in the cause of peace.

(*The Japan Council against A and H Bombs*).

INDIAN STANDARDS FOR FOOD PRODUCTS

The Indian Standards Institution has published the following two Indian Standards covering cube sugar and white bread :

1. *Cube Sugar*—The Indian Standard Specification for Cube Sugar (IS : 1168-1959) prescribes the requirements and the methods of test for two grades, namely, Grade 1 and Grade 2, of cube sugar. Grade 1 is made from crystalline refined sugar and Grade 2 is made from vacuum pan sugar (plantation white).

The sugar cubes should have certain amount of hardness so that they are not easily susceptible to breakage while packing and during transport. They should also disintegrate quickly in solution. Requirements have been specified in this standard to ensure minimum hardness and easy solubility. These requirements, as specified at present, relate only to the sizes of cubes being produced, at present. As and when cube sugar of other sizes is produced, the requirements for the above characteristics relating to the new sizes will be included.

2. *White Bread*—The Indian Standard Specification for White Bread (IS: 1483-1959) prescribes the requirements and the methods of test for white bread. It does not include brown bread, fancy bread, fruite bread, rolls and chemically aerated bread.

The standards are published in English. IS : 1168-1959 is priced Rs. 3.50 while IS : 1483-1959 is priced at Rs. 2.00. Copies are available from the office of the Indian Standards Institution, 'Manak Bhavan', 9 Mathura Road, New Delhi-1 and from its Branch Offices located at Bombay, Madras and Calcutta.

Containers For Milk

The Indian Standards Institution has published the following two standards concerning containers for milk :

1. *Tinned Mild Steel Milk Cans*—The Indian Standard Specification for Tinned Milds Steel Milk Cans (IS: 1373-1959) prescribes the requirements for milk cans of 10, 20, 30, 40 and 50 litres capacity, used for collection and bulk distribution of fluid milk.

In India, at present, milk cans in use for bulk distribution are made of mild steel, aluminium and stainless steel. The three-piece mild steel milk can, which this standard covers, is, however, the most widely used. The formulation of separate specifications to cover one-piece mild steel milk cans, aluminium cans and stainless steel cans as also dispensing cans for retail distribution of milk is too under consideration.

2. *Glass Milk Bottles*—The Indian Standard Specification for Glass Milk Bottles (IS: 1392-1959) prescribes the requirements of dimensions, qualitiy and performance for 1-litre. 500-ml and 250-ml glass bottles for liquid milk other than sterilized milk.

In view of the fact that the use of milk bottles in India is at present limited only to the organized sector of the dairy industry which is not large, and also that bottles need replacement at short intervals, being susceptible to breakage, it was felt that the change-over to the metric system would not have adverse repercussions on the bottle manufacturing industry or dairy industry. In fact, the view was that this step would give added impetus to the change-over to the metric system in the entire dairy industry.

The standards published in English are priced at Rs. 2.00 each. Copies are available from the office of the Indian Standards Institution, 'Manak Bhavan', 9 Mathura Road, New Delhi-1 and from its Branch Offices located at Bombay, Madras and Calcutta.



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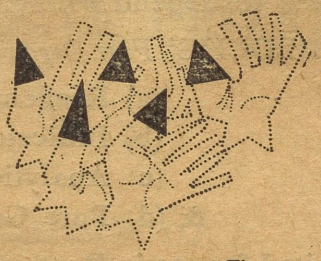

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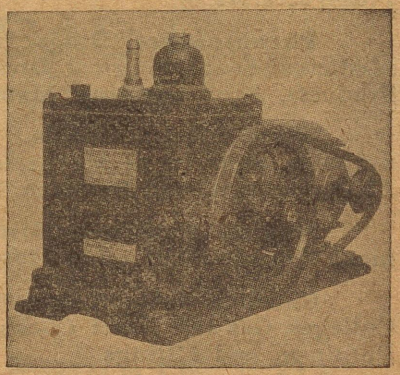

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