of London, and Secretary of State Henry L. Stimson, the entire American Museum fossil collection of the year 1928 was finally released by the government of China and is now on its way to the American Museum, after a prolonged and most unfortunate delay since August, 1928, when the collection was first detained in Kalgan.

A description of this and the preceding collections in vertebrate paleontology will constitute Volume V of the publications of the Central Asiatic Expeditions. Dr. Andrews has remained in Peking to write Volume I, "Narrative of the Expeditions," which have now been in the field since 1921; Volume II, "Geology of Mongolia," by Professors Charles P. Berkey and Frederick K. Morris, is in circulation; Volume III, on the "Geology of Mongolia," by Professors Berkey and Morris, is now in press; Volume IV will be "Topography of Mongolia," which will include maps by L. B. Roberts, and the volume on "The Permian of Mongolia," by Dr. Amadeus W. Grabau, formerly of Columbia University and now of the Chinese Geological Survey, is in press and will soon be ready for the printer.

It does not appear an exaggeration to say that, as a result of our exploration and survey of Mongolia, the researches in geology, paleontology and zoology mark one of the most important scientific advances of the twentieth century. The publication of these scientific researches will be of great educational as well as economic importance to China. These discoveries have not only aroused interest throughout the entire scientific world, but have spread very widely and have renewed a healthy popular interest in China and Mongolia, to offset the always disturbing and conflicting political news which we receive from these countries.

The interruption of the work of the Central Asiatic Expeditions is a misfortune. The permanent suspension of this work from any cause would be a calamity in the advance of science.

AFRICA AND SCIENCE. II

By JAN H. HOFMEYR

PRESIDENT OF THE SOUTH AFRICAN ASSOCIATION

What then can Africa give to science? In reply to that I can do no more than suggest some of the lines along which Africa seems to be called upon to make a distinctive contribution to science.

First there are the related fields of astronomy and meteorology. To astronomy I shall but make a passing reference. This continent of Africa, more especially the highlands of its interior plateau, with its clear skies and its cloudless nights, offers wonderful facilities to the astronomer. As proof of the necessity of utilizing those facilities, especially with a view to the study of the southern heavens, I need but quote the words used by Professor Kapteyn on the occasion of the 1905 visit: "In all researches bearing on the construction of the universe of stars, the investigator is hindered by our ignorance of the southern heavens. Work is accumulating in the north, which is to a great extent useless, until similar work is done in the south." Africa has to its credit considerable achievements in the past in the field of astronomical research. The increased equipment now available should make it possible to increase greatly the amount of systematic work now being done, and to offer important contributions to astronomical science.

But probably of greater importance is the work waiting to be done in meteorology. Few branches of science have a more direct effect upon the welfare of mankind—that is a lesson which we in South Africa should have learned only too well—but in few has less progress been made. And in meteorological work Africa is probably the most backward of the continents. It is not so long since Dr. Simpson, of the London Meteorological Office, declared that, save from Egypt, his office received practically no meteorological information from the great continent of Africa. Moreover, the backwardness of meteorology is in large measure due to the intricacy of the problems involved, and the necessity of having world-wide information made available. The problems of meteorology are emphatically not the problems of one country or of one region. The South African meteorologist must see his problems *sub specie Africae* (the seasonal changes in South Africa depend on the northward and southward oscillations of the great atmospheric system overlying the continent as a whole); and quite apart from what he can learn from the rest of Africa, the Antarctic regions have much to teach him. But while the development of meteorological research throughout Africa is of supreme economic importance for Africa, Africa in its turn has its contributions to make to other continents. In particular, we should not forget the close interrelation of the meteorological problems of the lands of the southern hemisphere. The central position of Africa in relation to those lands gives not only special opportunities but also special responsibilities for meteorological observation and research. For the sake both of South Africa and of science in general I

would venture to express the hope that this second visit of the British Association will give as powerful a stimulus to meteorology as did the first to astronomy.

Next, I would refer to Africa's potential contributions to geological science. Africa is a continent, portions of which have always had a special interest for the geologist because of the great diversity of the geological phenomena manifested, and the vast mineral wealth which, as its ancient workings so abundantly prove, has attracted man's industry from the very earliest times. But in our day the opportunities which it offers to the geologist to make contributions to the wider problems of science are coming to be more fully realized than ever before. Of special interest in this connection is the light which African geology, more especially in the form of the study of ancient glacial deposits, can throw on the Wegener hypothesis of continental drift. In the past our geologists have thought mainly of the correlation of our formations with those of Europe. It is time that they paid more attention to their possible affiliations with those of the continents to east and west of us. If geology can establish the hypothesis that Africa is the mother continent from which India, Madagascar and Australia on the one side and South America on the other have been dislodged, it will give a new orientation to many branches of scientific activity. For that investigation also Africa occupies a central and determinative position in relation to the other continents, such as we have noted to be the case in the sphere of meteorology. There are many other geological problems on which Africa can probably shed much light. There is, for instance, the constitution of the earth's deeper sub-strata, in regard to which, as Dr. Wagner has recently pointed out, the study of the volcanic Kimberlite pipes, so numerous throughout Africa south of the equator, and of the xenoliths they contain, including the determination of their radium and thorium contents, may be of the greatest significance. There is the possibility that the exploitation of Africa's great wealth in potentially fossil-bearing rocks of presumably pre-Cambrian age will yet yield us remains of living beings more primitive than any yet discovered; there are the great opportunities of study which the African deserts offer in the field of desert geology and morphology, and there is the assistance which African geology has rendered to vertebrate and plant paleontology, and can render to African anthropology in the investigation of this great museum of human remains and relics which we call the continent of Africa.

I pass on to medical science. I have referred already to the contributions to the study of the problems of industrial medicine and hygiene which the special circumstances of the South African gold-mining industry have made possible. Those contributions have, we may well hope, but prepared the way for advances of a revolutionary character in the early detection, prevention and treatment of all forms of respiratory disease. But even greater are the opportunities which the continent of Africa offers for the study of tropical diseases, of which it may well be described as the homeland. In Africa there have been and necessarily must be studied the problems connected with malaria, blackwater fever, sleeping sickness, yellow fever and many other scourges of civilization, and from Africa there may well come hope and healing for mankind. There are other problems of medical science for the study of which Africa is uniquely fitted. There are the physiological questions, important also from the political point of view, which bear on the fitness of the white races to maintain a healthy existence in tropical surroundings, at high altitudes and in excessive sunlight. For these investigations the diversity of conditions prevailing in the various regions of the African continent make it a magnificent natural laboratory. There is the elucidation of the factors which account for the varying susceptibility of white and colored races to acute infectious diseases, tuberculosis and certain types of malignant disease, together with the light which such elucidation may throw on the physical and chemical composition of the human body. Lastly, I would mention the exploration of that most interesting borderland between psychiatry and psychological science by an analysis of the mentality of the diverse African peoples. That investigation has an important bearing not only on the limitations and capacities of racial intelligence, but also on the methods which the ruling races in Africa should follow in seeking to discharge their obligations towards their uncivilized and unenlightened fellow-Africans.

Closely linked with medical science is the study of animal biology. In some instances the problems of the two branches of science are to be approached along parallel lines; in others, biological investigations are fundamental to the growth of medical science; of no less significance is that unity which there is in nature, making it possible for the truths of animal biology to be translated into facts concerning mankind. In the African continent there is no lack of opportunity to advance science by physiological inquiries into animal structure, by the isolation of the parasites of human and animal diseases and by the tracing of the life histories more especially of the minuter forms of animal life. "Nowadays," in the words of Professor J. A. Thomson, "the serpent that bites man's heel is in nine cases out of ten microscopic." But scarcely less important are the exten-

sive facilities which Africa still offers for the study of the habits and behavior of the larger mammals. The naturalistic study of these animals, not as stuffed museum species, but in the laboratories of their native environment, has received all too scanty attention from the scientist, and this is a reproach which African science, with its rich dowry of mammal and primate material, may confidently be expected to remove. Nor will this study of animal behavior, especially of those animals which approach nearest to the human type, be without its bearings on our investigations of the workings of the human mind. If in this hasty survey I may take time to mention one more point within this field, I would refer to the results which await the intensified activity of the marine biologist and the oceanographer in the as yet all but virgin territory of the African coast-line. This association of ours has long dreamed of an African marine biological station as broad in its conception and comparably as useful from the wider scientific and the more narrowly economic points of view as those of Plymouth or Naples or Woods Hole, and withal a rallying point for the naturalist, the zoologist, the botanist, the geographer, the anatomist, the physiologist—indeed for all those workers whose diverse problems meet at the margin of the sea.

From animal biology we pass by an easy transition to anthropology, the study of man himself. And here Africa seems full of splendid promise of discovery that may verify Darwin's belief in the probability that somewhere in this land-mass was the scene of nature's greatest creative effort. It would seem to be not without significance that Africa possesses in the chimpanzee and the gorilla those primate types which approach most nearly the form and structure of primitive man. To that must be added that in the Bushman, Pygmy and negroid races Africa has at least two and possibly three early human stocks which are characteristically her own and belong to no other continent. No less striking is the fact that in Gibraltar, in Malta and in Palestine, that is, at each and every one of the three portals into Africa from Europe and Asia in Pleistocene times, there have been discovered evidences of the presence of Neanderthal man. In Africa itself there was found at Broken Hill some nine years ago a skull with the most primitive or bestial facial form yet seen, and so closely akin to the Neanderthal stock as to establish firmly the expectation of finding further compelling evidence of a long-continued Neanderthaloid occupation of the African continent. The discovery at Taungs, on the one hand, which reaches out towards the unknown past, and the finds at Boskop and in the Tsitsikama, on the other, which assist in linking up the period of Rhodesian man with the coming of the Bushfolk, open up to us, in conjunction with the aforementioned facts, a vista of anthropological continuity in Africa such as no other continent can offer. The recent investigations in the Great Rift Valley, near Elementeita in Kenya, and the fossil discoveries on the Springbok Flats, north of Pretoria, have again fixed the attention of the anthropologist on Africa.

Nor are the data presently available restricted to these discoveries. The efforts of archeologists and the application of improved scientific methods in excavation are giving us stratigraphical evidence of the succession of stone cultures which is of the utmost importance. I have already mentioned the assistance which geology can render in this work, but there is needed also the cooperation of those who labor in the converging fields of anatomy, archeology, paleontology and comparative zoology. That cooperation has already commenced. In the investigation of the Vaal River gravels it has yielded important results, and we may look forward to its continuance and expansion in the years that lie ahead. Of the importance of African anthropology for the understanding of that of Europe there can be no question. Work of importance has already been done in the study of the relations between Paleolithic art in Europe and Paleolithic art in Africa. The significance of these comparisons is but emblematic of the importance of similar investigations in regard to stone cultures, rock engravings, ancient mining, stone circles and ancient ruins, methods of primitive mining and agriculture, tribal organization, laws and customs—indeed the whole range of the hitherto unexplained or partially explained phenomena of living and extinct cultures. There is no lack of avenues which the student of African anthropology may follow in the hope of finding at the end of them results of supreme value for science in general.

I would speak next of the vast field, as yet almost uncharted, of phonological and philological study. Here in Africa we have great opportunities for the examination of linguistic problems, and some of them have bearings which extend far beyond the limits of Africa. One thinks first of the opportunities which Africa offers for investigating the results of the transplantation of languages, which have a long history of cultural development behind them, to regions inhabited by primitive peoples. Here there are two sets of phenomena, each with its own special interest. On the one hand we have the modification of the languages of those European peoples who have established themselves in Africa as permanent settled communities, under pressure of the new linguistic influences into contact with which they have been brought. Of these phenomena the study of Afrikaans offers perhaps the best examples to be found in the

whole field of linguistics—its importance for the student of comparative philology is very far from being adequately appreciated. On the other hand we have those cases where European languages have come to Africa as the languages not of settled communities, but of officials and others like them who are but temporarily domiciled in this continent, and leave no descendants behind them to carry on the process of evolution of distinctive forms of speech. Here the phenomena which are of interest to the student of linguistics are to be found in the wealth of deformation and adaptation which the native populations have introduced in their endeavors to speak the European languages of their rulers. Work such as has been done by Schuchardt in Negro-Portuguese and Negro-French opens up a wide area of most attractive investigation.

But the most important task in the field of African linguistics is the actual recording of the native languages of Africa, our backwardness in respect of which is a reproach to science. Such study is, of course, important in relation to Africa itself, but of even greater significance for my present purpose is its bearing on scientific problems of wider scope. In that connection I would suggest two points. We are still only at the beginning of the study of Comparative Bantu. That in due course should lead to a knowledge of Ur-Bantu. Such a study and such a knowledge will necessarily be of importance to the comparative philologist, both because of the light shed by the study of one group of languages on the study of other groups, and also because it opens the way to the investigation of the relationship of Bantu to the other African tongues, and its place in the general scheme of the languages of the world. But of even greater interest is the study of African languages as throwing light on the inter-penetrations and interactions of primitive peoples. Language is a function of social relationship, and its study is therefore of great value for ethnological and historical investigations. May I give one instance of what I have in mind? Two millennia back southwest Arabia was the seat of the powerful commercial civilizations of the Mineans, the Sabeans and the Himyarites, radiating eastwards to India and southwestwards to Africa. The extent of their relationship with Africa it has hitherto been most difficult to trace, but linguistic evidence may prove to be of great value. Professor Maingard has pointed out to me that the Makaranga who live near Zimbabwe call water "Bahri," a word closely related in form to "Bahr," the "sea" of the Arabs, although the Makaranga themselves are not a sea-board people, and that "Shava" is their word for "to sell or barter," while to the Himyarites "Saba" meant to travel for a commercial purpose." Not less suggestive is the study of place-names, and while I do not suggest that I have evidence on which any conclusion can be based, I do contend that these investigations may prove to be of a most fruitful character. It would be interesting indeed to see what evidence linguistics can bring in respect of the relationship of South Africa with Madagascar, and also with Polynesia through Madagascar, where the tribe once dominant politically, the copper-colored Hova, are ethnologically and linguistically Melanesians amid the darker-hued Sakalavas and other negroid tribes. It may even be that such studies will conjure up to our minds pictures of great migratory movements with Arab dhows and South Sea praos cleaving the waters of the Indian Ocean. Only last year a canoe constructed of wood native to southeastern Asia was found in Algoa Bay.

And, finally, in this survey of what Africa can give to science, I would refer, with the utmost brevity perforce, to Africa as a field favored as is no other for the study of all those complicated problems which arise from the contact of races of different colors and at diverse stages of civilization. Of those problems, ranging from the investigations of the biological factors involved in the conception of race to the practical problems of the administration of backward peoples I need not speak. They have come to be part almost of the every-day thinking of most civilized men. What I would emphasize is that in Africa, as nowhere else, the factors which constitute these problems can be studied both in isolation and in varying degrees of complexity of interrelationship, that in Africa we have a great laboratory in which to-day there are going on before our eyes experiments which put to the test diverse social and political theories as to the relations between white and colored races, that in Africa there are racial problems which demand solution, and the solution of which will affect or determine the handling of similar problems throughout the world. We hear men speak of the clash of color, and are sometimes told that Africa is the strategic point in that struggle. I think of it rather as the continent which offers the richest opportunities to those who would investigate racial problems in the true spirit of science, and so discover the solutions which may yet enable that clash to be averted and the threat which it implies to our civilization to be dispelled.

I have sought—briefly and all too inadequately—to indicate some of the lines along which Africa seems to be able to make a distinctive contribution to science. It remains for me, yet more briefly, to speak of Africa's challenge to science, and to seek to answer the question, What can science give to Africa? I shall not stop to emphasize the point that the greatness of Africa's potential contributions to science, the key which perhaps she holds to the riddle of human

origins, the intriguing vistas opened up in the study of her relationship with South America and Australasia with its suggestion of past continental continuity, that all these and more constitute a challenge to science to actualize those potentialities. Let me seek rather to define the twofold challenge of Africa in another way. Firstly, Africa defies science to unravel her past. Throughout history she has ever been the continent of mystery. She was so to that pioneer of geographers, Herodotus, to whom nothing that was told him about Africa was so improbable that he declined to give it credence. She was so to the Romans, who regarded Africa as the natural home and source of what was strange and novel and unaccustomed. She was so to the navigators who did so much to break down the barrier wall between the Middle Ages and the Modern World. And though in our day the geographical mysteries of Africa have in large measure been solved, the work of the prober of her scientific secrets is only beginning. Then, secondly, Africa challenges science to define, to determine and to guide her future. If the great resources of this vast, undeveloped continent are to be made available for humanity in our own and the succeeding generations, science must make it possible for the man of European race to undertake that work of development by showing him how to protect himself, his stock and his crops against disease, by enabling him to conserve and utilize to the greatest extent the soils, the vegetation and the water supplies of the continent, by bringing to bear the resources of modern engineering on the exploitation of its wealth and not least by determining the lines along which white and colored races can best live together in harmony and to their common advantage.

That is the challenge of Africa to civilization and to science. It is not now thrown out for the first time; it is not the first time that it will have been taken up. It is in Africa that the Greco-Roman civilization won some of its most glorious triumphs, in Africa that the spade of the archeologist has in our day, by uncovering great Roman towns with noble public buildings and efficient irrigation systems, provided impressive evidence of the magnitude of the achievement of Roman imperialism. But Rome failed to conquer Africa for civilization, and left the challenge to those who were to follow after. She failed chiefly for two reasons: the might of African barbarism and the defiant resistance of African nature. We in our day, confronted by the same challenge, still have the same enemies, hitherto victorious, to contend against. But we meet them with the advantage of having resources at our disposal which our Roman predecessors lacked. It is to use those resources effectively that Africa challenges science.

In dealing with African barbarism we have weapons such as Rome could never dream of, and not the least valuable are those provided by the scientific investigation of the native peoples of Africa. The way to the solution of the problems presented by African barbarism is to be sought in an understanding of the character and mentality of primitive peoples, in the exploration of those regions in their social life where are to be found the factors that determine their reaction to diverse methods of administration. The study of African languages and of African anthropology is therefore fundamental to the development of the continent. For that work Africa possesses special advantages, and one can but hope that the facilities now being built up in our South African universities will be recognized in Britain and elsewhere, and become an important factor in the response of science to the challenge of Africa.

Not less formidable is the conquest of African nature, for the achievement of which also we in our day are far better placed than were the Romans. It is modern science which gives us that advantage. Three great tasks confront science in the conquest of African nature. First, science must make Africa safe for the white man to live in. I have spoken of the opportunities which Africa offers for the study of tropical diseases as likely to yield results of significance for science in general. But primarily will those results be of significance for the development of Africa? This part of the challenge of Africa is not lightly to be taken up. Africa has taken heavy toll of science. The recent deaths in Nigeria of Stokes, Young and Noguchi, worthy followers in the tradition of Lazear and Myers, are a reaffirmation of the gravity and insistence of that challenge. The importance for the cause of civilization of a successful response to that challenge can not be illustrated better than by the story of the construction of the Panama Canal. De Lesseps attempted the task and failed. For every cubic yard of earth excavated by him a human life was sacrificed to yellow fever or malaria. It was the successful attack some twenty years later on the death-dealing mosquito under the direction of General Gorgas that made possible the completion of one of the most important engineering enterprises of modern times.

Secondly, science must combat the foes which have to be contended with in the development of African agriculture. Africa is prodigal indeed in the production of insect and other foes to cattle and to crops. Science is already making an effective response to this part of the challenge. But there is much that remains to be done. And we shall be none the worse for the timely realization by the politician and the administrator of the contributions which science can make.

All too often in the past settlement schemes have been undertaken and ended in disaster in areas unhealthy to man, beast or crops, when, if the scientist had first been called in, precautions might have been taken which would have averted the calamity.

Finally, science must harness the great resources of Africa. And here there are suggested to us all the varied contributions which the engineer can make in the work of development. Has not the Institution of Civil Engineers defined the ideal underlying all engineering activity as "the art of directing the great sources of power in nature for the use and convenience of man"? Africa offers abundance of opportunities for the realization of that ideal. It is not by working in isolation that the engineer will realize it, but rather by cooperation with his colleagues in other branches of science, and by the correlation and coordination of the essential data which they must do so much to provide. First in the order of engineering development come the civil and mining engineers. Their tasks are the provision of facilities for communication, for health, for the conservation of agricultural assets, for the production of raw material and for the development of mineral resources. In their train there follow, with the advent of industrial activity, the mechanical and electrical engineers. Their tasks are to make the fullest use of the revolution in ideas of transport, including transport by air, which have resulted from the perfecting of the internal combustion engine, and to secure the maximum advantage possible from cheap production and efficient distribution of electrical power. The day must come, to give a concrete instance, when the Victoria Falls, with their immense water resources, will mean much more for Africa than Niagara to-day means for America. Later still there will be called in the services of the chemical engineer, ever engaged in problems of research to ascertain the most advantageous processes of converting raw materials into manufactured articles. In all these tasks it is the South African engineer who has, under the conditions of an undeveloped land, built up a technique and practice suitable to African requirements and showing promise of wider applicability, that we may well expect to assume a position of leadership and of inspiration. These are some of the ways in which science can respond to the challenge of Africa.

The picture which I set out to portray I have now completed. I have tried to suggest something of the magnitude of the rewards which Africa has in store for the scientist who has the enterprise to adventure and the vision to see. I have sought also to be the medium of the challenge presented to science by Africa's opportunities and needs. It is a vast canvas on which I have had to work. On it I have drawn but a few sketchy outlines. Yet I hope that the vision stands out clear. I hope that I have said enough to convey the power of its inspiration. Not least do I hope that you, our visitors, will play a great part, in the time that you will spend with us, in filling in some of the details of the picture, and in quickening and vitalizing its message for the scientists of South Africa. It is to them chiefly that it makes its appeal. The development of science in Africa, of Africa by science, that is the promised land that beckons them. I believe that they will not be disobedient to the vision.

OBITUARY

JOHN MERLE COULTER[1]

DR. JOHN MERLE COULTER was born at Ningpo, China, November 20, 1851. His parents were missionaries sent by the Presbyterian church to work in China, the family being left fatherless through death in 1853. John M. Coulter and his brother, Stanley, in the care of their mother, returned to southern Indiana, where their boyhood days were spent. His college education was secured at Hanover College, from which he was graduated with the A.B. degree in 1870 and from which he received his master's degree in 1873. The degree of doctor of philosophy was conferred on Dr. Coulter by the University of Indiana in 1882, and the degree of doctor of laws was conferred by the same institution in 1920.

After a period of secondary-school teaching at Logansport, Indiana, Dr. Coulter became professor of natural sciences at Hanover College, where he taught from 1874 to 1879. He then went to Wabash College, where he was professor of biology from 1879 to 1891. Then he continued his particular interest in botany as professor of botany in the University of Indiana, where he was also president from 1891 to 1893. He was president of Lake Forest University from 1893 to 1896. With the establishment of the department of botany of the University of Chicago, Dr. Coulter became a part-time teacher in that department and he soon resigned the presidency of Lake Forest University, becoming head of the department of botany of the University of Chicago, where he remained from 1896 to 1925. When William Boyce Thompson became interested in establishing an institution for plant research he consulted Dr. Coulter, amongst others, and finally asked him to become adviser in the organization of the Boyce

[1] At the fifth New York meeting of the American Association for the Advancement of Science the council named a special committee to prepare a statement for the association in memory of the late Professor John M. Coulter. The committee's statement is presented herewith.