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Articles, Book Reviews, Letters to the Editor etc. are invited from our readers.

Materials should be sent to the Editorial Office, Vijnan Karmee, 92, Upper Circular Road, Calcutta-9.

Trade Union movement amongst Scientific Workers.

Trade Union movement in general is not a very old one in this country. It dates back to early twenties of the present century. The close analysis of the history of the movement will indicate some form of periodication in its growth and development. In the first period from early twenties to late forties the movement was mainly restricted to working class with one or two exceptional cases. The movement has, thereafter, extended its frontiers and brought within its fold middle class employees under organised trade unions variously named as Bank Employees' Association, Petroleum Federation, Mercantile Federation etc.

But trade union movement amongst scientific workers is still of more recent development as indicated by the birth of this association viz. Association of Scientific Workers of India in the year 1947. The reason for delay in the growth of this movement amongst scientific workers can be fairly explained on the basis of the well known principle—the most affected being drawn in first and the least affected last. However the Association, soon after its formation was able to attract a larger section of scientific workers all over the country. But its growth thereafter was not up to our expectation which necessitates a reassessment of its organisational position in different sectors of scientific workers viz. University, industrial organisations (Govt. & Non-Govt.), and research institutions.

In the university sector the growth of the movement is still in its infancy. This is not quite unexpected simply because herein the employer-employee relation is not so clear-cut as to warrant the growth of a trade union organisation to protect the rights and privileges of scientific workers concerned.

In different research institutions where the Association should have a very strong foothold response in all probability is very poor. We may take for instance the growth of the movement in the net work of our national laboratories under the auspices of Council of Scientific & Industrial Research. There are as many as eighteen national Laboratories & Institutions under C.S.I.R. Out of these the Association has got branches or units only in 5 or 6, which show that it has not yet been able to bring within its fold the majority of scientific workers employed there. Now the question is why this is so. It is not a fact that these scientific workers have had no problem of their own—not that the employer-employee relation is not so acute as to warrant its growth, but the truth is that scientific workers there are confronted with numerous problems which need for solution a collective bargaining on a trade union level. It shows that subjectively scientific workers are not at all prepared to avail themselves of the objective conditions.

In the Industrial sector (Govt.) response is equally not encouraging whereas in commercial firms, in the private sector, the response is alarmingly poor although the Association should have penetrated far more deeply in the ranks of these scientific workers. It is to this question of retarded growth that scientific workers of all shades and opinions should give their careful consideration. It is generally agreed that it is not lack of problems but lack of initiative to solve a problem that stands in the way. Too many, indeed, are the problems which they fail to solve on an individual plane not only once or twice but many times in the brief span of their service-life. Sometimes they do feel the need of united action, collective bargaining etc. to mention a few of the traditional trade union tactics but fear of victimisation, real or unreal, does push them back to the wall. In a word, a fear complex mus be at play somewhere in the psychologcal make-up of scientific workers.

Healthy trade union movement can flourish only in a democratic set-up. Employers and employees do feel even to-day a sort of delicacy to sit across a table just to thrush out a solution for any problem whatsoever. It is very unfortunate and unbecoming of democratic India. It is high time that we, all scientific workers, should seriously ponder over the matter.

The World-wide Movement against the Atomic Peril*

By

F. Joliot-Curie,

Nobel Laureate, For. Mem. R.S.

The preparations for the use of atomic energy for the mass destruction of human beings were carried out during the world war in conditions of secrecy which made it very difficult for large sections of public opinion to take any stand on the matter.

However, some honest and clear-sighted scientists, who were aware through their own work of the preparations for launching an atomic bomb did not hesitate to express their disapproval of the possibility as soon as it emerged.

It is to the credit of a committee of American scientists, the "James Franck Committee," that they sent to the Secretary of State for the Defence on 2 June 1945, two months before Hiroshima, a soundly reasoned report, arguing notably :

> *"If the United States were to be the first to release this new means of indiscriminate destruction of mankind, she would sacrifice public support throughout the world, precipitate the race for armaments, and prejudice the possibility of reaching an international agreement on the future control of such weapons."*

The events of the years following the the last war show this warning to have been well founded.

The atomic bombing of Hiroshima and Nagasaki opened people's eyes to the destructive power of these new weapons.

The negotiations which started in the United Nations Organization in January 1946 to save mankind from the catastrophe of atomic war have not yet been concluded. The sharpening cold war and the danger of seeing atomic bombs used once again seemed to many to be growing very great and public opinion, disturbed, began to express itself. A certain number of eminent scholars published warnings. But probably the first great public expression of the will to put an end to the atomic danger was the appeal of the World Peace Movement in April 1949 "for the banning of atomic weapons and other means of mass destruction."

On 19 March 1950, the same movement decided to proceed further through consultation with individuals by submitting to everyone for approval a very clear and very brief statement, known as the Stockholm Appeal, for the complete banning and control of atomic weapons. In less than 10 months over 600 million signatures were collected. To-day it is generally recognized that this consultation—because of the explanations to which it gave rise—made a considerable contribution to awakening public opinion to the reality of atomic dangers and to

* From 'Scientific World' II. 2 (No. 4) 1958.

the necessity for sustained and widespread action to avert them.

When, on 1 March 1954, the explosion of an H-bomb at Bikini claimed many victims, including the crew of a Japanese fishing-boat which was 120 km away from the explosion, the opposition to atomic weapons gained a new impetus. Countless individuals and organizations demanded the cessation of nuclear weapon tests and the banning of these weapons : the World Council of Peace, the Science Council of Japan, the W.F.S.W., the World Council of Churches, the Executive Committee of the World Federation of United Nations Associations, the Interparliamentary Union, the Parliaments of Japan, Italy, and the G.D.R., the Prime Ministers of India, the U.S.S.R. and Indonesia, Professor Einstein and many others. Statements denouncing the danger of atomic war were published in the following year by 18 Nobel Laureates while the statement[1] warning against these dangers, prepared on the initiative of Bertrand Russell and Einstein, just prior to his death, which I signed with ten other colleagues, made a profound impression. In his Christmas Message for 1955, Pope Pius XII pronounced himself in favour of the following three measures : renunciation of experimentation with nuclear weapons; abandonment of the use of nuclear weapons and control of armaments in genèral.

It was in August 1955 that the 1st World Conference Against A & H Bombs was held in Japan. Since this date, world conferences have been held each year in Japan on the anniversary of the bombing of Hiroshima and Nagasaki, called by the Japan Council against A & H Bombs; their preparation and proceedings make a considerable contribution to the mobilization of public opinion against the atomic danger.

The position of scientists in this field is a special one. Those who are socially conscious feel a double responsibility : on the one hand their very knowledge of the peril impels them to try to convince the public by giving objective information on the threat which oppresses mankind ; they realize that for this task they are perhaps better qualified and that their opinion will carry more weight. On the other hand, they are appalled when they see the finest achievements of modern science beng perverted and used to produce instruments of destruction of unparalleled power, since they understand very well the tremendous influence for the good of all mankind implicit in these self-same scientific achievements, if applied to constructive ends.

The W.F.S.W., like the Federation of American Scientists, has made its position clear time and time again. The W.F.S.W. has launched many appeals to men of science in all countries asking them to raise their voices in favour of the cessation of test explosions and the banning of nuclear weapons. The revelation by qualified scientists of the dangers which the accumulation of radioactive products in the atmosphere will bring to our own and later generations has given rise to great anxiety in recent years and has alarmed public opinion in many countries.

The month of April 1957 marked an important stage in the development of the campaign. On 12 April, 18 leading scientists of the Federal German Republic issued a statement in which, after pointing to the dangers of strategic nuclear weapons, they drew attention to the artificiality of the dividing line between so-called "strategic" and "tactical" nuclear weapons. *"Every single atom bomb or atomic shell has an effect similar*

1 Known as the Russell-Einstein statement.

to the first atom bomb which destroyed Hiroshima" they said, and went on to declare that *"in any case none of the undersigned would be prepared to participate in the production, testing or use of atomic weapons in any way."* Their action was immediately supported by a number of leading physicists from the German Democratic Republic. On 23 April, in an address broadcast by the Norwegian radio, Dr. A. Schweitzer drew the attention of the public to genetic and other effects of continued tests of nuclear weapons and ended with these words : *"The end of further experiments with atom bombs would be like the early sunrays of hope for which suffering humanity is longing."* To reiterate the magnitude of the danger of burdening each one of us and above all our descendants, and the urgent need for a halt to test explosions of nuclear weapons, the present writer issued a new warning on the same day[2].

During the same month, the Bureau of the World Council of Peace began a new campaign for an immediate truce on tests.

From then on the movement for the cessation of tests began to grow ever wider in extent. In June 1957 the noted American biochemist, Linus Pauling, made public a warning signed by over 2000 American scientists which stated :

"Each nuclear bomb test spreads an added burden of radioactive elements over every part of the world. Each added amount of radiation causes damages to the health of human beings all over the world and causes damage to the pool of human germ plasm such as to lead to an increase in the number of seriously defective children that will be born in future generations.

So long as these weapons are in the hands of only three powers an agreement for their control is feasible. If testing continues, and the possession of these weapons spreads to additional governments, the danger of outbreak of a catclysmic nuclear war through the reckless action of some irresponsible leader will be greatly increased.

An international agreement to stop the testing of nuclear bombs now could serve as a first step toward a more general disarmament and the ultimate effective abolition of nuclear weapons, averting the possibility of a nuclear war that would be a catastrophe to all humanity.

We have in common with our fellow men a deep concern for the welfare of all human beings. As scientists we have knowledge of the dangers involved and therefore a special responsibility to make these dangers known. We deem it imperative that immediate action be taken to effect an international agreement to stop the testing of all nuclear weapons."

This statement was taken up by scientists in many other countries until, by the end of 1958, some 9000 scientists from many countries had added their names to it.

People in all countries owe a tremendous debt to Japanese scientists who have carried out systematic investigations of the effects of radiation from the bombs that devastated Hiroshima and Nagasaki and of the effects of nuclear tests in poisoning with radioactive contamination the atmosphere and the soil, not only of Japan but throughout the whole world.

In the U.S.S.R., too, many scientists have added their own appeals to the world-wide call for ending tests and for the abolition of nuclear weapons. From the Joint International Institute for Nuclear Research near Moscow—home of the world's largest accelerator of high energy nuclear particles—came a call signed by Professors Blokhintsev and Veksler and their leading colleagues, including scientists from China, Czechoslovakia, Poland, Rumania and Mongolia, which stated :

"We categorically pronounce ourselves in favour of banning atomic weapons and concluding an agreement among the countries as

2 N.D.L.R. The French Radiotelevision suppressed this broadcast but the text was published.

soon as possible on ending atomic and hydrogen bomb tests without delay, considering that any atomic war, wherever it may originate, would inexorably become a general atomic war, with dire consequences for mankind to-day."

Leading Soviet oncologists, including Professor Engelhardt, said in a statement :

"We side with our foreign colleagues in their desire to protect people from the harmful effect of atomic explosions. In principle we stand for the complete prohibition of atomic and hydrogen weapons and insist on the need to ban the tests of these weapons as the first step in this direction."

In France 1172 scientists and others working at the nuclear centre at Saclay signed a declaration calling for the French government to take the initiative in trying to get other governments to cease the testing of nuclear weapons.

And so one could go on. Scientists from China, Bulgaria, Czechoslovakia, Hungary, Poland, Rumania, Denmark, India, Argentina, Australia and no doubt from many other countries have all warned about the dangers, particularly of continued test explosions.

One other significant activity of scientists has been the international con ferences of scientists that have been assembled in response to a call made in the Russell-Einstein declaration of 1955. The first of these meetings was held at Pugwash, Novia Scotia, in July 1957 and at the end of its deliberations a most important assessment of the perils of nuclear weapons was issued, to which some twenty-two eminent scientitsts from ten different countries of both East and West, attached their names.

A further private conference was held at Lac Beauport, Quebec, in April 1958, while a large gathering of scientists is being organized in Kitzbühl and Vienna in September 1958, to draw up a statement that will, it is hoped, appeal in even more pressing and authentic terms, for a stopping of the nuclear arms race.

The efforts of the scientists have met with a ready response from the people in many countries. Great campaigns against nuclear weapons are being fought in England, in the Federal German Republic, in Japan and in many other countries.

The decision taken by the Soviet Government on 31 March 1958 to suspend tests of nuclear weapons unilaterally, raised the hopes of the world that this gesture would soon be followed by the Governments of the U.S.A. and Great Britain. Public opinion is following with close attention the conversations which are going on in the hope of reaching agreement on this question between the Three Powers who hold nuclear weapons. The widespread feeling of alarm about the possibility of nuclear war has had in recent weeks a profound influence on the policy of many countries and has led to the demand for a Summit conference between the Great Powers.

No one is in doubt as to the wishes of the public. They are on guard, they are conscious of the threat hanging heavily over mankind and they wish tests of nuclear weapons to be ended. If they know how to express their will with still more vigour, if all forces for peace follow this aim with determination, it can be attained before it is too late.

The Third Pugwash Conference*

Necessity to End Wars.

We meet in Kitzbuhel and in Vienna at a time when it has become evident that the development of nuclear weapons makes it possible for man to destroy civilization and, indeed, himself; the means of destruction are being made ever more efficient. The scientists attending our meetings have long been concerned with this development, and they are unanimous in the opinion that a full-scale nuclear war would be a world-wide catastrophe of unprecedented magniture.

Although the nations may agree to eliminate nuclear weapons and other weapons of mass destruction from the arsenals of the world, the knowledge of how to produce such weapons can never be destroyed. It appears therefore that atomic weapons are likely to be employed in any future major war, with all their terrible consequences. Mankind must therefore set itself the task of eliminating all wars, including local wars.

Requirements for Ending the Arms Race

The armaments race is the result of distrust between states; it also contributes to this distrust. Any step that mitigates the arms race, and leads to even small reductions in armaments and armed forces, on an equitable basis and subject to necessary control, is therefore desirable. We welcome the recent agreement in Geneva between representatives of East and West about the feasibility of detecting test-explosions. We note with satisfaction that the governments of the USA, USSR and UK have approved the statements and the conclusion contained in the report of the technical experts. This is a significant success; we most earnestly hope that this approval will soon be followed by an international agreement leading to the cessation of all nuclear weapon tests and an effective system of control.

It is generally agreed that any agreement on disarmament, and in particular nuclear disarmament, requires measures of control to protect every party from possible evasion. Through their technical competence, scientists are well aware that effective control will in some cases be relatively easy, while it is very difficult in others.

We recognize that the accumulation of large stocks of nuclear weapons has made a completely reliable system of controls for far-reaching nuclear disarmament extremely difficult, perhaps impossible. For this disarmament to become possible, nations may have to depend, in addition to a practical degree of technical verification, on a combination of political agreements, of successful international security arrangements, and of experience of successful co-operation in various areas.

Recognizing the difficulties of the technological situation, scientists feel an obligation to impress on their peoples and on their governments the need for policies which will encourage international trust and reduce mutual apprehension.

* An extract of the statement of the Third Pugwash Conference, held at Kitzbuhel, Austria, September 14-19. 1958 is presented. The statement was signed by distinguished scientists of different countries.—Ed.

Hazards of Bomb Tests.

At the first conference it had been agreed that while the biological hazards of bomb tests may be small compared with similar hazards to which mankind is exposed from other sources, hazards from tests exist and should receive close and continued study. Since then, an extensive investigation by the United Nations Scientific Committee on the Effects of Atomic Radiation has been carried out and its authoritative conclusions published. Their conclusions confirm that the bomb tests produce a definite hazard and that they will claim a significant number of victims in present and following generations.

It goes without saying that the biological damage from a war, in which many nuclear bombs would be used, would be incomparably larger than that from tests; the main immediate problem before mankind is thus the establishment of conditions that would eliminate war.

Science and International Co-operation.

We believe that, as scientists, we have an important contribution to make toward establishing trust and co-operation among nations. Science is, by long tradition, an international undertaking.

The ability of scientists all over the world to understand one another, and to work together, is an excellent instrument for bridging the gap between nations and for uniting them around common aims. We believe that working together in every field where international co-operation proves possible makes an important contribution towards establishing an appreciation of the community of nations. We hope scientists everywhere will recognize their responsibility, to mankind and to their own nations, to contribute thought, time, and energy to the furthering of international co-operation.

We call for an increase in the unrestricted flow of scientific information among nations, and for a wide exchange of scientists. It is our belief that science can best serve mankind, if it is free from interference by any dogma imposed from the outside, and if it exercises its right to question all postulates, including its own.

The Responsibility of Scientists.

We believe it to be a responsibility of scientists in all countries to contribute to the education of the peoples by spreading among them a wide understanding of the dangers and potentialities offored by the unprecedented growth of science.

In the present conditions of distrust between nations, and of the race for military supremacy which arises from it, all branches of science—physics, chemistry, psychology—have become increasingly involved in military developments. This diverts science from its true purpose, which is to increase human knowledge, and to promote man's mastery over the forces of nature for the benefit of all.

We deplore the conditions which led to this situation, and appeal to all peoples and their governments to establish conditions of lasting and stable peace.

Science and the Age of Sputniks

By

B. N. Tewari

TDE Textiles & Clothing, Kanpur

Men of Science have sometimes claimed that when they make a discovery, they have no more responsibility for its use than any other citizens. In fact they have often been reproached for not concerning themselves sufficiently with the effects of their discoveries on society. For they have an influence over contemporary action which is possessed by no other class in the society. While a generation ago, no one seriously doubted that science, a manifestation of the highest qualities of the human spirit, was one of the most fertile sources of material and spiritual benefits, the scientists are now, in the words of the late Archbishop Garbett, listened to by those who pay little heed to the ecclisiastic, the philosopher or the poet. Often their casual opinions, even on subjects outside their special field, are given reverent attention.

It is true that the spread of scientific knowledge among the peoples always encountered strong resistance from the devotees of mysticism and superstition, but in spite of the early difficulties and injustices due to misuse of scientific progress, the faith of the people in science has continued to grow steadily.

Nuclear explosions and the resultant distress.

The events, however, of the last fifty years have noticeably modified this general attitude. More and more frequently since the end of the last century, anxiety and distress have been expressed about some of the evil results of science. Some people even go so far as to question the value of science in civilisation. Recent events concerning the atomic, nuclear and thermo-nuclear explosions, radioactive fall-outs and their genetic effects have increased still more the state of confusion, both in the minds of scientists themselves, and in the general attitude towards science. Such an attitude should be regarded by scientists as a matter of the greatest concern. For in science and technology lies the key to wealth ; and the creation and distribution of wealth are the warp and weft of the many-patterned texture of politics.

Science and incumbent responsibility of scientists.

It is pertinently for the reason that scientists and engineers do not want to get themselves involved in political controversy that they have in the past deliberately avoided thinking more than they can help about the social consequences of their collective achievements. But it must be remembered that scientists share the responsibility with all citizens, of influencing the policy of the country in respect of nuclear power as in other matters : whilst physicists played a decisive part in the invention of the atomic bomb, to manufacture these weapons requires the whole resources of a modern state, and scientists alone cannot prevent their construction. On the other hand, they must educate their fellow countrymen to use rightly the inventions they have given them, and must make it plain that the devastating results may follow their wrong use.

Sputniks and the future of science.

Recent events, springing from the programme of the International Geophysical Year, have completely revolutionalised scientific thought. As the result of strenuous work of a large team of scientists, engineers, technicians and factory workers, it became possible for sputniks to be hurled into the outer space and was made to move in a predetermined orbit. The first Sputnik which was launched on October 4 last, weighed 184 lbs. and revolved around the earth at a maximum height of 630 miles; while the second Sputnik which was rocketed to the outer space within a month of the first one, weighed 1118 lbs., and was revolving at a maximum height of 1,000 miles. Both the Sputniks had a speed of 18,000 miles per hour. Yet another Sputnik, fitted with high-precision automatic apparatus, has now been circling the earth and the space with the object of taking a graphic view of the various elements those are extant and have hitherto been practically unknown. A Baby Moon has also been launched on the outer space. These have enabled scientists to conduct for the first time several experiments in the top layers of the atmosphere as also to study their characteristic features. Scientists all over the world are eagerly waiting to get the latest knowledge about cosmic rays, solar activity, magnetic storms and the colour of the earth. This in fact is a concrete symbol of man's coming liberation from the forces which have hitherto bound him to earth and wishing that the new techniques now developed could be harnessed for a greater cooperative human assault on the barriers of distance which still separate us from our nearest neighbours in space.

Indeed science has mastered techniques of producing extremely powerful rocket motors, materials of construction to withstand extremely high temperatures and automatic devices of extreme precision. It may well be stated with assurance that the first step to man's flight in a rocket has been already made, and mankind is already on the threshhold of realising the idea of interplanetary communications. In fact, the level of modern technique has already made it possible to build a rocket for a flight to the moon.

Conclusion.

Scientific thought and the applications of scientific technique has profoundly modified our appraoch not only to the social activities of manufacture and trade but also to the fundamental question of morals and the nature of the universe. Yet our public life is still dominated by an attitude that looks backwards rather than forwards, and is unaware of the opportunities waiting for those with a little courage. It is only by cooperation at an international level that scientists can help mankind to seize these opportunities for our great benefit rather than for our destruction. As Professor Joliot-Curie says, "Scientific knowledge brings peace to our spirits, and a firm faith in the assent of man, by casting out superstition and the fear of invisible forces; and by giving us an even clearer understanding of our place in the universe".

The Contribution of Indian Chemists to the Progress of Chemistry

By

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In the present article the results of a systematic attempt at searching the Annual Reports On The Progress Of Chemistry published by the Chemical Society, London (1904-1956) for the work of Indians are presented. It will enable those interested in the progress of chemical researches in India to derive a true picture of the number of first grade research workers during the last fiftythree years and the rate of progress of recognized researches in India as compared with that in the world on standards laid down by a disinterested distinguished foreign body.

While we feel proud of our achievements based on the number of articles published by us, it is necessary to be aware of our limitations by a knowledge of their critical valuation by competent authorities on the subject. In the Annual Reports important publications of the year are mentioned and, where necessary, reviewed in brief or at length. Mention is also made of the other publications of the year such as, books, pamphlets, reviews etc. which, in the opinion of the Publication Committee, is in some way conducive to the progress of chemistry.

The Publication Committee for 1956 consisted of 34 members of whom 17 were Fellows of the Royal Society, London. The committee was assisted by thirtyfour contributors, one editor and three assistant editors.

The writer undertook this work in the course of his studies and, finding that the results had national utility, thought of publishing them in the form of an article so as to enable certain bodies, scientific and others, in charge of public affairs, to have a direct access to the recorded opinion of an authoritative body on the research publications of the Indian chemists.

The number of papers published has little bearing on their worth and it is necessary therefore to have them assessed. Attempts have been made to present the research publications of Indian chemists in a concise form. The National Institute of Sciences of India in "The Progress of Sciences in India" has published an account of the research publications of Indian research workers ; but a work of this kind necessarily suffers from the intrinsically difficult task of critical assessment of the value of the published articles which no one person, nay, not even a small group of persons, can undertake. Perhaps a better attempt, as far as chemstry is concerned, was made at the time of celebration of the Silver Jubilee of the Indian Chemical Society about a decade ago. The souvenir, then published, made a good survey of the work on which chemists throughout India were engaged. The work of outstanding Indian chemists was presented in a nutshell and their activities were also pointed out.

The Chemical Society, London, undertook the work of reviewing the world output of researches of every year in the Annual Reports in the year 1904 and since that year the Annual Reports On The Progress Of Chemistry are regularly published. The body in charge of the work is a highly respectable one. The assessment of the published work of the Indian research workers by this distinguished body, carried out in the course of their routine activity, may therefore be taken as an index of quality of work as judged by a disinterested body.

The number of papers mentioned in the Annual Reports may not necessarily indicate excellence of quality but for most purposes it does; for, where the quality of one or a few articles only is above normal this is readily made out from a perusal of the review. Without mentioning names it may be stated in general, that instances of such articles of Indian chemists are not altogether absent in the Annual Reports.

It can scarcely be denied by enlightened chemists that a large number of Indian publications has scant material in them. Quite frequently an article which cannot find place in certain foreign journals even in the space alotted to "Letters To The Editor" is found to enjoy the proud place of a "Paper" in an Indian journal. Not quite infrequently "Notes" and "Communications To The Editor" are wanting in any important substance. Little wonder therefore that a body which does not make mention of even "Papers" published in such first grade journals as the Journal Of The Chemical Society, London, the Journal Of The American Chemical Society or Z. Anorg. Chem., does not deem them suitable for being recorded in the Annual Reports. The writer knows of some chemists who have published quite a few papers in the Journal Of The Chemical Society itself without any of them being mentioned in the Annual Reports. Hence the only plausible inference is that the material in the paper, or the article, must fulfil certain minimum standards of requirement and should be conducive to the progress of chemistry; on the otherhand, there is mention in the Annual Reports of 'Notes' and 'Communications to the Editor' published in periodicals even of less prestige. Practically all periodicals are mentioned at one time or the other in the Annual Reports. If criticism has to be objective and creative this probably is the proper view.

The present article affords a systematic collection of the number of articles of the Indian workers in the Annual Reports. The first impression which a survey of this collection creates in the mind of a critical observer is the profoundly small fraction of the total published work which has found place in the Annual Reports. Table I* records almost the entire statistics of the work of the Indians with name of the worker, the number of his papers classified as Independent work (under 'I') as Principal work (under 'P') and as subsidiary work (under 'S'). The year or years of the Annual Reports in which the paper or papers are mentioned are also stated under the name and beside the year is written letter (or letters), P.,I.,O.,B.,A. which signify the section of the Annual Reports in which the article is mentioned (P stands for General & Physical, I for Inorganic, O for Organic, B for Biolo-

* Table I has been published separately by the author as an appendix to this article. Those interested might obtain a copy of the same on applying to the author.—Ed.

gical and A for Analytical chemistry). The papers mentioned under other sections such as chemical kinetics, colloids, crystallography, photochemistry etc., which are topics of physical chemistry, are also classed under P. The papers in sections on Agricultural chemistry, Physiological chemistry and the like, which are related to biological chemistry, are grouped under B and those in sections of Geological chemistry, Mineralogical chemistry etc., are grouped under P. In grouping the papers in this way the utilitarian point of view has been kept in mind.*

During the last fiftythree years, from 1904 to 1956, about 2700 to 2800 papers of Indian workers seem to have been recorded in the Annual Reports. Of these about 1500 to 1600 constitute the work of Indians under someone else's guidance : foreign or Indian. The rest constitute the work of Indian workers as independent or sponsored work. For the purpose of this classification the work of Indian worker in collaboration with a foreign worker is assumed to be his subsidiary work irrespective of whether his name stood first, last or in the middle. Where the workers are all Indian, the number of published papers or the known prestige of the authors has been taken as criterion for calling an article principal or subsidiary. The writer is aware of his limitations and some discrepancies may be found. Because of the semblance of surnames, phonetic or otherwise, the names of some non-Indians may have been, by mistake, entered as Indians and so also some Indian names may have been left off if the surnames could not be deciphered correctly by the present compiler. Such discrepancies are inevitable in a work of this kind. It is hoped that such discrepancies are not many and are, at any rate, within the limits of normal comprehension in the region concerned, and the general conclusions drawn remain valid.

A note of caution must be signalled against overemphasis on the quality of our work. The output of work is apallingly poor and the quality, except in a few cases, leaves much to be desired. The writer is aware of some chemists who have over sixty publications to their credit with less than two mentioned in the Annual Reports. Some of these persons may be found to hold very high positions and it is in national interest to remember the words of J.B.S. Haldane, conveying that the Indian scientists are not mature enough, as a cause of the disappointingly slow progress of science in India despite fine laboratories and means. Professor Haldane says that in Europe the scientists are polite about the work of their juniors and ruthlessly critical about the work of those with established reputation. But the position in India is the reverse : those at the top will often not recognise the work of their juniors and will scarcely allow criticism of their own work. This means that where people in power do not, for some reasons, want to look up for truth about a matter, a talented worker may be crushed and stampeded for life ; for as Goethe has said it is easier to perceive an error than to find the truth : the former lies on the surface and the latter needs deeper probing which few are willing to undertake. Added to other weaknesses there are casteism and provincialism deep-rooted in the Indian soil. Great vigillance is therefore necessary on the part of those on whom devolves the responsiblity of making the future of India bright.

* For want of space Table I could not be included in this article. But a fairly good picture of the value of the Indian Contribution in Chemistry has been given in Table II.

Table II shows that some few chemists have given a good account of themselves. These people had the good fortune of being placed in positions of authority so that their intrinsic ability was able to display itself without outside hindrance. India has, in no period of its history, been found wanting in men of brains but quite often these brains are not free to work their way and others are busy working out constitutional methods of perpetuating casteism, provincialism and the like. Our men must develop character if we are to live and grow.

Acharya Prafulla Chandra's name has not been placed in Table II as his name and work stand on a different footing altogether and baffles comparison as the work of a pioneer of modern researches in chemistry in India. His position is in the centre at the top of the table. The Table shows that Physical chemistry, like physics, holds high promise and organic chemistry also seems to afford some promise but, as pointed out by Sir J. C. Ghosh some time back, Inorganic chemistry is on a decline and seems to hold little promise for the future despite the fact that the zone of inorganic chemistry is today far wider than what it was in the beginning of the present century. Boundaries of knowledge have receded in all ages and it is dangerous to cling to old frontiers. Professor P. Ray has been an active worker ever since 1912 and his work continues unabated till today and there is no doubt it will continue for many years, but it is regrettable that in all these years none has been found who can take his place. Recent recognition of the work of Santi R. Palit and R. Sinha in Physical chemistry, of Asima Chatterjee and T. R. Govindachari in Organic chemistry, of A. B. Roy in Biological chemistry and of B. S. V. R. Rao, A. K. Majumdar and G. G. Rao in Analytical chemistry is encouraging. But Table III shows how disappointing the picture has been in all the fiftythree years. The percentage of Indian chemists with recognized work to their credit is frightfully small and stands no comparison with the population figure. The last decade has seen some little improvement over its preceding decade, but this is of minor character, and not much work as independent or principal is discernible. There is, on the whole, a stalemate during the last forty years.

A word for Bombay state may not be out of place. Research has not thriven among the Bombayites. Amongst those who have received recognition in Indian scientific circles the names of only two are borne out by facts of this work. These two men are Dr. Mata Prasad and Dr. K. Venkataraman. It is not for the author of this article to divulge here the causes which have hampered the growth of truly scientific atmosphere and institutions in the state of Bombay.

Acharya J. C. Bose and Acharya P. C. Ray, the pioneers among the Indians to foster modern scientific research work in India, hailed from the East. Ramanujam and C. V. Raman hailed from the south and S. S. Bhatnagar and M. N. Saha hailed from the North. There is none except H. J. Bhabha who can be mentioned from the West in the category of these luminaries. The western India is much behind the rest of India in the output of recognized research work.

Before concluding is is important to point out that there is an acute dearth of properly qualified personnel in chemistry in India. During the last fiftythree years there have been barely 120 chemists from India with five or more than five papers mentoned in the Annual Reports. This figure is incredibly small and yet it includes chemists also as subsidiary workers. It is evident therefore that the need of chemistry personnel of India cannot be met by the limited numbers of men of such approved merits. Great care is therefore necessary in the selection of men for key positions, for it is these men who make or mar our future. Only men imbued with true scientific spirit can foster that spirit in the environment and inspire research workers to correct goals. Unless such conditions are created research cannot thrive. Results of scientific research work cannot be perceived overnight. It is not true to say that we have men of ability in all the fields of science. While some of the physicists of India can be compared with those of outside India, this is probably not true of men in the other branches of science. We must therefore be cautious in the execution of our plans of nationalisation of services or we will do damage to the very cause. If means are good, ends can take shape. Great precaution is necessary to guarantee that the younger generation is allowed to show its talents unhampered in their legitimate activities and aspirations.

It is necessary to refer to the obvious fact that the present criterion of judging the value of work through assessment by an impartial body of men (non-Indian), though very dependable, will, in practce, be not of great help. For, the number of persons possessing such recognized work to their credit is not large enough. It may therefore be used along with the National Institute of Science's publication : 'Progress of Sciences In India, Part III'. Looking to the fact that we are in great need of qualified chemistry personnel with sound basic training, intensive search for real merit of a candidate for appointment to an important post will have to be undertaken. In assigning merit, credit should also be given to the reference of the candidates' work in Reviews, standard Text-books, Monographs and the like ; for, it sometimes happens that a work not mentioned in the Annual Reports is well reported in these. It should also be recognized that aptitude for doing original work of merit is the criterion of ability and not the fact of foreign training ; for, very few foreign returned men have in recent times shown adequate work after return to the homeland.

TABLE II

Indian Chemists In The Annual Reports Of The Chemical Society, London, On The Progress Of Chemistry (1904-1956) *In The Order Of Their Number Of Papers Mentioned or reviewed :*

General & Physical Chemistry	Inorganic Chemistry	Organic Chemistry	Biological Chemistry	Analytical Chemistry
1. S. S. Bhatnagar I P S (Book) (31) 1 30 0 (1921, 24, 25, 31, 36, 39, 41, 42, 46, 49, 56)	1. P. Ray I P S (34) 1 32 1 (1912, 22, 26, 28, 29, 31, 33, 34, 35, 41, 44, 45, 48, 51, 53, 55)	1. T. R. Seshadri I P S (23) 0 21 2 (1930, 31, 36, 38, 39, 40, 42)	1. B. C. Guha I P S (12) 0 12 0 (1930, 33, 34, 35, 36, 37)	1. B. S. V. R. Rao I P S (28) 0 28 0 (1949, 50, 51, 52, 54, 55)
2. N. R. Dhar I P S (Book) (30) 6 21 3 (1912, 13, 16, 24, 25, 27, 28, 29, 31, 32, 35, 36, 37)	2. P. B. Sarkar I P S (14) 3 9 2 (1922, 26, 27, 28, 30, 31, 32, 36, 42)	2. J. N. Ray I P S (14) 2 10 2 (1920, 25, 28, 29, 31, 34, 37, 35, 43)	2. A. B. Roy I P S (12) 10 2 0 (1956)	2. A. K. Majumdar I P S (20) 9 10 1 (1935, 45, 46, 51, 52, 53)
3. J. N. Mukherjee I P S (18) 5 13 0 (1924, 25, 30, 40)	3. P. Neogi I P S (10) 1 9 0 (1911, 15, 17, 27, 28, 34, 39, 44)	3. K. Venkataraman I P S (13) 1 10 2 (1929, 31, 50)	3. Adair G. S. I P S (7) 7 0 0 (1925, 40)	3. G. G. Rao I P S (12) 1 11 0 (1940, 53, 55, 56)
4. Mata Prasad (Prasad, Mata) I P S (20) 1 16 3 (1924, 25, 31, 33, 35, 36, 39, 40, 41)	4. R. C. Ray I P S (12) 3 5 4 (1912, 17, 22, 25, 32, 37, 42, 48)	4. P. K. Bose I P S (13) 2 7 4 (1929, 31, 36, 37, 39, 40, 41, 50)	4. H. G. Day I P S (7) 0 7 0 (1939, 44, 46, 49, 54)	4. R. C. Gore I P S (12) (book) 6 0 6 (1945, 46, 49, 51, 52, 54, 56)
5. J. C. Ghosh I P S (13) 5 7 1 (1917, 19, 20, 24, 25, 30, 37, 49, 50)	5. T. M. Oza I P S (8) 1 7 0 (1948, 51, 53, 55, 56)	5. A. Chatterjee I P S (12) 0 10 2 (1949, 50, 53, 54, 55, 56)	5. M. Sreenivasayya I P S (7) 3 3 1 (1929, 30, 51, 52)	5. B. Singh I P S (12) 0 11 1 (1923, 52, 53, 55, 56)
6. J. Gupta I P S (16) 2 10 4 (1934, 35, 36, 37, 38, 51, 52, 56)	6. J. N. Rakshit I P S (6) 6 0 0 (1913, 16, 17, 27)	6. B. N. Ghosh I P S (11) 4 4 3 (1915, 16, 25, 54, 55)	6. V. Subramanyan I P S (13) 2 2 9 (1927, 30, 34, 36, 40, 44, 50)	6. A. Singh I P S (6) 1 4 1 (1936, 38, 42, 52, 53, 54)
7. S. R. Palit I P S (12) 2 10 2 (1950, 52, 54, 55, 56)	7. R. L. Datta I P S (4) 2 2 0 (1914, 17, 19, 55)	7. T. R. Govindachari I P S (9) 0 7 2 (1951, 52, 53, 54, 56)	7. R. H. Dastur I P S (5) 0 5 0 (1934, 36)	7. R. C. Mehrotra I P S (11) 2 2 7 (1950, 51, 52, 53, 54)
8. R. Sinha I P S (13) 10 1 2 (1944, 46, 50, 52, 53, 54, 56)	8. N. K. Datta I P S (5) 1 1 3 (1939, 41, 49, 55)	8. P. C. Guha I P S (7) 2 5 0 (1922, 38, 50, 55)	8. K. Neelakantham I P S (4) 0 4 0 (1942, 45, 51, 52, 53)	8. A. K. Dasgupta I P S (6) 0 4 2 (1951, 52, 53, 55)

TABLE III

Total Number Of World Chemists And The Number Of Indian Chemists In The Annual Reports (1904-1956) :

Period	Approx. Total No. of world chemists (average|year)	Approx. Total No. of Indian chemists (average|year)	No. of Indian chemists per 100 world ones
1904-10	1200	4	0.3
1911-20	850	11	1.3
1921-30	1670	33	2.0
1931-40	2540	66	2.6
1941-50	2395	44.5	1.8
1951-56	5520	135	2.4

Letters to the Editor

Dear Sir,

I would like to make the following comments on Shri Rais Ahmed's letter on "The Passive Scientific Worker" in the April, 1958, issue of the Vijnan Karmee. The comments are divided into two parts, I & II.

Part I

The Scientific organisations in India have within them certain components which are parasitic and sometimes behave as predators for their own life-blood. It is unmistakably true that juniors are exploited by seniors to the utmost degree for propelling their own career. Many a times the fresh entrant is unacquainted with the netherland activities of their seniors. When they become aware of it, the virgin devotion of their intellect gets the first demonic shock and becomes darkened. Those who are of austere habits and strength and refuse to associate themselves in the early manoevres, are soon stamped out by the toppers as nin-com-poop. A promising son of the soil is turned out to be redundant, null and void. The claw of starvation keeps them in perpetual chain to serve those punny lords. The situation parallels the condition of those who served the feudal lords prior to industrial revolution in the west.

Science is knowledge. Knowledge is power. Many must have known, science or no science, knowledge or no knowledge, position is *the* power and vice versa. A little senior position has hushed down, has stilled off the wonderful creative pulsation in many a bright young scientists in India and the play is being played out openly as well as secretly without any sign of wear.

The easiest ladder for lift is by human associations. The subject of human association has been polluted by the careerists and those who have lent support to this, are no less to be condemned.

The function of leaders in science and scientific organisation is to show the individual how to release his latent and undreamt-of energy in an effective and usable form for the organisation vis-a-vis the nation and thus uplift the individual from the despondent look and pallid expressions and obtain his real assent and obedience for the organisation and thus for the nation. India speaks of her ancient quality. One of those qualities was that they did not suppress the individual for personal benefit.

Shri Rais Ahmed's paragraph under "why this cynicism" contains the truth of an underworld.

Part II

I maintain large differences in views "on the way out" as visualised by Shri Ahmed. I do not discover anything *in the way* for juniors for whom he has been outspoken in the 'cynicism' column. He has rightly said that the "undercurrent of criticism should be brought to the surface in such a manner that it changes from personal grievance to a constructive and objective evaluation of the present practices and their results". He has not said how this is to be done and whatever he has said in the remaining paragraphs is too hazy and imperfect. In fact, it has become my impression if he was not trying to put the cart before the horse.

I would like to suggest the following as the functions of the ASWI with respect to the preceding problems. The ASWI should aim at emancipating the individual scientific workers from the present unhapy position by,

(1) inducing each scientific organisations big or small, Government or Private, to create incentives of various degrees amongst all levels of scientific workers and especially, the juniors.

(2) asking the senior scientists to be sympathetic towards the works of the juniors but critical about the seniors' works.

It is worthwhile to quote from Prof. J. B. S. Haldane's "The Dilemma of a Scientist" (published in "Hindu", Madras, dated 6 Oct., 1957).

"I have already come to one conclusion as to why science in India is developing with disappointing slowness. It is not because that Indians are stupid or lazy. It is because they are too polite. They spend hours daily in conversation with others, not on professional matters but on personal topics."

"At scientific meetings and usually in ordinary discussions my Indian colleagues are polite about one another's work. In Europe, we are usually polite about the work of juniors and highly critical of men and women of established reputation."

(3) vigorously agitating for graded promotion. A scientific worker must not remain in the same position throughout his career.

(4) insisting or giving responsibilities on each scientific worker.

The object of looking to the interests of juniors or individuals is not to make them well-contented, future—certain, lethargitic shoals of vanity-ridden scientific workers. The responsibility should thrust upon the scientific worker the sense that he must decide for himself and act for himself and not go on constantly referring to his seniors what to do and what not. In fact the seed of leadership should be ingrained here.

(5) examining the National Register.

It is well-known that the Register is incomplete. ASWI should find out if the fault is with the Management or the workers. They should impress upon the management of the CSIR who maintains this register, the need for advertisement in all newspapers over a period of several years. Even the question of allotment of a registration number may be mooted.

ASWI should enquire what use has been made of the Register. They should collect facts regarding, if a candidate has been called for interview from the list of Register and what has been the departmental attitudes in this respect. It should be ascertained if the Register is anything more than a calendar of numbers and also benefits those who has no good connection whatsoever except paper particulars.

(6) watching the recruitment policies and their operations.

Certainly ASWI cannot elect members to the recruitment bodies. Yet they can have certain measure of probe about the performances of candidates after selection. In spite of the best and no doubt impartial character of the composition of interviewing bodies, there are many shams who come up ostensively to guide others and these prove that there do exist serious loopholes. Who is to put finger upon these dark spots ?

The expression 'Junior' used vide infra, requires to be clarified. Anyone may be a junior to another in service. It is difficult to draw a line of demarcation. The line that divides between officers and non-officers is a good and true one. But still I would like to suggest a 38th parallel between those who are drawing below of Rs. 500|- and above. However ASWI is not a parochial organisation. It will aim at watching all status of persons.

Lastly let me touch upon an important and exciting point.

I do not belong to the company of those who hold everything Indian as good or even desirable.

ASWI is an Indian product. Does it contain self-less workers ? Does it contain workers who believe in its cause and are dedicated to it ? Or do not its members or rather the prominent members regard its membership & activities as the stepping ladder to some field for personal recognition ?

If ASWI can vouchsafe on having right type of workers and can be quick in dismissing self-seekers, whatever might have been their contribution on certain occasions, it might have laid down some foundation over which the future scientific workers could build its structure safely.

Yours faithfully,

J. C. CHAUDHURI

Defence Research Laboratory (Stores)
Kanpur.

Association News

Association of Scientific Workers, Lucknow Branch.

The Lucknow Branch of the Association of Scientific Workers of India held its annual meeting on Monday the 25th August, 1958 at the Central Drug Research Institute.

At the meeting, one minute's silence was observed to mourn the death of Prof. F. Joliot-Curie and the following condolence resolution was passed :

"While mourning his loss this Branch of the A.S.W.(I) pledges its whole-hearted support to the movement for peace and banning of nuclear weapons and sends its heart-felt condolences to the bereaved family."

After the passage of the resolution, the meeting discussed the treasurer's and Secretary's annual report and elected the following office bearers and executive committee members for the year 1958-59.

President :
Dr. B. Mukherji (Central Drug Res. Instt.)

Vice-President :
Shri S. L. Kumar (Railway Testing & Res. Cent.)
Dr. M. L. Gujral (Medical College)

Secretary :
Dr. V. C. Vora (C.D.R.I.)

Jt. Secretary :
Dr. D. N. Misra (Lucknow University)

Treasurer :
Dr. J. D. Kohli (C.D.R.I.)

Executive Committee :
Dr. R. N. Lakhanpal (Paleobotany Institute)
Dr. B. P. Adhikari (Lucknow University)
Shri K. Bhattacharya (Rly. Res.)
Shri Manoharlal (P.W.D. Res. Inst.)
Shri S. Bhattacharya (C.D.R.I.)
Dr. R. P. Rastogi (Ex-officio Secy., C.D.R.I. Unit)
Dr. Sharad Kumar (Medical College)
Shri B. K. Nayar (N.B.G.)

The meeting concluded with an appeal by the President to the Scientific Workers to take more active interest in the association and make it truly representative and effective as a trade union of the Scientific Workers.

Secretary's Report (1957-58) :

During this year the Executive Council met five times and was able to organise a number of lectures and cinema shows and a very successful contributory tea social which was attended by more than 175 scientific workers of Lucknow.

The following lectures were arranged during the year :

(i) Shri V. V. Giri
"Science & Social relations".
(ii) Shri S. L. Kumar
"Recent developments in Rail trans. in India & abroad."
(iii) Shri Sampurnanand
"Space Travel".
(iv) Dr. B. Mukherji

"Drug Industry and Research in India".

(v) Shri Sampurnanand

"Scientific basis of Astrology".

(vi) Dr. B. Mukherji

"Organization of scientific Research & teaching in U.S.S.R. and other countries".

For the first time the Central Executive held its meeting in Lucknow on 28th July, 1958.

In order to make this organisation truly representative it is necessary to have active units functioning in different scientific institutions in Lucknow. We have nucleus of such units in practically all the institutions in Lucknow except in the Central Sugarcane Research Institute and Planning Action Research Institute. Scientific workers in the P.W.D., Research Institute of the U.P. Government have succeeded in obtaining necessary permission for the formation of an association. This is mainly due to the persistent efforts and interest on the part of our Vice-President Shri Manoharlal for which he deserves our thanks and congratulations.

For an association of this type to succeed as a trade union of Scientific Workers, it is essential that Scientific Workers realize the advantages of uniting together and should take more interest in the workings of the Association.

A.S.W.I., Central Fuel Research Institute Branch. Dhanbad.

A Branch of the ASWI has been established at the Central Fuel Research Institute, Dhanbad with 51 members. The following office-bearers and members of the Executive have been elected :—

President :

1. Dr. M. S. Iyengar

Vice-President :

2. Shri B. K. Majumdar

Secretary :

3. Dr. R. K. Srivastava

Joint Secretary :

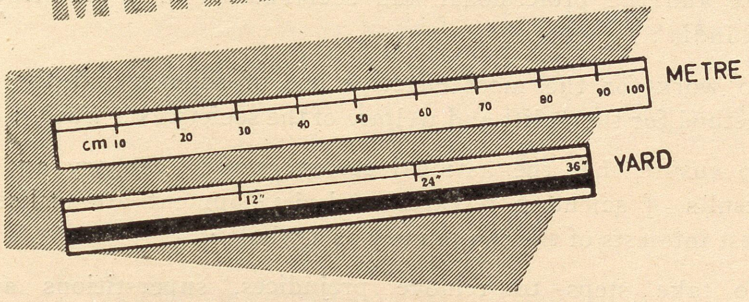
4. Shri P. N. Mukherjee

Members :

5. Dr. K. A. Kini
6. Shri T. Lahiri
7. Shri K. D. Venkataraman
8. Shri A. K. Das Gupta
9. Shri N. D. Sinha

The Branch held its General Body Meeting on 27th Aug. '58 wherein the President gave a brief talk outlining the aims and nature of the ASWI. The Branch was formally inaugurated on the 5th of September '58 by their Director, Dr. A Lahiri. At the same meeting, two resolutions were adopted condoling the deaths of Prof. Frederic Joliot-Curie and Dr. E. Lawrence. Two resolutions were also adopted congratulating Dr. K. S. Krishnan and Prof. S. N. Bose on their appointment as National Professors.

WHAT IS THE METRIC SYSTEM ?



The Metric System derives its name from the Metre, which is the primary unit for measuring length. In this system, as in all decimal systems, the basis of calculation is 10. We multiply or divide any unit of length, weight or volume by the same number i.e. 10.

In the Metric System, the multiples of a unit have the prefix *Deca* (10 times), *Hecto* (10 × 10 = 100 times) and *Kilo* (10 × 10 × 10 = 1,000 times). The sub-units have the prefix *Deci* (1/10) *Centi* (1/100) and *Milli* (1/1,000).

THE CHANGE-OVER TO THE METRIC SYSTEM OF WEIGHTS AND MEASURES BEGINS FROM OCTOBER, 1958

KNOW THE METRIC LENGTHS

The primary unit of length is

THE METRE

= 40 inches approx.
1 kilometre = 5 furlongs

SUB-UNITS

10 millimetres	= 1 centimetre
10 centimetres	= 1 decimetre
10 decimetres	= 1 metre

MULTIPLES

10 metres	= 1 decametre
10 decametres	= 1 hectometre
10 hectometres	= 1 kilometre

DA 58/109

2

ISSUED BY THE GOVERNMENT OF INDIA

Know the Association of Scientific Workers of India

Year of formation : The Association of Scientific Workers of India was formed in 1947 under the persidentship of Sri Jawaharlal Nehru and was registered as a trade union under Indian Trade Union Act, 1926.

Objects : The Objects of the Association are :

(a) To improve and safeguard the economic interest, the conditions of life and the professional and social status of all scientific workers in India ;

(b) To work for the most effective use of science and the scientific method for the uplift and welfare of the society as a whole ;

(c) To ensure that the national resources of the country and also the results of scientific research and development are utilised in the best interests of the community as a whole ;

(d) To take steps to remove prejudices, superstitions and other institutionalised social habits and customs inhibiting to progress and generally to inclecate the scientific spirit among the people ; etc.

Membership : Membership is open to professionally competent scientific worker as evidenced by possessing a degree or equivalent diploma in Science, Technology, Engineering, Medicine etc. Matriculates engaged in a technical capacity under the supervision of a professionally competent scientific worker, are eligible to be members of the Association.

Units of the Association may be formed in Scientific, Technical or Industrial institutions, who should have a minimum strength of ten members.

Forum : A monthly journal 'Vijnan Karmee' is published on behalf of the Association of Scientific Workers of India. The journal aims to act as a medium through which scientific workers can exchange experience and opinions on matters of common interest. It lays emphasis on the social aspects of science, impact of science on society, social factors which affect the promotion of science, the working conditions of scientific workers etc.

Offices : The Editorial Office is at the Department of Applied Chemistry, University College of Science and Technology, 92, Upper Circular Road, Calcutta-9. The Organizational Office is at Kanpur with Sri D. V. Varma as the General Secretary (Organization). The address is 15/211 Civil Lines, Post Box No : 388, Kanpur. Any enquiries may be sent to any of the above two places.

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(Founder-President : Shri Jawaharlal Nehru)

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CONTENTS

The views expressed in the journal are not necessarily those of the Association of Scientific Workers of India

Articles, Book Reviews, Letters to the Editor etc. are invited from our readers.

Materials should be sent to the Editorial Office, Vijnan Karmee, 92, Upper Circular Road, Calcutta-9.

Education or Catastrophe

H. G. wells warned us some decades ago, that the race is between education and catastrophe. This is still true for our times, particularly for India. Unless education is made wide spread there is hardly any way to escape the other alternative. Education does not mean the teaching of the three 'Rs' or mere technical knowledge, but an appreciation of wider issues also, which affect man and his environment.

We in India have accepted the twin goal of democracy and socialism. The necessary pre-requisite for both is a deep social understanding and a voluntary and conscious subserviance of the individual interests for the betterment of society. It is possible to establish democracy and achieve socialism when those constituting the society have a fair knowledge of what is happening and have confidence and faith in the progress underway, and that it in the long run, if not immediately, would be in the interest of every individual.

A cursory glance of the social scene in India would reveal the absence of a unifying objective and ideal, even though many might pay lip service to it, and lack of awareness of what is happening and hence lack of confidence and faith. Consequently the social scene is full of personal and petty squabbles or an *exaggeration* of it. Most of the people seem to be in a mad rush to benefit themselves individually, as if they would soon be be overtaken by a deluge The *exaggerated* individualism arises out of a sense of insecurity and lack of faith in future. Why this is so in the face of technical and social progress now taking place needs study.

We are living in a scientific era, i.e., science and technology are the chief instrument of change and should, therefore, be the frame work of our modes of thought and emotional motivation. Consequently, any efficient utilisation of science and technology necessarily involves an appreciation of its methods, techniques and their utilisation in the study and understanding of our social and other problems. The fact that we do not fully appreciate of what is happening around us and have confidence and faith in the change now taking place shows on the one hand the isolation of science as a mode of thought in social life and necessitates the filling up of this gap by the Scientists on the other. Unless active and vigorous steps are taken to popularise the facts of science, spread its content, method and techniques, and restate its social aid moral values, there is little hope for either democracy or socialism. The essential requirement of education, at the present moment is not that basic facts of science be taught, that is important but not enough. What is more important and significant is that citizens, those who with their votes control the key of future development, must be imparted an education to enable them to differentiate between the wrong and the right. They must be educated to cast away their age old superstitions and to embrace *science as a public virtue*. They must be made to understand that science is not a demon, that it is not some thing unfathomable to be feared and that it is not merely material. That it is the most material as well as spiritual thing that man has been able to discover and develope, and that in its development and promotion lies the material, cultural and spiritual salvation of mankind.

Also nothing is being done in this direction in India, neither by the Scientists nor by the Government. Science has, therefore, become a career for the privileged few. Isolated from the people it has not yet taken the shape of a popular movement for social transformation. Government seems to think that financing research alone may bring about the change. While the Scientists feel that their battles in their laboratories alone would lead to the establishment of truth. The Government is satisfied by forming a committee and the Scientists do not have the time for any such unremunerative channels. Consequently there is hardly any journal in the country either in English or in any of the national languages which seeks to popularise science as it should be, which tries to give explanation to people of things that happen in every day life and for which pseudo-religious superstitious explanations are available. There is hardly any concerted effort to wage a war against age old superstitions, which are exploited by unscrupulous politicians and adventurers, and towards which people lean in time of crisis and need. The film, radio, the daily press have yet to be developed as a vehicle of dissenimating scientific philosophy and out-look.

It is time that science should break the limitations to which it has been subjected to by our legacy, it is time it should be popularised on scale to make it really a social and cultural movement for democracy and socialism. For neither democracy nor socialism nor any progressive culture are possible without science becoming a part of public virtue.

Genetical Effects of Radiation from Nuclear Explosions*

By

J. B. S. Haldane, F.R.S.,

Indian Statistical Institute, Calcutta-35, India.

I have been asked to write on the above topic. However, I shall in fact consider the effects of radiations and of particles of high energy together. Their genetical effects are more or less proportional to their ionizing effects in air over a fairly wide range of energies. As will be seen our ignorance is so great that if neutrons produce about half as many mutations as X-rays of the same ionizing power in air, this is not very important. Most of the accurate work has been done with X-and gamma rays.

High energy events produce, among other things, mutations. To understand the meaning of this word we must state a little biology rather dogmatically. Every cell in a higher plant or animal contains a nucleus which is essential for its life. The nucleus contains a number of organs of molecular dimensions, called genes, which are arranged along thread-like structures called the chromosomes. Each gene is concerned in a specific biochemical process, usually the synthesis of a protein. The protein is often an enzyme promoting another reaction on a larger scale. The chromosomes, and probably the genes, are largely composed of very long molecules of desoxyribonucleic acid, which is the stablest of the cellular constituents in the sense that it exchanges labelled N or C atoms more slowly than any other. At each nuclear division the chromosomes, and the genes on them, are copied with considerable but not complete accuracy.

Almost all higher animals, and many higher plants, are formed by the fusion of two cells called gametes derived from their mother and father, whose nuclei contain the same or nearly the same number of chromosomes. If, at two corresponding places in two chromosomes, the genes differ, then the probabilities that any one of the progeny will receive the maternal and paternal genes are each approximately one half. Now if we have a stock of plants or animals each of which carry two like genes, almost all their offspring will also carry them. A very few will carry an altered gene. These are said to be mutants. I must emphasize that the definition of a mutant is operational. If and only if we have evidence that something is transmitted to half the gametes of an organism (called a heterozygote) which received it from one parent, are we justified in calling it a gene. Even so it may not be a gene. It may for example be a deletion of a section of a chromosome carrying many genes.

If a gene is concerned with the synthesis of an enzyme (for example of one of the enzymes concerned in skin and

* From "Scientific World", II 2. (No. 4).

hair colour production in a mammal), the mutant may catalyse the synthesis of an enzymatically inactive protein. Nevertheless though the heterozygote only contains half the normal amount of enzyme this suffices, and the animal appears normal. But if an organism has received a mutant gene from each patent it has no enzyme of this kind, and is visibly abnormal (e.g. and albino). The mutant gene is said to be recessive. If the recessives die (for example plants which cannot synthesize chlorophyll) the gene is called lethal. Most mutations are recessive, and a large fraction, perhaps over half, are lethal. Mutants which can readily be detected in heterozygotes are called dominants.

Mutations occur "spontaneously," that is to say for unknown reasons, in all organisms studied. Penrose and I first measured the rate of spontaneous mutation in man. Some human genes mutate with frequencies between 10^{-4} and 10^{-5} per generation, others less frequently. Muller found that the spontaneous rate could be increased several hundred times in the small fly, *Drosophila melanogaster*, by irradiation with X-rays. Rapoport, Auerbach, and others showed that some chemical agents are about equally effective. Later workers have found that some genes are easily induced to mutate by quanta or particles of high energy, others by chemical mutagens. Less than one thousandth of the "spontaneous" mutations in *Drosophila* can be due to radioactivity, cosmic rays, and so on. Human mutation rates are only a little greater than in *Drosophila* per generation, and as the generation is about 1000 times as long, I have suggested that most human mutations may be due to "natural radiation." Most workers think the fraction is one tenth or less. Thoday and Read showed that in the absence of molecular oxygen the mutagenic effect of X-rays is greatly reduced. Most of the effect of radiation is probably due to the production in a nucleus of metastable molecules such as peroxides and free radicals, which subsequently cause mutations. In *Drosophila* most quantitative work has been done on sex-linked lethals, that is to say lethal genes located in the chromosome of which the female has two and the male only one. These are easy to detect. The quantitative results are not simple, because the mutagenic effect of the same dose varies according to the conditions of the nucleus irradiated. It is particularly sensitive at certain stages of division. The most fundamental quantitative fact is that the number of lethals produced in a population is nearly proportional to the total dose in roentgens, regardless of whether it is delivered in a few seconds, or over several days. This is to be expected on physical grounds. A quantum stopped in a given nucleus will produce much the same effect no matter what is happening in other nuclei. However the lowest dosage rate at which mutagenic effects have been measured in *Drosophila* is one roentgen per 110 minutes. This is about half a million times the "natural" dosage rate of 0.1 r per year. Slightly lower doses have been used on mice, but no quantitative results from them are yet available. The highest dosage rate is about two million times greater and seemed to show a slightly increased mutagenic effect.

There are sound physical grounds for thinking that we can extrapolate from 0.01 r per minute to 0.1 r per year. But it is at least conceivable that small dosage rates are much less or much more effective than large ones. If a rare precursor of a mutagenic compound is almost all used up long before the dosage rate reaches 0.01 r per minute the effects of low dosage rates are more serious than calculated. If on the other hand organisms have some unknown protective agent against dosages of 0.1 r per year which breaks down at higher rates, low dosage rates are less dangerous. I think both alternatives improbable, and shall neglect them in what follows. But it seems a little rash to regard a danger as negligible on the basis of an extrapolation involving a factor of 500000.

The dosage required to produce a lethal gene in *Drosophila* is about 10000 r. Thus if we irradiate a population of these flies with a dose of 100 r, about one hundredth of their progeny will be heterozygous for a lethal. Most of these lethals are autosomal (non-sex-linked) recessives. They are only effective when both parents of an individual fly carry the lethal (though some of them also lower the vitality of heterozygotes). Thus if the population is constant in each generation the total number of deaths caused by 100 r in all future generations is a bit over one two-hundredth of the population number, but less than one hundredth. Besides these recessive lethals a few dominants are produced, a few visible recessives (such as white eyes, short wings and bent bristles) and a number of mutations which slightly lower the vitality for no obvious reason. These last may be as frequent as the lethals, or more so.

Finally a very few genes may be produced which increase the viability or fertility of the animals. These are extremely rare for a very simple reason. Plants, animals and men are pretty well adapted to their environments. Any change in their make-up is likely to be for the worse unless one can somehow control its nature. However 'good'' mutations are possible. One can induce a mutation such as miniature wings in *Drosophila* by X-rays, and then irradiate miniature winged stock. Along with about 10000 lethal mutations about one mutation to normal wings occur per hundred million roentgens. Of course mutation producing humanly desirable character (e.g. absence of bitter substances or spines in economically valuable plants) are somewhat commoner than this.

The only quantitative data on induced mutation rates in man are those of Lejeune and Turpin. These authors followed up a number of men and women whose gonads appeared to have received doses of over 1000 r during therapeutic treatment of other organs. If a recessive lethal is induced in the X chromosome of a woman's egg, then if the egg is fertilized by an X-carrying sperm it will develop normally into a daughter. For the paternal sperm carries a normal gene which masks its lethal effect. If the egg is fertilized by a Y-carrying sperm it, or the embryo developing from it, will die; so a potential son will perish. Thus irradiated mothers should have an excess of daughters. This was found. Similarly a dominant lethal in a male X (very probably a missing part due to breakage) will kill some of his potential daughters, so irradiated fathers should, and do, beget an excess of sons. Neither excess is by itself, statistically significant at the 5 per cent level, but the difference between the performance of irradiated fathers and mothers is so. It is consistent with the dose needed to produce a lethal in an X chromosome being about 10000 r (not for example 1000 or 10000).

A little work has been done on guinea pigs and other small animals, and a good deal on mice. Numerous translocations have been produced, that is to say parts of two different chromosomes have been exchanged. Mice heterozygous for a translocation are semi-sterile, for many of their gametes carry an incomplete set of chromosomes. A number of visible recessive mutations have been produced, some, such as tremor associated with syndactylism (fusion of fingers) being lethal at about three weeks, while others are less serious, and some such as blackness and piebaldness apparently quite harmless. Russell, at Oak Ridge, observed 54 mutations at 7 loci in 48007 mice whose fathers, after receiving 600 r had been mated to females recessive at these loci. Two mutations appeared in an equal number of controls. This is about 15 times the comparable mutation rate per gene in *Drosophila*.

This result is of great biological interest. But it does not answer the question, which is surely fundamental "How many lethal and sublethal mutations are produced in a mouse per thousand roentgens?" This could have been anwered with considerably less expense had the authorities at Oak Ridge so desired. Russell's figures do not answer this question because it is not known how many genes a mouse possesses; and as Russell investigated loci which had mutated spontaneously they were perhaps unrepresentative. A provisional answer has been given by T. C. Carter at Harwell in England. Carter compared the litter sizes in inbred mice whose grandparents had been irradiated with those of controls. If the lesser litter size was due to lethal genes he concluded that about 300 r are needed to produce a lethal mutation in mice.

I had supposed that the whole question was being adequately dealt with at Oak Ridge. When I learned that this was not so I devised a method based on linkage, which should allow the discovery and enumeration of recessive lethals in sections of chromosomes near recessive marker genes. I made a guess at the possible dosage needed to produce a lethal mutation. As a mouse or human nucleus contains 30 times as much desoxyribonucleic acid as a *Drosophila* nucleus I guessed that the dose was one thirtieth of the *Drosophila* dose, or 300 r. Since a death extinguishes two recessive lethal genes this is one death per 600 r. While Carter has confirmed this figure, he is now using my method, and a rather more powerful one of his own devising, to estimate the dosage more directly. I do not think that much weight should be given to the figure of 300 r till the results of this work are published.

Of course it does not follow that human genes are equally sensitive, but Lejeune and Turpin's results suggest that they are, since the X chromosomes in a woman are about 4 per cent of the total volume of all the chromosomes. Even if the above figure is confirmed we have a further and very important question to ask. Suppose we knew that the dose received by a population would cause 1000 ± 100 deaths in future generations if the population size remained constant; the vast majority might occur in very early embryos causing at worst a missed menstruation period. If so they would not be socially harmful. They would be more serious if they caused abortions or still-births, and worst of all, perhaps, if they caused death at about 20 or 30 years of age after 10 years or more of invalidism. One at least of the radiation-induced genes in mice has an effect comparable to this.

Others are better qualified than I to assess the total extra irradiation to which the human race has been and will be exposed as a result of experimental nuclear explosions so far carried out. It is of the order of magnitude of 0.01 r.* Persons exposed to it will perhaps have about 2×10^9 children.

* The magnitude of the gonad dose that will be received from bombs already exploded is discussed in the article by T. Doke (p. 23); (Scientific World II. 2. no. 4).

If the world population does not increase, this dose will cause $0.01 \times 2 \times 10^9/600$ or 33000 deaths, spread out over several thousand years. Besides these there would be a number of cases of congenital ill-health not causing premature death or complete sterility in most cases. This number would be of the order of magnitude of 30000, because even if there were many fewer mutations, a number of more or less handicapped lives would be needed to wipe out each gene. In my paper on the subject I used the word "guess" for the figure of 300 r. Plausible arguments can be given for lowering it to 50, which would give 200000 deaths for a world dose of 0.01 r, or raising it to 1000 r, which would give only 10000. The correct mean dose is presumably somewhat less or greater than 0.01 r. As pointed out, much depends on the time at which deaths occur. In the event of a nuclear war, survivors in belligerent states might perhaps receive mean doses of 100 r, and neutrals doses of 10 r. This would increase the above figures several thousand times.

The British Medical Research Council estimated the "doubling dose," that is to say the dose which would double the existing mutation rate, and then compared dosages from atomic bombs, luminous watches and so on, with the doubling dose. As this dose is not known, and might cost about three million rupees to estimate even in mice, this serves to obscure the issue. So does the statement that a calculated increase in death or disease incidence is not statistically significant. No individual murderer is likely to increase the annual number of deaths in a state by its standard sampling error. Nevertheless murder is severely discouraged. The notion of a permissible dose of radiation is at least partly a false analogy based on protection against poisons. In the case of ordinary poisons, 0.01 of the median lethal dose is not dangerous. But if one cut down the intensity of machine gun fire on a road to 0.01 of what would kill half the people crossing it, one in two hundred would still be killed. The same is true for many effects of radiation, including probably the production of leukaemia and of mutations. However government officials insist on defining "safety limits" for radioactive poisons and the like based on methods which have been quite successful against lead, arsenic and so forth.

Though Carter's work seems to me to be well planned and executed, it is most desirable that experiments of this kind should be carried out, using if possible a variety of techniques, in as many places as possible, and preferably in institutes where the possibility of government interference is as small as possible. In Britain the universities have been starved of late years in favour of government institutions which are not always efficient. Other countries are handicapped in other ways. But such work does not require expensive apparatus, though it may need large numbers of small mammals, and, of course, experienced geneticists. Experiments even on small numbers can be used as part of a total. It is therefore greatly to be hoped that research may be done in many countries on a question which concerns the whole human race.

Government and Science in India

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Summary

[The Science Policy Resolution of the Government of India is a farsighted, imaginative and bold statement and a very welcome step in the logic of development. Its implications are many and far-reaching and its implementation will depend upon the awareness of the government of the basic scene of science and the information it has on the diverse aspects of science. An attempt has been made here to give an outline of the basic requirements.

Science elsewhere developed as a movement of revolt; in India it was, in its modern form, imported alongwith the British. It was isolated from the people by barriers of language and due to nationalist sentiments. It has from the beginning, been associated with government and its departments and scientists guided by the civil service rules.

Since Independence the opportunities have been extended greatly but the pattern of organisation has remained the same as before, if anything its dependence on government increased and its isolation not yet broken. Basic requirement now is popularisation of science at all levels to widen its scope and character, and giving of greater freedom and latitude to scientists to be critical as well as take the necessary initiative.

There is a need for development of technical liaison and information services in western as well as eastern countries, to develope a better understanding and appreciation of national developments abroad and in India, and utilise this knowledge for the industrial growth of the country and help the neighbours. There is also a need to revise the policy of participation in International Conferences; some of which can be covered by Scientific Attaches, who are to be a part of Liaison and Information services, for others working scientists, rather than administrators, are to be encouraged to participate.

A scientific, non-administrative, approach is an urgent necessity in the national sphere with regard to working facilities and decision making opportunities to the scientists. The major role of the government should be in giving full freedom and opportunities to the scientists; to be skeptics and to make bold experiments on the one hand, and popularisation of scientific results, taking of progressive socio-technical decisions and implementing them and creating a wider support and enthusiasm for them. The present practices have made science timid, circumspect and limited in scope. Organisation of services which should supply the government with the basic data on which she could take the decision, is a great necessity.

There is a need to organise an independent body of scientists to objectively discuss scientific developments, make

critical evaluation, discuss it with full freedom amongst colleagues at all levels and advise the government. This role can be fulfilled by proper organisation of societies particularly the Science Congress and National Institute of Sciences in India, and through scientific journals. The publication of scientific journals need a complete reorganisation, to develope higher standards, and to remove wastage of information. Further, there is a very great and urgent need to publish popular scientific journals for the people and for scientists.

The programme for full and proper development of science and technology and its utilisation depends upon the creation of a national perspective, an idealism and an ethics and morality which represents the noblest tradition of this country. They are lacking at the moment. These cannot be created in a day nor through preaching, laying down rules and policies. They are part of the values of the country and can develope in a congenial atmosphere and through precept. Unless scientists are freed from want and given a prestige and sense of responsibility, the atmosphere for dedicated selfless service would not be created and the nobler humanist aspects can hardly be developed. In the rise and fall of civilization and vicissitudes of fortunes man has looked for the nobler traditions to give him courage and hope and it is to this tradition that Indian scientists should dedicate themselves.]

Government and Science in India

1. *Historical Background*

Science is essentially a movement of social and intellectual revolt. It was a social revolt in so far it sought to establish an honourable place for the artisans, and craftsmen, and give an incentive to their efforts of working with hands and innovate and discover. Its intellectual revolt lay in its effort to overthrow the overburden of barren logic and the endless commentaries on the masters. In an effort to assert its own methods and ways it came into conflict with conservative forces of the time and ultimately won its ground by winning over the adversaries with the help of powerful tools it had developed. The early efforts to mining came in sharp conflict with the prevalent prejudices and notions about agriculture and it was mainly the effort of Agricola, who by example, reasoning and economic prospects convinced the people to the contrary. Galileo and Darwin on a more ideological plane had to fight their battles against stagnant knowledge and religious bigotry. In this conflict scientists appealed to the experience and reasoning of people and sought to win them over with the help of their powerful method of observation and experimentation to accept or reject a proposition. History of Science is the story of growing knowledge as well as the contracting darkness.

The Scientific movement nourished itself mainly from three sources. Firstly in the knowledge gathered by merchants and travellers which undermined the Ptolemaic geographical concept of the world. Secondly in the discoveries of craftsmen and artisans who in their humble workshops combined the theoretical knowledge gained by experience with the practice of things and who thus innovated and discovered things. Thirdly in the quest which sought to discover simple explanations for the natural phenomena and comprehend its diverse and numerous aspects with the help of a few and simple laws. In view of the diverse sources that fed the scientific movement, it became the repositary of diverse traditions and influences : religious, social, economic, political, philosophical and aesthetic. Each of these enriched it and left its impact on it. Looking at the individual contribution of any outstanding scientist, or the total contribution in a particular period of history of a country, a general trend and a dominant outlook in science is perceived which is the result of the influences it is subjected to. It is this dominant outlook or the general trend which has, in a period of history, laid down the rails of its development, and engendered changes which ultimately lead to its reorganisation.

As a movement of change it encourages doubt and skepticism, actually it promotes heresies. Everything has to be constantly looked into, observed, analysed and conclusions derived from such a study, nothing has to be taken for granted irrespective of the quarter it comes. Since it encourages the tendency to doubt and criticise the elder and respected scientists, to subject their work to criticism and reject it if necessary, it developes intense individualism in each of its votaries. Each scientist knowing that his labour would be subject to criticism takes intense pain with his work and, in view of this, is emotionally attached to the product of his labour. This individualism does not preclude team work and cooperative effort amongst the scientists, nor it impairs its cumulative nature. In fact scientists are aware of their debt to other scientists and know that if they are able to see farther than others it is possible only because of their being able to utilise the work of their predecessors and contemporaries. Consequently free and easy communication has a special meaning for scientists.

The atmosphere that is best suited to the development of science is, therefore, the one which maintains its revolutionary character by allowing freedom to doubt and reject whatever does not come up to scientific standards, latitude for the individualism of the scientists and free communication. Irrespective of the changes it might have undergone since its rebirth during the renaissance, this atmosphere has remained a prequisite for its development. Whenever, as has been the case in recent history, there has been any suppression of any one of the aspects, its growth has stopped and its onward march has suffered a set-back. By its close association with society, science is subjected to a number of social influences which retard or accelerate its progress, their exact role depends upon the correct appreciation and the impact they have upon scientific investigation. The divorce of science, for instance, from the practical activities made it a purely intellectual attitude limited to the universities, and deprived industries of the advantages of theoretical knowledge, and it is only recently that it has bridged this gulf. In fact, the pendulum has now swung to the other extreme, every thing now is being viewed from the point of its practical application. This has introduced certain new features in the pattern of scientific organisation and has brought it under new influences which have to be studied critically for their effects.

2. *Social Shifts and Science*

The main factor in this change has been the entry of the government in research. Research is now being treated as an investment from which returns, both short and long term, are expected. By virtue of the government's financing the research at all levels and its direct interest in research results, it has come to have a directing hand in laying down its programme and controlling its progress. The main impact of this emphasis is that scientists are no longer free to choose their own problem of research, According to Whyte[1], of the 600,000 scientists now engaged in research only 5,000 are choose their problem.

A necessary consequence of this loss in the freedom of choice in science has been the problems of morality in science such as those arising out of misuse and perversion of science by industry or the government, and those which concern the very survival of mankind. Connected with these but also of equal in magnitude have been the consequence on individual scientists who are no longer following the dictates of their conscience or their creative urges. They are more and more made to fit into a pattern where application of ideas constitute the sole purpose of research. Consequently, more and more scientists are trying to know the *how* rather than asking the *why*.

The government's requirements have also intruded upon the present beliefs, association and mode of work of the scientists. They have to satisfy a host of administrators about their reliability, whatever that might mean. In other words technical competence and desire to to work is no longer an asset to work, now bring an opportunity for research. Further these checks may deny the opportunities, cramp individualiy, or distort outlook. The proceedings of the loyalty checks in U.S.A. have revealed to what degrading extent things could go. The greater harm they did was by way of intimidating scientists into distorting their own outlook and perspective, as is evident from an analysis which reveals that a considerable American programme of scientific research was not only based on the acceptance of cold war but also to fulfil its purpose[2].

Further, the government's intervention takes away the freedom of communication from the scientists. This loss reduces the scientific effort from being a cooperative endeavour to a compartmentalised affair, which is in bits and pieces and leads to much duplication, as facts once discovered are locked in secret files and have to be rediscovered before any conclusion could be drawn from them.

Lastly scientists have to satisfy a large number of people in various capacities and at different levels with regard to the purpose of their work and the progress they are making. And very often much valuable time is lost, and very promising lines of work given up to satisfy administrators or those who control the financial strings. Further, useful results in a field can be utilised in a perverse manner against the advice of scientists, in other words, scientists have no control over the results of their researches.

These changes, however, will have to be seen as a first step in the growth of science and its recognition as a major factor of change in society, and a proper evaluation of those can only be made when they are seen in the historical context of each country, and unless this is done no possible alternative could be developed. The effect of these changes would vary in different countries depending upon its tradition and the interplay of different forces and their sway.

3. *Development of Science in India*

Science in India developed in opposition to older methods of learning and in an alien language, i.e. it could not have the wider and deeper character of a movement of a social change which draws its nourishment from diverse strata of society. Its character was, to begin with limited to the maintenance and test

(1) William H. Whyte, The Organisation Man. London : Jonathan Cape.

(2) Edward A. Shils, Torment of Secrecy, London : William Heinemann.

jobs, and in the universities it was taught more as a discipline rather than as a new method and outlook. This reduced its effectiveness as a tool for social change. Further, as it was introduced alongwith alien rule, the new techniques and ideas which it brought were looked with disfavour and suspicion and as something to be actively combatted.[3] This social situation was fully exploited and the few protoganists of science were completely isolated. Consequently, scientists or those few who appreciated science had no other alternative but to look upon the government for support and upon administrators for favour of acceptance of their views and aid.

The result of this isolation has been that scientific thinking has very largely been guided by administrative approach, much of research was organised in government departments and results of research administered bureaucratically. The endeavour itself was fragmented and no semblance of social movement based on scientific ideas and technical practices could be developed. The isolation of scientists on the other hand was complete enough to produce intense careeristic individualism in them. In addition, to this situation there has been the impact of another strong tradition, to make it further individualistic. The tradition, backed philosophically as well as socially, recognises the attainment of *truth* as an individual endeavour. Truth is grasped by an individual, who then imparts to others, consequently scientific research, which has been equated as a search for truth, has become the field of individual attainment, leading to the fragmentation of the effort and reducing the social effectiveness of science.[4]

The first contact of science with the social movement came with the establishment of a Planning Committee by the All India Congress Committee, under the chairmanship of Shri Jawaharlal Nehru, which recognised the role of science in the national development and brought the scientists, social reformers and politicians together for a definite purpose. Another event, the out-break of the Second War also broke this isolation of Indian scientists in another way, though did not break its dependance upon the bureaucracy, instead accentuated it. The scientists during the war were geared to the various problems arising out of the shortages, maintenance and repair problems. They consequently, were brought to tackle social problems of a short term nature, and 'and gave a new turn to their thinking. The development of science and its requirements has, therefore, to be seen in the context of this background of science with its specific social and historical features.

4. *Main Requirements in India*

The basic requirement of science in India is, therefore, two-fold. Firstly to

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(3) The strong opposition was first developed by religious groups, who dubbed the scientists as atheists ; conservative elements of society who called Scientists as tools of British and collaborationists and lastly from Gandhian idealists. The opposition from the last group was based on the misuse and perversion of science and due to the mechanisation of life arising from industrial development. Besides this the religious element was also a part of this opposition. The net result of this opposition has been a dichotomy in the life of scientists. In social life they are often conservatives, following religious practices and its mode of thought, while in the laboratory and in particular field of research they endeavour to be scientists.

(4) Prof. J. B. S. Haldane recently criticised an attitude amongst the Indian scientists where leading scientists are applauded even for their commonplace expression whereas younger scientists are discouraged. This respect for elder scientists might be an echo of the respect for *Guru,* whose even commonplace expressions are endowed with special wisdom & meaning.

break through this isolation of science and to disseminate results of science in such a manner as to enable people to appreciate the implications involved. People and their representatives in the parliament have to be informed to enable them to take correct decisions on problems of foreign policy such as atomic weapons, their testing in peace time, and on matters involving science and technology such as establishing of industries or developing alternative industries to those existing. Such an information is vital not only for the taking of decisions by the people but also for checking the administration for its errors, in other words for the effective functioning of democracy. In the absence of such a set-up all the decisions would be left to the administration as in the case in India. The main features of the existing situation are the lack of democratic control on the one hand and constructive criticism by the people of the new developments now taking place. The lack of information has reduced this democratic control to mere picking of holes and shouting about alleged wastages, often without appreciating the issues involved.

Secondly, in view of the fact that administrators have to take decisions they have to be fully aware and appreciative of the developments of science, for which they have to have the machinery at hand to supply them the basic socio-technical data for policy matters. This is necessary to affect proper coordination between various departments of the government as well as to fully utilise the developments in different branches of science. Recent develop ments in India have shown the inadequacy in both the respects i.e. lack of coordination between the government departments and ignoring of the developments in India, with the result that foreign exchange has been wasted on import of material and equipment and personnel which could easily have been avoided. This situation has been brought to light in the parliament and through press and has brought criticism to the government and placed Indian science and scientists at a disadvantage.

Taking of these steps, viz., intensive popularisation of science at all levels for different purposes in view and creation of a proper machinery for the collection for data for policy decisions, will be advantageous for broadening the horizon of science and breaking its present isolation. In the logic of its further development it cannot escape this widening, a more organised and conscious effort in this direction will, however, avoid wastage of effort and save valuable time, thus accelerate the pace of development, and make some of the uncontrollable features more guided and purposive.

It will be worthwhile to examine in detail this second aspect i.e. the organisation of machinery for information at an administrative level and outlook of administrators on science in so far it affects the latter's growth.

Scientific cooperation in the international sphere covers broadly three spheres, those of government foreign policy, international relations concerning technology and international scientific communication through conferences and organisations.

5. *Science and International Relations*

5.1 Foreign Policy :

In the matter of government foreign policy the major issue at the moment is one of atomic war, and preceding that one of preparation for it and the consequences of such preparations. The danger of atomic war is appreciated fully in India and an endeavour to achieve peace has been the basis of Indian foreign policy. In accordance with this policy, India has herself ruled out the utilisation of atomic energy for purposes of war.[5] Further, the testing of the bomb on Asian soil and the consequent damage by radiation to human beings, and fauna and flora has created a situation where full data is to be collected and disseminated to create a proper appreciation of the government decision. It appears at the moment that the basis of the public opinion and government policy is primarily the asian sentiment and the general pacifist trend as represented by Gandhian philosophy rather than a technical appraisal of the issues. The Indian scientific leaders in this field are abreast of world developments, but a well organised machinery for evaluating developments and checking the trends and shifts is lacking, as well as the machinery to develop appreciation of the implications involved in the situation at all levels. These limitations at any one time may sway the decision against the present policy and the emotional impact of any one of the factor in the political situation may brush away the technical aspects.

5.2 Scientific and Technical Cooperation—

5.2.1 With Advanced Countries :

In the field of international relations in technology and science India is placed in a dual position, that of a receiver and giver. She has not only to be aware of the developments elsewhere and make an assessment of these to utilise it for her own purposes but also to advise and guide other neighbouring countries who look up to her. The technical developments now taking place in advanced countries are a part of the social situations existing there, i.e. as a consequence of their requirements and demands. These varying and multifarious developments represent, in many cases, number of alternatives from amonst which India has to choose to fully benefit herself. The basic considerations for the choice being, availability of raw materials, technical and personnel resources. How best she can make her choice and effectively exploit it, will depend upon the background knowledge of these developments, the availability and the degree of technical knowledge and an awareness of her own national conditions.

A cursory look at the development in this field since independence would reveal that the knowledge of international developments has primarily been based on the limited personal awareness and opinions of a few leading scientists with all its advantage and limitations, a purely departmental approach which ignores the knowledge in another department and its requirements, and a lack of appreciation of the national potential and awareness of national developments. These conclusions have further been strengthened, from time to time, by the reports of the various committees that have been formed to make a particular enquiry.

The situation is primarily due to the absence of suitable liaison and information services in the country and in our embassies abroad. In advance countries the absence of internal services is obviated by the existence of consultant

(5) This policy in general has been acceptable to the people at all levels in India, inspite of the disquiet at the American decision to equip Pakistan with nuclear weapons. The only voice against this policy in a limited manner has now been raised by the army, which has demanded nuclear weapons as a part of its modernisation and to increase its effectiveness as a defensive army. This is an important development as on it, on depending upon pressure army is able to bring about and the general international political situation in particular attitude of Pakistan, may depend the reversal of the present policy.

agencies, bibliographic and documentation services, run on commercial lines. If some information is required either on the commercial or technical aspect of a problem or of a general nature covering a number of departments, one does not know whom to ask for, and some of the general sources of information start collecting information only after you have asked for it, through letters addressed to government departments and private institutions. These, of course, take their own time to reply and the information collected is often incomplete and not reliable. Besides this limitation, there are hardly any services which could advise universities or laboratories about the merits and demerits of a particular equipment now in the market. Scientists who are very often not familiar with the new equipment, have to depend upon the publicity blurb and salesmen's advice and only learn by the method of trial and error. The bibliographic and documentation services are also very inadequate. The only well organised centre is Insdoc, which is too inadequate to meet the national requirements. The net results of these inadequacies is the wastage of funds, time and resources and the limitation of scientific effort.

The lack of information services in missions abroad deprives us of an early appreciation of the scientific and technical developments abroad and their consequent utilization. India is fairly well aware of the developments of the English speaking countries, because of the associations, personal contacts and a free flow of information. Though in the field of technical developments, due to the traditions of industry and lack of published data and material, this awareness is rather restricted. To overcome this specific limitation our missions could play a useful role, which they unfortunately can not due to the absence of technically qualified staff. The liaison office in U.K. High Commission does issue a Newsletter containing abstract of papers, which is usually available earlier through other channels and which is received only by government departments, where it is delayed enough to make it out of date, and often cyclo-styled in way to make it unreadable.

These limited contacts are absent when there are language barriers, which is true particularly in the case of USSR and other associated countries. The number of papers published in Russian are second in number only to English. This not only deprives us of the knowledge available in Russian but also makes Indian scientific understanding one sided, and technically dependent upon only one group of countries.[6] A better and well organised service would be of great help in the political policy of non-involvement, and would strengthen India's position with her neighbours who look up to her for advice and guidance. In the absence of translating facilities, and the limited resources of the institutions it is not possible to obtain Russian journals translated in America or U.K. There is no central organisation in the country which receives all the Russian technical journals and is prepared to circulate titles or abstracts to acquaint people with the lines of work and progress in USSR.

There is another disadvantage besides the lack of knowledge. Indian scientific tradition is linked up with the English scientific thinking, so much so that many of the purely social aspect of science

(6) This has particularly been borne out in the case of the development of petroleum resources of the country, where the unilateral agreements were overcome with the approach made to the Russians and its further follow up. The same may be true of the competition in steel.

which are the product of British historical conditions are taken here as a central feature of scientific thought, such as a certain pragmatic approach, and in particular the attitude towards the relation of science with industry. The Indian scientists take for granted the industrialists point of view as representing the interests of the industry and follow the British pattern for the organisation of the dissemination of results of research and their utilisation in industry. An awareness of the developments in USSR would give them a comparative picture and thus help them to have a better social perspective of science.

5.2.2 With Asian Countries :

There is also a complete lack of any awareness about the developments and requirements of science and technology in the Asian countries which not in line with the political role India is required to play in this region. This knowledge is necessary not only from the political point of view but is also necessary for the scientific and technologic development of India.

Asian countries have so far looked to the western countries for help and this has fully been exploited by them. This attitude had many-fold effects. It has obstructed the development of national resources, led to the misuse and wastage of imported material and made these countries dependent technologically. Very often equipment and personnel were imported which were outdated and incompetent and out of place in the social set up prevailing. Anyway, west is now in a mood to revise this policy, even if it was a part of their generosity.[7]

There are a number of problems which face all these countries, such as those of deserts, forests, conservation of water resources, where work through international organisations as well as on a national level is proceeding; a cooperative effort of these countries which includes pooling of resources, would not only accelerate the progress, but would save valuable foreign exchange which could be utilised more usefully. Besides, most of these countries do not have the resources to establish liaison services to collect information from different countries, nor for bibliographic and documentation services. Organisation on a regional basis will be feasible and useful. India in this context can play a very useful role, if it has a proper appreciation of the problems and a perspective, besides developing a suitable organisation and efficient machinery to meet such requirements. This unfortunately is not so. Indian scientists are going out to those countries only as a part of international institutions and in their personal capacity, and this effort is uncoordinated. Besides she does not have the machinery in these regions to collect the information or disseminate. The recent attempt of ASWI has revealed this gap besides indicating the limitation of our diplomatic mission, whose approach to these problems is more administrative than scientific. In any case they do not appear to have any contact with the scientific world of the countries where they are established.

5.3 Participation in International Conferences :

There are a number of international scientific organisations, as a part of special agencies of the United Nations, or as unions created by association of national scientific societies and institutions. These organisations hold from time to time Seminars, Conferences, discussions on specialised topics or on those

(7) Alec Dickson, Technical Assistance & Idealism : Misgivings and Mistakings, *The Adv. of Science,* 14(55), 177, 1957.

of a generalised nature covering a wide range. Their importance can hardly be minimised and an active participation of a growing country like India need hardly be emphasised. There are, however, two special aspects of such a participation covering the need for and the character of the participants. There are certain conferences where there is a need for the leading scientists from a country to participate, while at others such an expenditure is not a necessity. An active liaison and informtaion service in different European countries and America can save the expense and can usefully disseminate the information it can collect by its participation. Such service can be built round scientific Attaches, as is being done by some advanced countries. Scientific Attaches should be technical men of experience and wide learning to be useful.

There has been a tendency of late, which is not limited to India alone, but has a peculiar twist here, by which many important scientific conferences are turned into platforms for the expression of political ideas or ideological opinions prevalent in a particular country and the sessions instead of being venues for pooling of information are converted to shows where least information is divulged. This has led to a criteria for the selection of delegates on the basis of political conformity and reliability. In India the representation is often given to administrators or those who are not active scientists. A cursory glance at India's representation at the International Conferences will reveal that only those associated or being a member of the administrative hierarchy have the opportunity to go abroad. This deprives the working scientists of the much needed contacts and benefits of personal discussion. The situation is very hard on younger scientists, particularly so as their own funds and resources do not permit them to take a private journey, as is being done by scientists abroad.[8] In other countries scientists are allowed to go by making private arrangements on leave, whereas in India most of the scientists are government servants and such arrangements are looked with disfavour and not permitted. Thus the contacts with international science remains purely on official level. Much of the information collected in this way by official delegates rarely reaches working scientists. This limits both the character of participation as well as the benefits accruing from it.

6. *Science as a Factor of National Development*

6.1 Popularisation of Science :

There is no definite policy of the government to popularise science. Popularisation very often is taken as mere dissemination of results of research. There is a committee of the Government of India for the purpose, but what has been done by it is not known. The Vigyan Mandirs and Community Development in some way are doing the work of dissemination of results of researches, which might be inducing farmers and villagers to look at things from a more dynamic angle than they had done hitherto and develop an incentive to improve and innovate. This work is however very limited and how far it is scientific has yet to be seen.

Popularisation of science has to be carried at various levels from different angles, including popularisation amongst

(8) Recently a newly elected fellow of the Royal Society wished to go abroad, but could not do so as he could not get facilities from the government, till he got himself invited from a foreign government; while he approached the government and waited for reply, a number of official delegations were sent.

scientists, who themselves suffer from many unscientific attitudes. Their purpose at all levels being two-fold : to fight against prevailing superstition and ignorance and to create confidence in scientific method and its achievements. There is not a single popular science journal in the country at the moment,[9] which could meet the requirements at all the levels or at a particular level. Besides the propagation through the written word there is need to popularise science through other channels such as lectures, demonstrations, and cinema in particular, with regard to health and hygiene and also to mobilise people to governments programme and voluntary work such as those of blood banks etc.[10] It is not necessary for India to go through the same conflict which west had to against religious, social and other forces, but it is unavoidable in some form or other if the shift in thinking is desired. What would be the attitude of the government in the form of such a conflict; would it be able to take social measures to ensure progress, particularly when the measures do not have popular support?

6.2 Language and Science :

The major reason of the isolation of science has been the fact that a foreign language has so far been the carrier of scientific ideas. Efforts are being made to so develope Indian languages as to accommodate science and its ideas. Bengali and some South Indian languages have made notable advances, but not so Hindi, which is the national language. The work is being guided by the committees appointed by the government, which may be competent, but are not very scientific in their approach. The emphasis has so far been on translating the English term and searching its equivalents in Sanskrit, with some very adverse consequences. Firstly such an attitude imports the outlook and philosophical ideas of antiquity, which no longer hold true, and takes away the precision that has been developed out of years of usage and refinement. Secondly the usage of such words in preference to current names, popular and well understood, creates the gulf between the written knowledge and the one acquired by experience and in the process of growing up with things. It thus creates additional problems for the popularisation of science and is an uncritical copy of the English tradition, which we need not follow. Lastly the coinage of words in this manner does not permit a series of derivations.[11] Recent studies by Flood and West[12] have shown the nature of construction of scientific words and Young[13] has pointed out historical reasons for the origin of particular words and such an undertaking and appreciation of the process and lead to better coinage of words. But the government committees are dominated more by linguists than by those who understand science better, with often disastrous results.

6.3 Dependance of Science on Government :

The isolation of science and scientists

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(9) Science and Culture has been doing a very useful service in the field of social implications of science & Vigyan Pragati has rendered some service of publishing popular articles on research under progress in Hindi.

(10) A recent example Vijnan Karmee, *10*(*5*), 16, 1958 illustrates clearly the need of such a work to substitute scientific knowledge in place of antiquated social beliefs.

(11) The naming of All India Radio as *Akash Vani* would illustrate the point. It may be poetic, but not scientific and very cumbersome.

(12) W. E. Flood & Michael West, Dictionary of Scientific & Technical words, Longmans & *New Scientists,* (23), 9, 1957, April 25th.

(13) J. Z. Young, Doubt and Certainty in Science.

have been pointed out earlier; the discussion on popularisation of science and language problem reveals another characteristic, viz., the complete dependance of the science and scientists on the government. There hardly appears to be any movement to promote an aspect independent of the government, which makes science circumspect and riddled with administrative considerations.

This complete dependance of science and scientists affects science deeply in many ways. Firstly it is responsible for the development of a purely administrative outlook and machinery in place of a more scientific approach and organisation. The report of the Public Accounts Committtee recently pointed out the delay in execution of projects and non-utilisation of funds. Amongst the reasons for this, it pointed out that basic considerations in asking for funds were those of prestige and administration. In scientific laboratories these considerations lead to obtaining of costly equipment from abroad which is not necessary and is not used, and the indiscriminate expenditure of funds before the close of the financial year. The administrative approach in the field of social implications of science, such as dissemination of results of research or the machinery for their utilisation, instead of developing collaboration between various institutions, government departments are being established with all the para-phernalia of an office. These offices in their turn depend upon the original sources of reports, comments, answering of enquiries. Occasionally more than one such office exists with the result that a research institution apart from sending reports to the parent office, has to answer numerous such requests to two or three or more such offices, taking away valuable time from research and study. Experience in some of the national laboratories have shown the inadequacy of such an approach for the utilisation of research results. If the research were to be organised as a collaborative and collective effort, the team working on a particular problem on its diverse aspects is found to be the most competent and efficient to translate the results in practice; the vigour of such an attitude is derived from personal interest and is advantageous for the industry. The pioneers of industry have been scientific investigators in early life and having developed the method in the laboratory they created the industry—Perkins, Bessemer and a host of others. This is also true in modern research sponsored by the government of a country such as nuclear research in U.S.A. or U.K.

There is yet another drawback. The defects inherent in such an approach and its consequent isolation and division in different bits and pieces developes vested interest in each sphere and is not conducive to a cooperative and collaborative effort. There is, therefore, what is often called as, Empire Building, where apart from wastage, there is considerable dissipation of energies of the scientists on trivial issues. The situation as a whole leads to the undermining of the position of the scientist and strengthening the position of the administrator, which the latter are able to point out and attribute it to the lack of practical sense in the scientists. Further the situation as it has existed so far, had shown limited results. A situation which is more due to the prevalent atmosphere than to the lack of contribution of scientists. And in order to cover up the retarded development,

(14) According to the Provisional List of Technical Terms of the Ministry of Education: Field of Force is बल क्षेत्र Scope of Enquiry is अनुसंधान क्षेत्र i.e. *field* & scope are expressed by the same word and how force means that the Pandits alone know.

premature publicity of achievements and displays and exhibition are arranged. Often there is not much money available for research and if it is made available, only after lot of questionning and criticism and with long delays, but money on publicity and exhibitions is spent in a manner which is out of proportion with the financial resources and the achievements.

The second consequence of this total dependance is due to the application of civil service rules to the scientific personnel, where a scientists is rated not by his attainments but by the first post he holds. His promotion and the facilities are consonent with these two conditions and not with his capabilities and attainments. There is at the moment two much gradation where the persons in the lower grade are not looked with respect and those in higher grades are able to, and in fact do, take advantage of the work of their juniors. Consequently, the promotion and recognition depends very largely on being in good books of the superior and hence much initiative and bold imaginative thinking is not in favour and has no premium.

Personal initiative and enthusiasm are essential elements of scientific effort. This is, however, not possible in view of the machinery developed and the organisation that now exists. The proposal for a research project, if from a junior research worker, depends on its acceptance upon senior research workers, and if from a senior research worker has to go to too many committees and too many questions have to be answered before it is finally accpeted. Scientists have developed two peculiar attitudes because of this procedure. Firstly they try somehow to adopt only such schemes where lot of cladding is possible and which are likely to be accepted by the members of the committees, with the result that there is considerable slip shod thinking on the technical side and more dependance on pleasing members of a committee to seek their general approval. Secondly for really original scientific work, the schemes details are not revealed for discussion, in order to hide the real purpose and data from others, lest others pick holes or steal away the problem.

Thirdly, the major disadvantage of this dependance is the lack of an independant body which could make a critical evaluation of the trends of developments, or form an independant opinion on specialised or general issues concerning science, technology and research. The value of such an independant and unfettered opining has recently been demonstrated in U.S.A. and U.K. on questions of secrecy, loyalty checks and other matters regarding scientific programme and policy. In India most of the scientists are directly or indirectly employed by the government, whose rules and regulations do not permit such an expression of opinion in a personal capacity. The only channel to voice opinions are government routine channels where they are usually lost in files. This is true of semi-autonomous bodies also. Further, there is an additional reason why scientists usually do not take even the limited opportunities offereds to them through routine administrative channels. As pointed out earlier, promotion depends upon good-will and opinion of supervisors, an expression of a critical opinion puts the scientist in disfavour, and very few would dare to take the risk, when the opportunities for remedy are few and remote, and there are very few alternative possibilities of employment outside. The lack of this freedom and opportunity deprives science of a self-correcting mechanism, and a mistake once made has more chances of perpetuation than correction. The only channel now available is through official committees. These committees can only be few and far between, their personnel may be in some way connected with the government and in any case far removed with the experience of younger scientists and the ferment in their minds. The limited time available to them is spend mostly on meeting scientists on higher level and hence the data on which they base their observation is limited. Consequently the chances for a desirable change are few and far between [15] [16]. Further any change that is not liked by the administration, can easily be prevented on financial grounds or circumvented by establishing a new code under the pretext of new of additional requirements[17].

Besides giving opportunity to the scientists to express their opinions and utilise their experience in matters of organisation of research and science, there is a great need for economic studies on research and development. In advanced countries these studies are carried out independently by the universities as a part of their economic and social research or through special agencies. Studies on sources and magnitude of funds for research, information on how they are spent, and data on manpower devoted to research, are required by different parties such as the universities, industries and the government. The information would be useful in properly deploying research facilities.

Further, it would also be necessary to carry out similar investigation on relation of industry with research, on the effectiveness of utilisation of results of research, on factors hindering or promoting dissemination and utilisation of information. The progress of research and its effectiveness can very usefully be a subject of research. In the absence of suitable scientific studies people depend on their limited experiences and arrive at sweeping generalisations on this limited basis, with the result that there is lot of confusion and many errors are perpetuated on the basis of such wide generalisation. Some studies, such as those of Meier, and Manchestor Research Council have shown the importance of such researches in presenting a clearer picture of the situation and posing the correct questions. The functioning of the research committees, the principle of allotting funds on the basis of schemes, the results achieved through such schemes are some of the problems that could be studied, besides a host of others.

7. *Role of Scientific Journals & Societies* :

There are two more features which play an important role in the organisation of scientific effort and its direction—scientific journals and societies. The

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(15) For such a correction a committee headed by Sri J. C. Ghosh was appointed. It examined some of the national laboratories and made some very long desired recommendations. These, however, have not been implemented to this day.

(16) The Economy Committee on the Electricity Department of U.P., recently pointed out : The Chief Engineer is entirely out of date. The additional Chief Engineer is guilty of ruining our Sarda Grid. The other engineers are unable to assist themselves or incapable of delivering the goods. This is very strong stricture. How could it happen ? This is only possible when administrative practices are followed in technical departments, and further with the connivance of administration. How could any changes be made and improvements attained when there is such a machinery at top ?

(17) The CSIR reviewing commitee recommended that scientists should not be bothered by too many reports, but now under the requirements from other ministries different type of reports are being asked for, with the result that more reports are now being required to be submitted.

number of journals published by institutions, organisations, societies is fairly large, though the standards vary greatly, the financial conditions of many is not sound and hence the printing standard is also not very high. Looking at them more critically one becomes aware of the prevalent narrow and parochial attitude. Every department, laboratory, institution, even universities have their own journals with the result that publication is irregular, standard is lower, as anything would be welcome to make a sizable issue, there is lot of duplication in coverage, and wide dispersal of closely related material, making search difficult and giving an additional strain to the scientist to cover larger number of journal, with the increased possibility of missing the information. There is a need here for the major societies and the organisations of science like the CSIR to take initiative and organise the publications on a more scientific and rational basis than is the case at present.

Scientific societies also play an important role in directing and organising science. There are the specialised societies who have a very significant part to play in organising scientific discussions on specialised topics. There is a more generalised function of the scientific societies, firstly with regard to popularisation of science by giving a forum for discussion to a wider section of the scientists such as the Science Congress, and secondly a more select body devoted to discussing and deciding generalised aspects of science such as requirement of personnel, deployment of funds, science policies, and programming, which should be done by the National Institute of Sciences of India.

Science Congress has a long established tradition, it started as a platform for discussion of results of researches, it now serves this function as well as that of popularisation of science and carries out discussion of current topic. It is not able to do justice to any aspect and time is scarce and not enough for anything. Amongst younger scientists it is regarded as a *social mela*, where the older scientists display themselves in gowns and the opportunists seek contacts. It can play a very valuable role in duscussing social relations of science, and the current problems of science in India, and also disseminate knowledge and information to general public. Its work could be organised on a more continuous basis than a mere annual sessdion[18].

The National Institute of Sciences of India originated on the model of the Royal Society, recently it has been developing on the basis of Science Foundation of the U.S.A. or Academy of Sciences of U.S.S.R. It has from time to time taken up and discussed issues, and also expressed opinions on generalised aspects of science and its organisation in the country its recommendations also carry weight with the government. But it has not the authority which is vested with the Academy of Sciences in USSR nor it has funds at its disposal like the Science Foundation in U.S.A. to organise research. Further its importance as an adviser on scientific matters was minimised by the appointment of a separate advisory body, the Panel of Scienist, of the Planning Commission. That an autonomous body of slect Scientists of great eminence is unquestionable, what is now required is that it should have the necessary directing hand in the affairs of science as against the administrators or those scientists who have greater administrative associations.

(18) The British and the American Association for the Advancement of Science, who had a similar origin have recently made changes in their activities to fulfil this dual role. Similar reorganisation is necessary in India also.

The problem of planning of research necessitates a thorough discussion at all levels before any decision is taken. If the wider section of scientists are not actively associated with planning of research, necessary enthusiasm cannot be created. Further, planning of research involves the question of industries, ordering of equipment abroad, coordination of diverse disciplines and departments, it would be possible only through wider appreciation of decisions taken. This can be done through the Science Congress, while the decision of choice and final selection can be done at a higher level, preferably by an autonomous body of eminent scientists like the NISI, which alone have an elastic and scientific appreciation of coordination, progress of research and results achieved.

8. Scientific Idealism

Science is closely linked up with the social values of a particular age, yet it cannot grow and prosper as a mercenery activity. It is a weapon in the hands of man which is being perfected but will never be perfect, to gain knowledge and utilise it further to gain more knowledge and better social life, to give man more leisure and freedom to think, to think creatively and imaginatively. It is steeped with human values and represents the highest traditions of humanism and has therefore to be utilised as such, any departure from this tradition not only severs scientists but will check its progress. In India, at the moment, the atmospheres of idealism is lacking, science has become a career, a mere profession to earn a livelihood, consequently the humanistic outlook, moral and ethical values of science and social perspective is missing, with the result that science is no longer a weapon to spread light and combat darkness, it is not seized upon as an instrument of national construction and cultural revival. It is necessary to make science, with all its moral, cultural, social and technical values, a part of emotional life of the individual and the country as a whole and only then it can be fully utilised for its historic mission. In the vicissitudes of history it is hope and faith which have inspired and given courage to people to dedicate themselves in a selfless manner and achieve immortality. The challenge of construction and the opportunities of transformation that now face us, require all that our nobler tradition have stood for and it now remains with us to fulfil the ancient dream and turn hopes into reality and relive into the glory that was once ours.

News Round-Up

Worldwide Control Posts to Detect Nuclear Tests.

The Geneva conference of nuclear scienists from East and West in a report published on August 30, recommended world-wide network of 170 to 180 control posts to police a ban on nuclear tests.

The conference, which met from July 7 to August 20 and was attended by top scientists from the United States, Britain, France, Canada, Soviet Union, Poland, Czechoslovakia and Rumania, decided that it was possible technically to supervise international political agreement to cease nuclear tests.

It suggested the establishment of a control system consisting of 160-170 ground stations plus about 10 on ships. The distance between the control posts would be from 1,000 kilometres to over 3,500 kilometres.

The control system would use aircraft for air sampling, which would fly regularly on north-south oceanic routes over the Atlantic and Pacific, and also over areas of the oceans remote from surface control posts.

When control posts detected an event which could not be identified but was suspected of being a nuclear explosion, the international control organ could send a special inspection group to the site. The main methods of detecting nuclear explosions would be as follows; from seismic waves; from radio signals; and from radioactive debris. For the purpose of detecting nuclear explosions which might occur at such heights, the Geneva conference considered it possible to use earth satellites and ground-based equipment to record gamma rays and neutrons, optical phenomena, and ionization of the air.

Atoms-for-Peace Conference in Geneva.

Opening in Geneva, on September 1, the second international conference on the peaceful uses of atomic energy, the UN Secretary-General, Mr. Dag Hammarskjoeld, recalled the "vast declassification" of nuclear energy information that took place at the 1955 conference, and added that now "some of the very last barriers guarding hitherto classified information on fusion and on some aspects of separation of uranium isotopes have been removed for this conference."

The most convincing demonstration of this declassification could be seen at the two exhibitions (one scientific, the other commercial) running concurrently with the conference.

The conference alone was twice the size of that held in 1955, with well over 5,000 delegates and observers from about 80 countries, who had before them 630 papers presented orally, in addition to about 2,000 others those were tabled. All told, there were 77 sessions during the fortnight's conference.

Reviewing the work of the conference Sir John Cockroft, head of the British delegation, said that the two full-scale exhibitions had provided the world's scientists with a "feast, perhaps too rich". The lectures and exhibits had enabled them to see in a few days, in an exciting visual way, work proceeding throughout the world.

U. N. Report on Effects of Atomic Radiation.

The Report on the Effects of Atomic Radiation, published recently by the United Nations Organisation, substantally corroborates the findings of a report on the same subject brought out by the Government of India in June 1956, and endorses its main conclusion that any further exposure of world populations to radioactive fall-out from nuclear explosions is fraught with grave dangers to the present and future generations of mankind.

The U.N. Report is the result of more than two years of extensive study and research carried out by this Committee, on which eminent scientists from fifteen countries were invited to participate. India was represented on the Committee by Dr. V. R. Khanolkar of the Cancer Research Institute, Bombay. The Report brings together a large body of information from various sources concerning the physiological and biological effects of atomic radiation.

Present knowledge concerning long term effects of atomic radiation and their relation with the amount of radiation received from experimental explosions of nuclear weapons does not, as the U.N. Report confesses, warrant anything more than mere "tentative estimates with wide margin of uncertainty". Enough, however, is known even today to lead the writers of the Report to the conclusion that "the exposure of human populations to increasing levels of ionizing radiations may cause considerable and wide-spread somatic damage........Even a slow rise in the environmental radioactivity in the world, might eventually cause appreciable damage to large populations before it could be definitely identified as due to irradiation. Such a situation requires that mankind proceed with great caution."

Reform in the Present System of Examination Reviewed.

Dr. K. L. Shrimali has told in the Rajya Sabha on 19.8.1958 that it was a fact that Government were proposing to bring about a change in the present system of examination with the help of Dr. Benjamin S. Bloom of the Chicago University. Some changes in methods of education, he said, were likely to follow improvements in examination techniques. So far as the Secondary stage of education is concerned the following work has been done :—

During January to April, 1957 Dr. Bloom held six five-day workshops of represenative secondary school teachers from almost all the States of India for introducing them to the technique of preparing test materials with reference to certain well-defined educational objectives. He also held one ten-day workshop of teachers of training colleges for the same purpose.

A progarmme of Action was placed before a Conference of Administrators of Boards of Secondary Education and representatives of universities conducting the Matriculation Examination. It was accepted by the Conference and copies of the resolutions passed were sent to all State Governments for necessary action.

Five fully trained evaluation officers were appointed to form the nucleus of the Examination Unit and ten carefully selected persons were sent to the Chicago University for training in new methods and techniques of Examination. On their return they have started work in this field. These evaluation officers are engaged in training secondary schools teachers in all states in constructing improved test material.

As regards reform in examinations at the University level the services of Dr. B. S. Bloom were placed at the disposal of the University Grants Commission for conducting four regional seminars for the benefit of lectures in universities and colleges. The topics for discussion in the seminars have been 'reform in examination system' for different arts and science subjects. The University Grants Commission propose to consider the question of introducing reforms in University Examinations after the reports of these seminars become available. (Press Informaion Bureau : Govt. of India)

Helping India's Drug Industry:—Russia proper Source.

General S. S. Sokhey, former Assistant Director of World Health Organisation said in Calcutta on 31.8.58 that the Soviet Union was the proper source that could help India build a fully integrated drug industry.

General Sokehy, who was in Calcutta touring along with the Soviet Drug Experts, addressing a special meeting of the Calcutta Corporation's Standing Health Committee at the Central Municipal Building emphasized that the Soviet Union did not observe secrecy in technology and were agreeable to give 'know-how' free of charge and on a continuance co-operation for future advance. What was equally important was that they could provide all necessary equipment and accept payment in rupees thus cutting out the bother of finding foreign exchange.

General Sokhey said that the invited group of Soviet experts were in Calcutta to study the pharmaceutical industry of West Bengal and to talk matters over with the State Government as to what facilities exist in the State for such industry.

"It is however to be regretted that before the Soviet experts had arrived the Ministry of Commerce and Industry entered into an agreement with the American firm of Mercks to extend Pimpri to produce 45 tons a year of streptomycin. This action is understandable because for the collaboration Govt. of India will pay for a period of 10 years very heavy royalties to this firm. This may amount to more than 2 to 4 crores to be paid in dollars, while the same assistance could be had from the Soviets free of charge. What is more serious still, the Hindustan Antibiotics will be called upon to observe technological secrecy, which will damage the progress of this new science in India, as it will prevent the Indian workers from freely collaborating with World Science, particularly that of the Soviet Union, Czechoslovakia, Poland and China, who are quite agreeable to collaborate with Indian Scientists".

Leeway for Retirement Age given to Technical Personnel.

As at present, the Government employees will retire at the age of 55 years though they may be re-employed or extended in service for two years in the first instance and continued for another year if the public interest so requires.

In a recently issued Govt. press note (23.9.58), it has been said that the retention of employees beyond the age of 55 will be allowed liberally in posts requiring specialist and technical qualifications which are not of an administrative character. Nevertheless, in exceptional circumstances, further continuance in service beyond the period of three years will be permitted.

Besides the requirement necessitated by public interest, a person will be re-employed or extended in service "when it is evident that other officers in service are either not ripe enough to take up the appointment or that the retiring officer is of such outstanding merit that Government consider it desirable to retain him."

U.K. to Help Commonwealth Solve Science Problems: Oversea Research Council to be Set Up.

The United Kingdom is to set up an oversea research council to advise and assist Commonwealth countries working on scientific projects. The Earl of Home, Secretary of State for Commonwealth Relations, announced this on September 24 at the Commonwealth Trade & Economic Conference which met in Montreal, Canada.

He said the United Kingdom research councils—the Department of Scientific & Industrial Research, the Medical Research Council, and the Argicultural Research Council—were willing to give any help within the limits of available funds.

The oversea research council would co-ordinate this assistance and advise Ministers on questions of co-operation in scientific research overseas. It would also provide a central point to which Commonwealth governments and research institutions could refer for advice and information, Lord Home added. (British Information Services).

Message-Carrying Satellites.

Earth satellites that can carry messages or mail in a fraction of the time, now required, will probably be developed within a few years, according to Dr. Wernber von Braun, the famous United States rocket expert. According to him, plans for such a project are already well advanced.

It is estimated that half a dozen such satellites would be enough to handle as much information as is now sent from place to place in all the mail of the world both civilian and governmental,

Dr. Von Braun added that the development of such "communications satellites" is now possible because of new developments in electronics. The entire contents of a book could be recorded in a few seconds with an electronic tape recording system. Then the message could be carried to its destination in a satellite, which would relay it by radio as it passed overhead.

Dr. Von Braun explained the working of a communication satellite as follows: As the satellite passed over New York, for example, its tape recorder would be triggered by a radio station that would receive what was then on the tape and would record, on the newly-cleared tape at high speed, message for, say, Capetown. As the satellite passed over Capetwon, the process would be repeated—taking off the messages from New York and recording new messages for some other part of the world. (USIS News Feature)

Pilot Plant for Making White Cement Established.

A pilot plant for the implementation of a scheme to manufacture white cement from indigenous raw materials has been established at the Regional Research Laboratory, Hyderabad. One rotary kiln has already been procured ; and plant and equipment for the fabrication of a second rotary kiln is being obtained.

The process which has been developed at the Laboratory itself makes use of felspar, limestone, and gypsum. All these materials are available in large quantities in different parts of the country. A mixture of these materials is to be heated in the rotary kiln, treated with water, heated again, powdered and mixed with other materials. The white cement obtained by this plant has been found to be of very high quality and is comparable in strength, setting and other properties with good Portland cement,

Association News

Association of Scientific Workers Ordnance Establishments Kirkee :

The Executive Committee meeting was held on 10th Sept. 58. Shri N. B. Datar, President of the Federation, narrated the proceedings of the Central Executive Committee (Federation) meeting held on 26th and 27th Aug. 58 at Kanpur. Following are the important points tackled by C. E. C. Federation.

(1) Draughtsmen and their promotions in T. D. Es.

(2) Forwarding of applications.

(3) Counting of E. T. E. Service towards pension.

(4) Stagnation of staff in T. D. Es— particularly T. D. E.(M. E.).

(5) Problem of accommodation and House Rent Allowance.

(6) Rationalisation of pay scales and posts.

(7) Absorption of S. S. As. and Fore men in existing Class II Gazetted Posts.

(8) Deputation to the Ministry of Defence.

(9) Shifting of the Federation to Kirkee, for the year 1959.

Joint Forum :

A meeting of the Representatives of N. G. Os Staff Association, Supervisory Association and our Representatives was held on 7th Sept. 58 in the office of this Association. Problems arising out of the bifurcation in T. D. Es. were discussed. It was decided unanimously to tackle the issue jointly.

Monthly Income-Expenditure Data of Scientific Workers :

Monthly income—expenditure data was collected from the members and was forwarded to the Pay Commission. It is definite that this will strongly support the demands regarding pay scales.

Six Monthly Review :

New enrollments: 11 Members.

Total collection : Rs. 450|-

New Books added to Library: 2.

Representations and memorandums: 20.

E. C. Meetings: 7.

Average attendance at E. C. Meetings: 60%.

General Body meetings: 1.

Cultural and other programms: Social 1958, and Independance Day celebration.

Bulletin Published: 4.

Membership propaganda appeal: 1.

Facts and Figures about A. S. W. Kanpur:

(1) Total membership: about 400.

(2) Membership is drawn from all ranks from Supervisors to Superintendents.

(3) The Subscription is collected monthly @ 50 nP.

(4) Association has undertaken to conduct a 'Symposium' on "Scientific Conservation of Materials"., some time in Feb. 59.

The Social Gathering of the Association is likely to be celebrated some time in Feb. 1959.

Central Food Technological Research Institute, Mysore :

A new unit of A.S.W.I. has been formed at Central Food Technological Reserch Institute, Mysore with following as office-bearers for 1958-59.

President :
Dr. V. Subrahmanyan,

Vice Presidents :
Dr. D. S. Bhatia
Dr. H. A. B. Parpia

Secretary :
Dr. R. Rajagopalan

Treasurer :
Major N. V. R. Iyengar

Joint Secretary :
Miss M. Nagarathnamma

Executive Commitee :

Dr. J. S. Pruthi
Mr. M. V. L. Rao
Dr. N. L. Lahiry
Dr. W. B. Date
Mr. S. K. Lakshminarayana
Dr. M. A. Krishnaswamy
Dr. M. V. Patwardhan
Dr. K. S. Srinivasan
Mr. R. C. Bhutiani

Federation of Defence Scientific Workers:

The following resolution was passed by the Executive Committee of Federation of Defence Scientific Workers.

"The Executive Committee of the Federation of Defence Scientific Workers expresses its deep sense of sorrow at the sad demise of Prof. Joliot Curie who during his life time rendered valuable service to the advancement of science for peaceful purposes and who was endeared by all peace loving people throughout the world."

Indian Regional Centre of World Federation of Scientific Workers.

At the Council meeting of Association of Scientific Workers of India held on 5.1.58 at Madras it was decided that the Regional Centre would be formed and it would be located at Calcutta. A regional conference of the scientific workers of Middle East, South and South-East Asian countries would be held in November 1958. A sub-Committee consisting of President, and the two Secretaries, was formed to establish contact|liaison with the scientists of these countries. It was decided that the tentative Topics of discussion of the forthcoming Regional Conference would be (a) service condition of scientific workers (b) problems faced in the planning and rapid industrialisation of under-developed countries. It was also decided that Government of India should be approached for a suitable grant in connection with holding of the conference.

To begin with, our President has written to the Embassies of the Governments of Middle East, South and South-East Asia for names of scientific workers in these countries and also for information on the organisation of scientific workers if any. World Federation of Scientific Workers was also approached for names of individual scientists in these countries who could be contacted directly and also for suggestions about the functioning of this newly formed regional centre. In the meantime the Ministry of Scientific Research and Cultural Affairs, Govt. of India has been approached for a suitable grant.

Bureau, W. F. S. W. appreciated the initiative taken by the Association of

Scientific Workers of India to organise the forthcoming regional conference in India and a sum of £ 200|- only was granted to the preparatory cost of organising the conference.

At a recent meeting of the Central Executive Committee of the Association of Scientific Workers of India, held at Lucknow on July 28, 1958 on the position regarding the Regional Conference of Scientists from Asian and West Asian region was discussed. It was noted that the names had been received through the Embassies of the following countries:

Iran, Thailand, Viet-Min, Ceylon, Burma, Sudan, United Arab Republic, and Pakistan.

Reminders have been sent to Embassies in Iraq, Viet-Num, Lebanon, Malaya, Jordan, Afghanistan and Indonesia. It was also noted that Saudi Arabia, Laos and Cambodia have written that there are no scientists or scientific organisations in their countries.

It was further decided that the regional conference should preferably be held at Delhi in January, 1959. In the same C. E. C. meeting an ad-hoc committee of the following has been formed to manage the affairs of the Indian Regional Centre of W. F. S. W.:

President :
Dr. S. H. Zaheer

Secretary :
Dr. S. K. Bose

Treasurer :
Sri J. N. Misra

Members :
Shri D. V. Varma
Shri Baldev Singh.

The names of the ad-hoc committee have been forwarded to W. F. S. W. for approval. The General-Secretary of W. F. S. W. has informed that according to the constitution the Executive Committee of W.F.S.W. has to approve the Heads of the Regional Centres, and asked for a formal proposal and accordingly the the name of Dr. S. H. Zaheer, our President has been proposed as the Head of Indian Region.

Regd. C 3982

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