

SCIENCE

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SOME OF THE SCIENTIFIC PROBLEMS AND DUTIES AT OUR DOORS¹

WE are here at the second meeting of a new endeavor on the part of the American Association to foster an interest in scientific work and in scientific research, and it is sincerely hoped that we shall worthily do for and in this portion of our country what the parent association has done for the country at large; and what the British Association has so long been doing for Great Britain. It is for us not only to keep alive the interest in the good work of the general organization, but to widen its scope, to extend its influence and to bring it to a higher degree of usefulness.

Our national association has been a power for good in this country from its inception in 1848, for it has helped to awaken and has kept alive a widespread interest in science throughout our country, and it has brought together and kept in touch with each other persons interested in the various branches of science.

Since 1831 the British Association for the Advancement of Science has been a powerful and even a remarkable agency in the encouragement of local workers in Great Britain, and in the quickening of interest in every branch of science. But while the British Association has of late years visited Australia, Canada and South Africa, from the outset most of its activities have been confined to England, Wales, Scotland and Ireland, an area (121,112 sq. ms.) smaller than that of the state of

¹ Presidential address before the Pacific Division of the American Association for the Advancement of Science, at Stanford University, California, April 5, 1917.

California alone (158,360 sq. ms.), and having a population of forty-five millions as compared with California's one and a half millions at about the same period. But when we consider that we are expected to hatch out the eggs of science over the area extending from the Rocky Mountains to the Philippine Islands, and from the polar regions in northern Alaska to the torrid zone, we must realize that we have entered upon no trifling undertaking.

These facts are mentioned in order that we may not have false ideas of the relations of our population to the area of our operations—a factor in the problem that can not be overlooked. In a denser population where interest in any one subject has a large following it is comparatively easy to keep that interest alive and active. With our smaller population scattered over a vast area, and that population but indifferently provided with educational facilities, we must expect to meet obstacles that are inseparable from a country as new as this of ours, and to find it necessary to make extraordinary efforts if we would look forward to extraordinary results.

Many of the people about us here on the Pacific coast are quite as well prepared to do scientific work as any in the world, but we can not shut our eyes to the fact that the great bulk of our population are engaged in the work of pioneers whether they live in cities, villages, on farms, in the forests, or in the mines. Our educational institutions are manned by as able scholars as can be found anywhere, but the number of such scholars is small, while the library and laboratory equipments at their service are more or less defective. We must huddle together, as it were, to keep warm and to keep up our courage.

But even if we are still living in the pioneer days of science on this coast, we have the rewards of pioneers for whatever we

may do: we live in the open, we have a certain independence that is worth much to the student of science in the way of encouragement of originality, while the fact that we are thrown on our own resources in many respects has decided advantages for young workers, and even for the older ones.

Our Duty to the Public.—We may well ask ourselves what duties devolve upon us as live and active members of this lately formed organization of scientific men with its center of activities right here about the Bay of San Francisco. My experience with the work of the American Association and with the British Association cover a period of thirty-five years, so that in making a few suggestions in regard to what seems to be the legitimate scope of our future operations, I shall not be drawing entirely upon my imagination.

The benefits to be derived from such an organization are, or should be, vastly more than what is to be expected from the simple conferring together of those who are interested in similar kinds of scientific work.

What of our relations to the public? In my opinion we have no more serious duties than to have and to cultivate a broad and intelligent interest in science as it is related to society at large. If we do not have such an interest we fail in one of our most obvious opportunities as men of science and as public-spirited citizens.

Scientific questions often arise in the discharge of the duties of our public executive officers. Our presidents, governors, judges, mayors and others in public office need the services of men of science, while legislators who have to legislate upon matters that involve scientific problems are equally in need of the advice of competent and unbiased men. It is clearly our duty to place our knowledge, our training, and our best judgment at the service of such men, and thus at the service of the public,

and to stand together in whatever is right in connection with matters relating to or involving a knowledge of science.

Legislation.—In any and every state a glance at a list of the bills introduced in the legislature can not fail to impress us with the need and the importance of a knowledge of various branches of science on the part of our legislative and executive officers. Legislative support for our scientific bureaus and for higher education must come from the backing given them either directly or indirectly by men of science. But when executive and legislative officers are chosen as ours are it would be a mere accident if they had the special knowledge necessary to legislate about matters that require such knowledge. Indeed it not infrequently happens that our public officials have their judgment biased by hearsay information and prejudices that are difficult to deal with.

Take as an example the case of legislation upon vivisection that has lately been up right here in our own state. We are impelled to ask what is to be expected from legislation on such a subject unless the men of science in the state make themselves heard and felt. Not that most of us really know anything about vivisection; we do not. But we do know what scientific methods are and where they lead, and as men of science we are bound to use our influence in support of such methods. Physiologists—not sentimentalists—are the ones to determine whether or not vivisection should or should not be allowed, and our voices should be heard in support of the physiologists and in favor of right methods in that as in anything else.

The new kelp industry of our coast already has problems in our state legislature. Surely the questions involved in this and in all similar cases should not be left to haphazard legislation dictated by selfish

interests of any kind whatever, but should be settled by scientific men as scientific problems that concern the community at large.

I might well add the importance of scientific knowledge in the drafting and passing of fish and game laws, laws relating to the seal fisheries, to insect pests, to smelter fumes, to the conservation of timber, and to rational methods of mining and the conservation of our mineral resources, all of them problems closely related to our industries and to our future.

I have heard it objected that we have no call to offer our advice where it is not sought. This raises a point in ethics which puzzles some persons unnecessarily. We have also heard of a person who would not rescue a drowning man because he had not been introduced to him. We do not hesitate to cast our ballots and to lift our voices in favor of what we regard as right methods in public affairs. Nor should we hesitate to do any other act that we know to be for the public good, whether that act be formally called for or not.

I merely mention these instances in passing and as examples of some of the public duties of scientific men which we too often overlook. Such problems confront men of science everywhere, and it is to be hoped that we shall not evade them in this the newer part of our country.

SCIENTIFIC PROBLEMS

If I were asked by this association to suggest problems that the scientific world has a right to expect us to solve, or at least to attack seriously, it would bring to mind first of all the most scathing criticism I ever heard of any scientific man—a criticism made on the ground that he had spent a lifetime in a certain field where he had a unique opportunity for solving certain problems that he never solved, and that he

never made any serious effort to solve. Evidently the man had no powers of imagination, and no comprehension of the importance or bearing of the problems under his feet, and he seemed to stare and blink at them like a dazed owl. What little he did lacked purpose enough to keep him awake and at work, while ordinary professional courtesy prevented others from going into the field that accident had placed in his incompetent hands. And what has that to do with us?

One's life as a scientific man is like his life as an individual in this, that he has the hope of rounding it out satisfactorily and of leaving his work well and conscientiously done. We can not conceive, therefore, of anything more humiliating to us in our professional capacities than a failure to attack the problems that nature or opportunity has placed under our hands.

I can imagine some one objecting to local problems as not being big enough for full-grown men. It is true that the laws of science are world-wide, they are even as wide as the universe itself. None the less some of these problems have been solved right here on this humble little earth of ours, and, if we are big enough, we may yet solve more of them right here in the state of California.

Some problems are necessarily localized; and nowadays when one wants to study a thing he goes where the thing is. And that is just another way of saying that laboratory work is best done in a laboratory, while field work is best done in the field where one can see his materials in abundance.

What have we here that they have not everywhere else in the world? What local problems have we that are well worthy of our attention and of our best efforts? I can only mention two or three of them, and these must be accepted simply as examples.

Chemistry.—For the chemists we have one of the great oil, gas and asphaltum regions of the world with all of the complex problems connected with the origin of petroleum and with the vast number of products derived and derivable from it.

We have here too a great number of lakes of concentrated waters: soda lakes, borax lakes, and salt lakes, with an infinite number of interesting problems that call for solution, and offer substantial rewards for it.

The availability of a cheap and abundant supply of electricity affords unusual opportunities for studying and investigating electro-chemical subjects.

In the presence of these subjects and opportunities the chemists seem to stand on the shores of a vast and uncharted ocean that they hardly dare embark upon.

Tropical Diseases.—The territory allotted to the Pacific Division of the American Association includes large areas in the tropics—Mexico and the Sandwich Islands, and the Philippine Islands. These facts, and the opening of the Panama Canal and the growth of trade, and the development of commercial intercourse between our western ports and tropical countries, and especially between us and Asiatic countries, ought to impress us with the importance of our study of tropical diseases. Soon or late we shall have to deal with such diseases, and unless we undertake the work promptly and with thoroughness we shall pay dearly for it later on. If we are not willing to do this from our interest in science, we shall have to do it as a matter of self-protection. The port of San Francisco is close to every town on this coast, and it is at San Francisco that tropical diseases are most likely to land.

Geology.—As I have said, these cases are cited merely as examples, for I find that there is hardly a branch of science that has not here, within our province, an em-

barrassment of riches well worthy of the best efforts of our best men. I therefore pass over most of these subjects and come to geology, with the problems of which I am more familiar. And if I speak of them more at length, it is because of that familiarity, and not because I regard them as of more importance than those of other branches of science. But even in speaking of geology, whose local problems are remarkably numerous and important, I am obliged to confine myself to a single topic.

We have in geology an excellent illustration of the importance and of the splendid results to be expected in attacking some of the problems under our hands. The fossil vertebrates found in the asphaltum deposits near Los Angeles have been promptly and thoroughly looked after by our colleague Dr. Merriam, of the University of California, with results that have not been surpassed by any work of the kind done in any other quarter of the globe. How fortunate for us and for science that Dr. J. C. Merriam did not think a local problem unworthy of his attention.

Earthquakes.—But I regret to say that we also have here a geological problem of another kind. I hesitate even to mention it, perhaps because an old Spanish proverb says that “in the house of a hangman one should never mention rope.” And in California one has to take his courage in both hands when he says “earthquake.”

Here is a problem, or rather a great group of problems, that nature has left on our very doorsteps. What are we doing with it, and what do we propose to do?

The earthquake of 1906 jolted us into a state of temporary wakefulness, but we seem calmly to have gone asleep again. The only thing to our credit in connection with it is the excellent report of Dr. A. C. Lawson, which stands out, and stands alone, as a contribution to seismology in this

country. Very largely through the impetus given to the study of seismology by the earthquake of 1906, the Seismological Society of America was formed here in California in the hope that we might get the cordial support of scientific men and of public-spirited people generally in the study of earthquakes.

Through the patient exertions and personal sacrifices of a handful of men and through the generous contribution of our colleague Mr. Robert W. Sayles, of Harvard University, we have been able to publish six volumes of the society's quarterly bulletin and to get started on a road that seems to lead somewhere.

I am merely stating a fact in connection with this subject when I say that instead of taking hold of the problems of the earthquakes, most of us seem disposed to run from them; or what is still worse, we deny their very existence, while the cooperation and help we hoped to receive from the public has not been forthcoming. Certain branches of business are especially liable to damage from earthquakes, and it seems quite reasonable that such industries should cooperate with us by gathering and sending in data regarding earthquakes as they occur. Our railway lines, with their many bridges, cuts and fills, are liable to be seriously damaged and their service interrupted, to say nothing of the possible danger to human life through trains running into dislocations; our telegraph and telephone lines are liable to be broken and their service interrupted; our electric power companies are liable to have their dams injured, their pipe lines and wires broken, and their service seriously interfered with; our water companies are liable to have their dams injured or destroyed, their water mains broken and their service impaired; while our insurance companies are perplexed by rate problems in a region

where, in order to protect themselves, they are compelled to make their customers pay for risks about which we are all equally ignorant. As a matter of fact not a single railway or tramway company, not a single telegraph or telephone company, not a single insurance company, not a single electric power company, and only one water company—the Spring Valley Water Company of San Francisco—has ever manifested the slightest interest in our work or lifted a finger to help us gather the data necessary for a rational study of the earthquake problems of this coast. What could we not do if we had the cordial cooperation of all such organizations on this coast? It seems almost incredible that the business interests of this state and of this coast should willingly and weakly, year after year, allow a permanent threat to hang over their industries, their transportation lines, their public utilities, and their very existence, without making an intelligent effort to study the subject or to help those who are willing and anxious to study it, and to find means of meeting it. Yet such are the sad facts.

What is the explanation of this remarkable state of affairs? So far as I am able to judge, it comes from the false attitude into which the people of this coast have unwittingly drifted. At the time of the earliest settlement of the Pacific coast by whites, pious people grouped the earthquakes along with a choice lot of other disasters and calamities commonly known as “acts of God.” And naturally enough pious people regarded the acts of God as things to which we should take off our hats, but which should not be questioned or irreverently pried into.

In time they came to be simply accepted as drawbacks to the general attractiveness of California, and as such it seemed best to regard them as evils to be endured but not

to be talked about. Here was a great and beautiful land that lacked capital, a good class of immigrants, and the development of its natural resources; and nothing must be said or done to frighten away either the capital or the immigrants. If the news of an earthquake occasionally made its way out of the state it was immediately given a back seat by being confronted with the enormous damage done by destructive tornadoes and annual floods in the Mississippi Valley. Our real-estate agents rarely or never heard of earthquakes; it seemed better that they should not; such things interfered with business. About the same time the newspapers fell into the habit of forgetting to mention them, and there seemed to grow up spontaneously a sort of conspiracy of silence in regard to the subject. And so it came about that when the earthquake of 1906 broke the water mains of the Spring Valley Water Company and at the same moment set fire to the city of San Francisco, we were entangled in the snares of our own weaving. And now see how we tried to hide our heads in the sand. The geologists hereabout were very anxious to gather the data made available by that particular earthquake, but as the necessary field work required considerable funds efforts were made to interest some of our business men in the subject. But our business men rose up almost to a man and assured us in the most emphatic language that there had been no earthquake, and we were told to “forget it”; to “cut it out,” and above all, to publish no report on it.

It is not necessary to tell this audience that such an attitude is false and absolutely untenable. The battles of science can not be successfully fought with the weapons of ignorance and bigotry.

I am confident that this state of affairs can not long endure. Very likely indeed we have not done our own duty in pointing

out what seems to be a rational method in handling the whole matter. But a rational method demands first of all that we face about and get on the right road.

Science knows but one way to deal with its problems, and that is to face them in the open; that is the doctrine to be preached, and to be practised, and it is the only one.

The more I study earthquakes the more I am convinced that their dangers have been greatly exaggerated by our ignorance and through our efforts to cover them up; and the more am I convinced that a systematic study of the subject on this coast will yet enable us to outline with reasonable precision the areas in which they are liable to be severe, and in this way we may yet do away with their greatest dangers. Such work should eventually enable us to locate dams, bridges and buildings with reference to earthquake risks, and it should enable the insurance companies to deal justly with their customers, and, at the same time, to protect their own legitimate interests.

But such work can not be done in a month or a year, nor yet in ten years. Neither can we depend on the stimulation of violent earthquakes to keep people alive to its importance. Indeed, very little is to be expected of people who require violent stimulants to keep them going. Machinery of that kind generally stops when the stimulants give out. Those who enter this field should be people of some steadfastness of purpose, and who have little or no ambition to pose or dance in the limelights.

It will require years of careful collaboration, of patient gathering of data, of careful study, the mapping of the areas in which the shocks are felt, and the study of the geology in order to know just what is going on, and what is likely to happen.

To those who may think favorably of helping us in our efforts to study earthquakes I should speak this word of warn-

ing: Don't expect too much of us, and don't expect it too soon. Science must go its own gait, in its own way, and it often finds itself in a blind alley. It is trying; we wish it were otherwise; but it can not be helped. We can not trust the methods, dogmas or conclusions of authority in science.

Science bows down to truth and to truth alone; we have no apologies to make for its methods, its processes or its conclusions. The more we know about the complications and apparent contradictions of absolute truth, the more we distrust the cocksure and the authoritative settlement of scientific problems. To many minds authority points out the only satisfactory way and not only insists upon it, but cites volume, chapter and page to prove it, while science hesitates, vacillates, theorizes, and, brazenly or weakly, confesses its ignorance. There is no doubt about which one of those guides the crowd will follow, but neither is there any doubt about where a crowd, so led, must finally come out. Eça de Queiroz quotes a learned writer as stating that "Adam, the father of men, was created October 28th at two o'clock in the afternoon." Here speaks authority, and we must confess that it offers us a clean-cut starting point for the human race that does away at a single stroke with the doubts and hesitations of modern science.

Compare this with the confession of a modern, conscientious physician who is called to attend a sick child. He asks a great many questions, he takes temperatures, and he does everything he can to discover the nature of the illness, and finally when asked point blank what ails the child, he replies: "Mrs. Blank, I'll be doggoned if I know what the matter is with the baby."

People who depend on hocus-pocus, and are on the lookout for the psychology of the

case would probably say that such an admission is a psychological error, but I am sure that it warms the heart of every scientific man to find a man who has the courage to tell the unvarnished truth, however much he may regret the necessity of it. And we shall have to follow this course and no other in dealing with earthquakes. In this spirit we need the cooperation and support of all men of science, and we feel that we are justly entitled to such support. We also need the support of business men, and we feel that we are equally entitled to it.

Very likely some of you may feel that you do not like to have this or any of these local problems flung at your heads in this brusque fashion. But, my friends, nature has already flung these problems, not only at our heads, but in our very faces. Is it not for us to wake up and be equal to our opportunities? Unless we take hold of the problems of seismology that are so conspicuously our problems here on this coast we shall stand justly discredited in the minds of our colleagues in other parts of the world. The Portuguese have a proverb about people who "fetch water after the house is burned up." Let us see if we can't fetch the water in season.

And while I am using plain language about disagreeable things, I may as well refer to one more unpleasant subject, and have done with it, and that is the necessity of financial backing. Men of science can do the work of science, but they can not foot the bills. For that part of this undertaking we must look to business men. And we look to them with confidence that they will cheerfully do their part. And if we will all pull together and keep up our courage, I feel confident that the day will come when earthquakes will have lost most of their terrors, not only for us on this coast, but for the human race.

Let me end with the words of a California

author (Edward Rowland Sill) on opportunity:

OPPORTUNITY

This I beheld, or dreamed it in a dream:
There spread a cloud of dust along a plain;
And underneath the cloud, or in it, raged
A furious battle, and men yelled, and swords
Shocked upon swords and shields. A prince's
 banner
Wavered, then staggered backward, hemmed by
foes.
A craven hung along the battle's edge,
And thought, "Had I a sword of keener steel—
That blue blade that the king's son bears,—but this
Blunt thing—!" he snapt and flung it from his
 hand,
And lowering crept away and left the field.
Then came the king's son, wounded, sore bestead,
And weaponless, and saw the broken sword,
Hilt-buried in the dry and trodden sand,
And ran and snatched it, and with battle-shout
Lifted afresh he hewed his enemy down,
And saved a great cause that heroic day.

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SCIENTIFIC EVENTS

THE USE OF PRIMITIVE ART IN TEXTILES

IN answer to the demand of the American textile industry for designs inspired by the primitive art of this continent, the American Museum of Natural History of New York City on April 16 sent Dr. Herbert J. Spinden, of its department of anthropology, to make special researches in Central American countries. His mission is a development of the policy of the institution to exert a formative influence on modern industry. The European War placed manufacturers of textiles largely on their own resources, as far as designs were concerned. Previously they had been guided largely by the traditions and example of Paris. The museum, recognizing this condition, placed all of its resources and research material at the command of the American looms, and its collections were studied by designers from all parts of the United States. The recent exhibition of figured textiles in the museum conveys an idea of the success which has attended the intro-