

education in the Northwest Territory. That ordinance provided for the support of education by generous grants of land. Out of this the public school system rapidly grew. The development of the public schools made possible the growth of the State university.

Nor need I remind you that the most characteristic feature of education in the last twenty-five years has been the growth and development of the State universities in this great territory. Nor need I remind you that to the west of us may be found a number of State universities older and better equipped and with a larger teaching force than the one with which you are now meeting. Ohio was the first State carved out of the Northwest Territory, but practically the last to develop her university.

To the west you may think of Indiana, Illinois, Michigan, Wisconsin, Minnesota, Nebraska, Kansas, Missouri, Colorado and others. You are meeting to-day at the gateway to these great educational centers. The Ohio State University is exceedingly happy in the privilege of extending a welcome to you, not only in her own name, but in the name of all these institutions which are to do so much in the future for industrial and scientific education in the Great West. We recognize in this Association a body of men devoted to the study of science and scientific education. We trust that your stay with us will assure you that the Ohio State University proposes to prove her right to existence by ministering to the needs of the people, and by presenting to them an open opportunity to the best that modern education can supply.

Let me assure you of a very cordial welcome and of our best wishes for a successful meeting.

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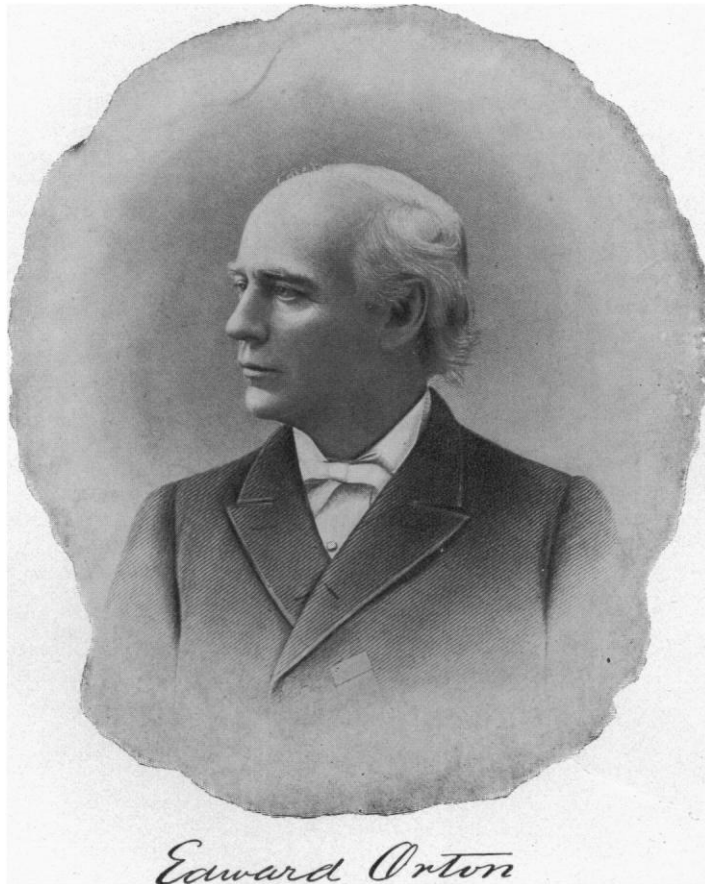
*ADDRESS OF THE PRESIDENT.*

DR. EDWARD ORTON said: In behalf of the American Association for the Advancement of Science I return to you our cordial

thanks for the welcome which you have this day given us to the capital of Ohio. We note with pleasure all that you say of the State and the City. We are sure that you have not exaggerated the charms of this noble section of the Mississippi Valley, which, all things considered, its location, its climate, its agricultural and its mineral resources, we take to be as the great Frenchman, De Tocqueville, declared, three-quarters of a century ago, the noblest dwelling place that God has fitted up for the occupation of the human race.

The principal office of such a reception as this is, I take it, to set both parties at their ease, to put host and guest on good terms with each other. You have spoken for the host and we accept all that you claim for the city and the State at its face value. We count ourselves happy to be here. We are glad to enjoy for a few days your hospitality. We hope and expect that the Columbus meeting of the Association will prove a memorable one, one that will shine in our annals, if not by the announcement of great discoveries in the heavens or earth, still by the inspiration it will give to multitudes of workers in the several fields of science.

And now let me say a word for the guests on this occasion. I shall ask you to accept, without any discount, all that we shall say about ourselves, all that we claim for our work, in the same generous spirit that we have already manifested toward you. People come to be on good terms with each other more easily, perhaps, if they are first on good terms with themselves. As our hosts you have shown a good measure of self-complacency, and you will not expect us to fall behind in this virtue. Well, then, I may say for the American Association for the Advancement of Science that it is well worthy of the hospitality which you proffer. It deserves all the honor that Columbus or any other community of the



*President of the American Association for the Advancement of Science.*

country can pay it. No organization ever visits an American city that has a better claim on the appreciation and respect of all its people.

In the first place, you can hardly expect to entertain an organization of larger range, so far at least as its name is concerned. It is the American Association. It transcends not only all State limits, but national boundaries as well. An organization that represents the United States takes in a respectable part of the land areas of the planet, but this is not merely a United States organization. It especially includes that potent and ambitious neighbor of ours to the northward that owns more than three million square miles, or a full half, of the North American continent. The Association always counts with all confidence on its Canadian contingent. You can hear this afternoon an address from the honorable Canadian Vice-President of one of our sections, Mr. Whiteaves, of Ottawa.

Our name is broad enough to include also our neighbors to the southward, Mexico and the Central American republics, but these countries have thus far devoted so much of their time and force to military science in the practical way that they have not had much enthusiasm left for the cultivation of the other branches of science in which our Association is especially interested.

But there are American associations and American associations. They are not all alike. They are devoted to various interests. Some of them, in spite of the broad name they bear, have but a comparatively narrow field.

For example, there is an American Numismatic Society, an American Stock-breeders' Association, an American Strawboard Company, an American Detective Agency, etc., but this is the American Association for the Advancement of Science. As I have said, no organization can well have a broader geographical name, and

when we come to its subject-matter, the field in which it works, certainly no organization can claim wider interest or greater importance.

The American Association for the Advancement of Science! Have you considered what this name implies? We are coming to the close of the nineteenth century, which has been well styled the century of science.

Alfred R. Wallace has recently published a careful inventory of the discoveries and inventions to which the progress of the race is mainly due, and he divides them into two groups, the first embracing all the epoch-making advances achieved by man previous to the present century, and the second taking in the discoveries and advances of equal value that have had their origin in the nineteenth century. In the first list he finds but fifteen items of the highest rank, and the claims of some even of this number to a separate place are not beyond question. They may not really be of epoch-making character. But he puts into the list the following, viz: Alphabetic writing and the Arabic notation, which have always been the two great engines of knowledge and discovery. Their inventors are unknown, lost in the dim twilight of pre-historic times. Coming after a vast interval to the fourteenth century A. D. we find the mariner's compass, and in the fifteenth the printing press, both of which, beyond question, are of the same character and rank as alphabetic writing. From the sixteenth century we get no physical invention or discovery, but it witnessed an amazing movement of the human mind, which in good time gave rise to the great catalogue of advances of the seventeenth century, the most prolific of all the centuries antecedent to our own. To it we credit the invention of the telescope and, though not of equal rank, the barometer and thermometer, and in still another field the invention of the

differential calculus, the all-important discovery of gravitation, of the laws of planetary motion, of the circulation of the blood, of the measurement of the velocity of light. To the eighteenth century we refer the more important of the earlier steps in the evolution of the steam engine and the foundation of both modern chemistry and electrical science. This completes the list. Counting all these inventions and discoveries as separate we get sixteen. Wallace places the barometer and thermometer under one number and thus makes a total of fifteen.

What is there to be added to this list? Some would urge that Jenner's discovery should be included here, but this claim Wallace would indignantly deny.

In making such a list it is evident that the personal equation of the author needs to be recognized, and different orders of arrangement, even if the elements were the same, would be assigned by different students. At any rate, something like this is the list of what the race has gained in science since it first came to itself, up to the year 1800. The greatest steps have certainly all been counted.

And now what has the record been since 1800? How does the 19th century compare with its predecessors? A brief examination will show that in scientific discovery and progress it is not to be compared with any single century, but rather with all past time. In fact, it far outweighs the entire progress of the race from the beginning up to 1800. Counting on the same basis as that which he had previously adopted, Wallace finds 24 discoveries and inventions of the first-class that have had their origin in the 19th century, against the 15 or 16, already enumerated of all past time. This is not a proper occasion to review, compare and set in order the several elements of this glorious list, but let me simply recall to your minds a few of them.

Of the same rank with Newton's theory

of gravitation, which comes from the 17th century, stands out the doctrine of the correlation and conservation of forces of our own century, certainly one of the widest and most far-reaching generalizations that the mind of man has yet reached. Against Kepler's laws from the 17th century we can set the nebular theory of the 19th. The telescope of the 17th is overbalanced by the spectroscope of the 19th. If the first reveals to us myriads of suns, otherwise unseen, scattered through the illimitable fields of space, the second tells us what substances compose these suns and maintain their distant fires and, most wonderful of all, the state in which each exists, whether solid or gaseous, and the direction and the rate in which each is moving. Of the 56 stars whose motion in the line of sight have thus far been determined five were determined in the Emerson McMillin Observatory.

Harvey's immortal discovery of the 17th century finds a full equivalent in the germ theory of diseases of the 19th. The mariner's compass of the 14th century easily yields first place to the electric telegraph of the 19th, while the barometer and thermometer of the 17th century are certainly less wonderful, though, perhaps, not less serviceable, than the telephone and phonograph and Röntgen rays of our own day.

I need not pursue the comparison exhaustively, but, in addition to the advances now enumerated, the great doctrine of Organic Evolution, supported especially by the recapitulation theory in embryology, finds nothing to match with it in broadening and inspiring power, in all the past history of the race. The same can be said of the periodic law of Mendeljeff in chemistry, of the molecular theory of gases, of Lord Kelvin's vortex theory of matter, of the glacial period in geology, and of the establishment of the origin and antiquity of man, all of our own century.

Nothing can be brought from all the past

to compare for one moment in direct application to the relief of man's estate with the discovery of anæsthetics, while by his discovery of antiseptic surgery the name and fame of Lord Lister will grow to the last syllable of recorded time. In the mobilization of man and the giving to him the freedom of the globe, the railways and the steamships of our century are absolutely without any elements for comparison in all that the past has left us.

There are, however, three inventions and discoveries that have been inherited from the past and that have been already named, two of them from some distant but unrecorded centuries and one from the darkness of the Middle Ages, which have proved so indispensable to all subsequent advances that it is impossible for even the 19th century to present anything that can be properly compared with them. I refer to the alphabet, Arabic numerals and the printing press. To this list might perhaps be added language and the use of fire. The factors I have named are pre-supposed in all modern progress. By the very necessities of the case they must have preceded the progress at which we have glanced.

As I have before said, the 19th century is the century of science, and it is science, mainly physical science, that constitutes the proper object of this Association. Our geographical name is wide, but the scope of our Association is wider still. It deals with and is devoted to science, which is the product of the best powers of the human mind—the human mind, created in the image of God and divinely inspired to interpret this wonderful universe.

This Association marks the stage already reached in this interpretation, but in its very title it indicates that the work is incomplete, that it is still in progress. Its founders, fifty years ago, clearly saw that they were in the early morning of a growing day. The most unexpected and marvelous progress has been

made since that date, but as yet there is no occasion and no prospect of modifying the title. We are still laboring for the advancement of science, for the discovery of new truth. The field, which is the world, was never so white unto the harvest as now, but it is still early morning on the dial of science.

It is possible that we could make ourselves more interesting to the general public if we occasionally foreswore our loyalty to our name and spent a portion of our time in re-stating established truths. Our contributions to the advancement of science are often fragmentary and devoid of special interest to the outside world. But every one of them has a place in the great temple of knowledge and the wise master builders, some of whom appear in every generation, will find them all and use them all at last, and then only will their true value come to light.

We do not always know the real significance of what we have in hand. A fact or an observation that we may put on record here may have in reality a different significance from what we are disposed to give it, and consequently may have far more importance than we recognize.

We welcome our hosts to our meetings and our discussions. We cannot promise that all will be found interesting, but occasionally conflicting views will give rise to animated debate in which human nature sometimes asserts itself so strongly and naturally that the debate would prove interesting to the outsider even though it may be carried on in what is practically a foreign tongue.

Thanking you again for your words of welcome and gratefully recognizing the arduous and efficient labors of the several committees of the gentlemen and ladies of Columbus in providing for our entertainment, I now declare the forty-eighth meeting of the American Association for the Advancement of Science open for the transaction of its appropriate business.