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MINERALS' SHARE IN THE WAR[1]

By D. N. WADIA

THE Indian Science Congress meets to-day for the fourth time since the beginning of the war. This meeting, only a few hundred miles remote from one potentially active war theater, is an event which bears significant testimony to the place science has won in India. The attendance of so many members drawn from many fields of scientific activities and Government institutions from almost all parts of the country, provides gratifying proof of their devotion to the cause of science and of their subscribing to its exacting ideals. Calcutta has once again made its contribution to the spread of science in India by inviting the congress for the sixth time. We keenly appreciate the warm hospitality it has accorded us under conditions of difficulty we all realize, and it is no mere formal expression of thanks that in your name and on your behalf, I tender to the organizers of this session. A distinguished citizen of India was to have presided at this meeting and no one here shares, more keenly than I, in the disappointment at his absence to-day. I seek your forbearance at my having to address you because of an existing rule which requires your president of the foregoing year to continue in office until its assumption by his successor. Pandit Jawaharlal Nehru's contributions to science in India have not been in the limelight, but they have been a leavening influence in the organization and working of the National Planning Committee, which, since 1939, is engaged in the great task of coordinating applied science with productive industry in every field, industrial, educational, cultural and organizational. Ladies and gentlemen, please believe me, I sympathize with you for having missed his rousing address.

Death has removed from our midst during the year several distinguished workers in different fields of science. The Indian Science Congress mourns the deaths of Rai Bahadur Ramprasad Chanda, anthropologist, archeologist and student of Indian art; Rai Bahadur Sarat Chandra Ray, Tibetan scholar, archeologist and founder-editor of *Man in India;* Mr. Gauripati Chat-

[1] General presidential address before the Thirtieth Indian Science Congress, Calcutta, 1943.

terjee, meteorologist, distinguished for aerological researches in upper air; Dr. G. de P. Cotter, late of the Geological Survey of India and a past president of the Section of Geology; Colonel Sir Francis Younghusband, reputed soldier, Central Asian explorer, geographer and a close student of Indian philosophy.

Reviewing the events of the year that has passed, the most outstanding and dominating event was the approach of the war to the doors of India. For the first time in the 4 millenniums of recorded Indian history, the enemy has assaulted the Eastern frontiers of the country. By sea, land and air our 2,000 miles long eastern walls have been approached and threatened by the invading enemy. But equally significant in the annals of 1942 was India's answer to the invaders, the answer conveyed through its munitions factories, electric, chemical and the host of technical plants, industrial research laboratories and the hundreds of young university-trained men manning engineering, medical, naval and air corps during the year. This may truly be regarded as the greatest event of the last few years in the cultural life of the country—for the first time after her age-long belief in the force of philosophic and spiritual striving as the goal of life, India has taken up the challenge of science and the machine and is adjusting itself intelligently and conscientiously and with surprising quickness to compose a society in which striving for both material and spiritual well-being are equally regarded as ruling factors in a perfect life. That indeed is an ideal difficult to achieve for any people, but in present-day India the change-over is taking place at a remarkably accelerating pace. Indian scientists by their last thirty years' work in different branches of science have made a notable contribution towards fostering the new mental attitude which has brought about this difficult welding. Lord Linlithgow happily expressed the need of such welding for the people of the East as well as the West in his opening address before the Jubilee Session of the Indian Science Congress held in Calcutta in 1938. "Even the most enthusiastic believer in Western civilization must feel to-day a certain despondency at the present failure of the West to dominate its scientific discoveries and to evolve a form of society in which the material progress and spiritual freedom march comfortably together. Perhaps the West will find in India's more general emphasis on simplicity and the ultimate spirituality of things, a more positive example of the truths which the most advanced thinkers of the world are now discovering." To this consummation philosophy and science must aim if the one is not to end in ultimate futility after ages of persistent effort and the other not to achieve, as a reward of its magnificent discoveries and inventions and its conquests over nature, a barren desert of frustration through a succession of world wars.

MINERALS' SHARE IN WAR

A geologist's work during war time is largely mobilizing all mineral resources in his own limited sphere for munitions purposes. Free international movement of minerals having ceased, every country has to produce the full quota from its domestic mineral resources. Far-reaching questions will arise in the near future, if indeed some have not already arisen, as to how long minerals from accessible depths of the earth will be able to sustain man's wars.

Man's advancement to civilization from the hunter and peasant stage is due to his mastery over metals and minerals, but this advance has caused most serious inroads on the world's stock of minerals and especially of metals. During the century and quarter between the Napoleonic wars and the Hitlerian war, the consumption of minerals has been over a hundred-fold of that consumed during the entire history of man on earth and so far as metals are concerned, man has used up between 1914 and to-day, between the two German wars, more metals than during any previous period of history. Metals such as tin have almost reached depletion stage, silver is being made to stand substitute for tin, while the extractable stock of platinum, silver and gold left for future needs of the world within manageable depth will be very meager. The consumption of fossil fuels, coal and petroleum has been at a far more serious rate, so serious that the world's known reserves of mineral oil at the present rate of production will be exhausted in a few decades. The total world coal reserves are larger, but they will last only a few decades longer, if the present acceleration of production and consumption of coal and its use for the ever-lengthening catalogue of by-products continues in the future at the same rate. So far no checks have been devised for this alarming depletion of the world's underground wealth, and this robbing of the earth by the living generation at the expense of future generations. Metals and minerals are a rapidly wasting asset of a country for which there is no renewal or replacement. Agricultural and forest resources of a land can be rejuvenated by suitable measures and manures, but no fertilizer can revive one exhausted mine, for geological processes are exceedingly slow, requiring hundreds of thousands of years to form a vein of metallic ore or a bed of coal.

There are some 1,500 distinct species of minerals known; of these about 200 find application in commerce and industry and are considered economic minerals. Among these again there is a rapidly mounting list of metals and minerals which are of vital use in the manufacture of munitions of war and of highly specialized commodities of strategic use. In the defence program of a nation under the present-day conditions of totalitarian warfare, the metallurgical

industry and its ancillary mining of minerals yielding the ferrous and alloy metals, fluxes, refractories and accessory minerals are of essential importance. A significant feature of the distribution of these minerals is the concentration of their production and manufacture in a comparatively few countries in the world, happily nearly three fourths of these being centered in, or controlled by, the United Nations as against the Axis group. Of the total annual mineral production of the world in pre-war years as much as 85 per cent. came from North America and Western Europe, of these the United States, England and Germany and latterly Russia contributing over 75 per cent. This, however, does not mean that nature has endowed these countries to this unequal extent with valuable minerals; it rather is an index of the country's industrial and technical development and the energy of the people. Russia's three successive five-year plans are an example of this. Industrial progress of other parts of the world may materially change this condition. For instance, China's vast reserves of coal, hitherto untapped for lack of economic employment, may, in the not distant future, be put to use in metallurgy, or in the production of heat energy or other profitable channels. India's resources in iron-ore are of a magnitude quite out of proportion to the bare couple of million tons of pig iron per year it has only recently begun to produce. Only in a few districts of Bihar and Eastern States Agency, the high-grade iron-ore reserves are calculated to be of the order of 4,000 million tons. Large reserves of aluminium-ore are still only potential assets. The minerals of South America and Africa are yet in an early stage of development, while Australia's store of mineral wealth is yet unknown over wide tracts of that region. When these untouched reserves enter production stage, the apparent inequalities will diminish and the countries bordering the North Atlantic basin will not occupy the dominating position in strategic minerals they do at present.

But even so, when the whole world's mineral resources are fully known and mobilized, the stock will not last many generations, if it is made to feed the waste of recurring wars on the scale of magnitude and frequency of the last two world wars. If the supply and free movement of a few ferro-alloys and a few strategic key minerals for non-industrial uses is controlled by some central world organization, the demon of totalitarian war can be banished and the remaining wars shorn of their insane waste involved in military as well as non-military devastations. Then the wreckage of tanks and armor-plates can be beaten back into ploughshares and its superior steel released for beneficent uses in peace.

It is no exaggeration to say that half of the later wars of history have been directly or indirectly motivated through the desire of gaining access to stores of strategic mineral products, ores, fuels, salts, alloy metals and essential industrial minerals.

The international mineral situation during pre-war years was in a chaotic state. While the United Nations were in a state of "vacuous unawareness" about it, the Axis powers grabbed as much of the indispensable munitions minerals as they wanted and the war has been waged by them on the stores of hoarded minerals and metals.

Only the adoption of a wise and justly planned international mineral policy framed by an international directorate can preserve peace and goodwill amongst countries unequally endowed by nature with mineral wealth. No country in the world, however well supplied it be, is self-sufficient in mineral requirements, nor is any so situated that it can regard its mineral resources as purely domestic or national. Embargoes, tariffs, patent rights and transport controls imposed for political reasons do not offer a solution, but by hindering free movement of minerals become powerful contributive factors in precipitating world wars. Unequal geographical distribution of minerals being an unalterable fact, planned international economy should devise means not only to eliminate this cause of inter-country friction but to increase the interdependence of nations on each other for their vital trades and industrial needs and so make minerals a rallying point for international cooperation and goodwill. The preliminary recommendations of the Conference on Mineral Resources and the Atlantic Charter convened by the British Association's Committee on Social and International Relations of Science last July, appear to be on the right lines, but they will not go far enough if their implications are meant to safeguard the interests of the British Empire only, or even of the whole United Nations' group. These should embrace all the free countries and should call for sacrifice from all participating nations of part of their national and natural advantages for the ultimate benefit of all and the future security of the peoples of the world. The main resolution of this conference reads as follows:

> This Conference, having specifically dealt with mineral resources, submits that, as a first step, the Council should initiate forthwith consultations with appropriate scientific and technical organizations, to secure an understanding on the principles involved. The Conference would further urge that a scientific review of mineral resources, using and supplementing all existing data, should be among the first tasks of any international organization for the social applications of science, such as was envisaged at the recent Conference on Science and World Order. To this end, the Conference recommends that the Council should consider how it might help

to promote the establishment of an International Resources Organization, as a fact-finding and advisory body for Governments, as a contribution to world stability, and in the spirit of the Atlantic Charter.

The fourth article of the Atlantic Charter postulates access for all states on equal terms to the raw materials of the world. But if the Atlantic Charter does not unreservedly provide for all peace-loving nations of the earth, whatever oceans bound them, its fulfilment in a partial degree will not achieve the goal of post-war minerals allocation, nor succeed in removing a focal infection point in the body politic of the world.

The position of mineral affairs to-day being what it is, it behoves us as non-Utopian science workers to ask —what is India's place in the world's mineral map? The mineral outlook of the Indian region is on the whole satisfactory both for war and peace-time requirements. India's resources in minerals of strategic importance, minerals for munitions and defence armaments, base metals, alloys, fluxes, refractories and accessory minerals can be regarded as adequate, in several but not all of them. India is deficient in tin, tungsten, lead, zinc, nickel, graphite and liquid fuels. But in the basic metals, iron, manganese, aluminium and chromium, the country is well supplied, in the case of the former three, in large excess. Our neighbor, Burma, has abundant stocks of the munition metals of which India is in defect, while her oil resources must yet be regarded as considerable. Ceylon has reserves of the world's finest graphite, a mineral indispensable in metallurgy and of a magnitude sufficient to last a long period. Ancillary minerals such as asbestos, cement, fertilizers, clays, mica, sulphur, various salts, ores and other minerals of industrial utility are available in quantities sufficient for the country's needs, while some are in exportable surpluses.

The experience of the last three years' war effort in the production in India of a wide range of munitions, without any previous apprenticeship, is satisfactory proof of the country's adequacy in some respects, though still unequipped in a number of essentials, *viz.,* specialized steels, machine tools, manufacture of aircraft, high explosives, automobile engines, big ship construction, etc., on a scale commensurate with her internal requirements.

The Social Obligations and Relations of Science in India

Last year, while addressing you on the progress of the exact sciences in India during the last 30 years, I stated that the retrospect was satisfying and held out promise of further developments. The time, however, has come, and the events of the last few years forcibly remind us of the fact that science, as pursued in the laboratory and the field, is becoming more and more a specialist's job and is becoming divorced from the life of the people. Science, as applied to the problem of daily living and the social needs of the common man, is the great necessity of the day. The advent of the motor bus, the radio and railway engine in the villages of India is not the same thing as bringing science to the homes of our villagers. The impact of science on the Indian masses has come in the form of a rather rude intrusion of machines and mechanics into the essentially simple rural economy of the country and it is not surprising that this meeting has not been a particularly happy one. It has disturbed the economic structure and created, if not some aversion, an indifference to the cult of science in the popular mind. But we all know that science is not all mechanics nor are its practical uses to man the greatest thing about science. The greatest thing about science is the scientific method—the most effective thing man has for discovering truth and the ways of nature. It can bring solid benefits by releasing life from stagnation and the bonds of ignorance wherever these prevail, whether in cities or in the country-side, among the laboring masses or among the governing class. The awakening to the social obligations of science is of recent date and even in Europe and America, this aspect of the cultivation of science was for long not realized and left to sporadic individual efforts. With this awakening, a two-fold problem faces science all over the world to-day—to press the newest discoveries and inventions of applied science into the service of agriculture, manufactories, hospitals, homes and schools and alongside with it to so control the impact of these on his private life that his mechanized work-a-day life may not be totally divested of all higher spiritual values. Our future national life and its material well-being largely depend on a wholesome balance being maintained between these two—the impulse to harness science to increase physical comforts of life and a restraining desire to preserve the old-world spiritual calm and simplicity of living. Happily for India, this balancing is somewhat of a natural hereditary trait and does not need much emphasis. While in the European countries the evolving of a true synthesis, a *via media,* demands much searching and learned arguing, our age-old traditions have made this work easier. India's late start in the application of science to industry also gives it an opportunity of planning along right lines. The significance of this problem has been realized by both our political leaders, as well as scientists, and some progress is made in this direction. I refer to the inauguration in 1939 of the National Planning Committee under the chairmanship of Pandit Jawaharlal Nehru, with the specific object of coordinating science with industry in all its phases and to the establishment by the Indian Sci-

ence Congress at its Lahore session in January, 1939, of a subcommittee on science and social relations, mainly with the object of studying the influence of science on India and collecting data relating to the effects of science on society in India.

The National Planning Committee, through its 29 subcommittees, has set out on formulating a program covering many phases of the country's future life and activities, material, productive, educational, artistic. Their work unfortunately is in a great measure suspended to-day, though some of the 29 subcommittees have furnished more or less complete, well-documented reports, while others have submitted interim fact-finding reports. Their conclusions, doubtless, will be subjected to thorough revision and deliberation by the main body which comprises 200 of the leading industrialists, publicists and scientists of the country, before they are offered to the public, but a great deal of spade work is accomplished, a valuable mass of ascertained classified details collected and many blueprints prepared. A planned reconstruction in a greater or less measure of India's commerce, industry, finance, land labor, mining, transport, power-generation, technology alongside educational, cultural and social reorganization is expected to emerge from the labors of this body.

PROPOSED ACADEMY OF SOCIAL SCIENCES FOR INDIA

The executive committee of the Indian Science Congress has before it a proposal for the institution of a National Academy of Social Sciences drawn up by the subcommittee on science and social relations. It is interesting to trace the origin of this subcommittee which goes back to the Blackpool meeting of the British Association for the Advancement of Science in 1936, which meeting was devoted to the discussion of the social relations of science. In the following year, a few leading science associations took cognizance of this subject. The International Council of Scientific Unions, with its headquarters at Delft, Holland, at its meeting held in April, 1937, in London, established a Committee on Science and Social Relations with Professor F. G. M. Stratton, of Cambridge University, as president. This action of European scientists was followed by a resolution passed by the American Association for the Advancement of Science at its meeting in 1937 urging the various scientific organizations of the world to reundertake examination of the profound charges brought about by science in human society and thus be in a position to promote "peace among nations and intellectual freedom in order that science may continue to advance and spread more abundantly its benefits to all mankind." In 1938 the British Association at its meeting held at Cambridge brought into being a special Division for Social and International Relations of Science with Sir Richard Gregory as its chairman. This division organized a conference on "Science and the New World Order" in London during September, 1941. In conjunction with these sister organizations of Europe and America, the Indian Science Congress instituted a subcommittee on science and social relations at its annual session held in Lahore in January, 1939. This subcommittee has been working for the last three years and its labors have fructified in the above proposal which in due course will come before the Indian scientists and to which they will have to give their most careful consideration.

The proposed academy should be a body of high academic standing and professional knowledge, which can take up long-range problems of social well-being of the people or India which the older societies and associations, established along familiar but too general lines in some cases and rather over-specialized lines in others, can not deal with without suspicion of religious or political bias. Socio-medical and political subjects, human relations, anthropology, political science, vital statistics, social biology, population problems, sociological research in particular bearing on various Indian communities are the subjects on which such an academy can work in collaboration with the Indian Science Congress and half a dozen other institutions already existing in the country for some of the above-named specific objects. It can be a living organ in the body politic of India for voicing the collective opinion and focussing the specialized points of view of numerous isolated working bodies on the one problem how to promote the well-being of the common man. The subcommittee has begun a survey of the status of sociological studies in all the Indian universities. Vice-chancellors of many Indian universities have endorsed the proposal about the academy favorably, and the secretaries of those learned societies that have been approached have announced their readiness to cooperate. Dr. K. Motwani, the secretary of the subcommittee, personally placed the scheme before Pandit Nehru last July and, in accordance with Pandit Nehru's wishes, the executive committee proposes to appoint a committee of experts to suggest ways and means of bringing this academy of social sciences into being. The matter rests here. It is too early to outline the exact task to which the academy will address itself. Its chief function will be to explore those avenues through which the contributions of science may be adapted to the life of the individual and the nation without allowing any anti-social applications of science such as have made a shambles of so many countries, ever raising their heads in our midst. Secondly,

the academy should emphasize an integrated, synthetic approach to every problem, pressing into service the contributions of various basic social sciences such as human geography, anthropology, psychology, economics, political science, philosophy and sociology. The bringing into being of a national academy so constituted may well become a crowning achievement of the Indian Science Congress.

OBITUARY

JOHN OTTERBEIN SNYDER

DR. JOHN OTTERBEIN SNYDER, professor of zoology, emeritus, at Stanford University, died in Palo Alto, California, on August 20, 1943. Professor Snyder was born in Butler, Indiana, on August 14, 1867. He is survived by his wife, the former Frances Hamilton, and two children, Corporal Cedric O. Snyder, U. S. Medical Corps, and Evelyn Hamilton Snyder, of Palo Alto.

Professor Snyder's boyhood was spent in the town of his birth, where he received his early education. In 1890 he went to Indiana University. There, as a freshman, he came under the stimulating influence of the late Dr. David Starr Jordan, became interested in the study of fishes and followed Dr. Jordan to Stanford in 1892. From that time until his death he was closely associated with the Stanford community, first as student, later as teacher, administrator and citizen. In each role he played a leading part.

From the year before his retirement from the university (1931) to 1937 Professor Snyder was director of the Bureau of Fish Conservation of the California Division of Fish and Game. His understanding of the fundamental biology involved and his genius for organization resulted in a complete revision of the work of that bureau along scientific lines. On retirement from the service of the state, he left the administration of the bureau in the hands of a former graduate student whom he had selected and trained especially for that work.

Professor Snyder's more serious research interests were broadly in the field of ichthyology; he was the author of many papers dealing with systematic ichthyology, with the distribution and life histories of freshwater fishes and with fisheries biology. In his systematic work he was especially interested in the finer differences shown by closely related forms, and in some of his earlier papers he developed methods for studying series of specimens that foreshadowed the present statistical approach to similar problems. His studies of the salmon of California were of special importance in providing a scientific background for his conservation work with the California Division of Fish and Game.

As a young man Professor Snyder took part, as ichthyologist, in a number of important scientific expeditions. He accompanied Dr. Jordan on trips to Mexico, Hawaii and Japan, and served as naturalist on the U. S. Fish Commission research vessel *Albatross* at various times between 1902 and 1906. Until 1916, he was at frequent intervals associated as assistant with the Fish Commission and with the succeeding Bureau of Fisheries. In 1914 and 1915 he served as ichthyologist in the U. S. National Museum and in 1925 was appointed director of the Marine Biological Laboratory of the Bureau of Fisheries at Woods Hole, Massachusetts. He was an active member of the California Academy of Sciences and was corresponding secretary for a number of years beginning in 1920. Professor Snyder was always keenly interested in the general welfare of the communities in which he lived. At Stanford University he served actively on various academic committees. He was a member of the city council of Palo Alto from 1917 to 1922. During World War I he quietly rendered services to the nation that were known only to a limited number of close associates.

As a youth, J. O. Snyder was widely interested in nature—in the geology and biology of his native Indiana. This interest sharpened his naturally keen powers of observation, and he developed into a superb field naturalist. This interest in the things of out-of-doors he retained throughout life. During the years of his teaching at Stanford his courses in ornithology, always popular with students, provided for many of them a source of pleasure that carried over into their lives long after their leaving the university.

His understanding of, and helpful interest in, the younger men and women who came under his influence were conspicuous traits of his character and inspired many of his students to an abiding interest in biology. It was characteristic of these interests that he regularly organized field expeditions, many of which lasted for several months, and on which he took one or more younger men. His methods in the field were systematic, thorough and ingenious, and his field notes were models of accurate observation and careful recording. The training he gave on those trips, chiefly by example, was incomparable. And training apart, the delightful comradeship and the refreshment of those days in the open with "J. O." has remained a high light in the lives of many of the students who were privileged to experience them.

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