Harvard College) went on record as affirming that no scientific generalization is more strongly supported by the thoroughly tested evidence than is that of organic evolution.

A scientific generalization, as we understand it, means a general truth based on the great mass of scientific data that has been compiled since science attained the exactness and definiteness that could make it the basis for reaching conclusions regarding the nature of life.

The men who form the association which has taken this action looking toward a public teaching of the doctrine which has been considered basic in the development of the system of knowledge are the best equipped students and minds in the country. If the lawyer is not to be accepted as authority in his field, if the jury which is called upon to determine cases can not accept the testimony of the experts in various lines which is laid before them in an effort to mete out justice; in a word, if the expert in any line is to be debarred, and his learning and studies discounted, then we have arrived at a point where further progress for the race is impossible. The men who are engaged in America, and the world over, for that matter, in endeavoring to build up a body of knowledge useful for the advancement of the race do not profit greatly by this labor. The fact is, they could do many other things that would bring them greater compensation. This being true, and the fact that life's blood is spent in an endeavor to gain information that will be of welfare to humanity, when considered, should at least make the general public pause and say these men have put forth their greatest efforts in attempting to gain knowledge. It is at least due them that we should weigh and consider what they would have us know.

We hold no brief for the particular doctrine, or as they call it "generalization" of evolution. If people choose to believe that they "sprang from monkeys" that is their affair. The old joke in which the man who voiced this belief was told by his hearer that evidently "he didn't spring very far" was probably as true of the one as the other man in the conversation.

The point lies here. What the best minds of the country believe and would teach, that is the thing which should be promulgated in schools. Those who know less are not the ones who should set themselves up as judges as to what the youth of the country should be taught. Two other things should be kept in mind. One is that the schools to-day are not principally engaged in pouring stuff into the noggin of the pupil. They are busily engaged in teaching him how he can learn things for himself. The other big thing to keep in mind is that beliefs and teachings are more or less a matter of fashion. Ideas and thoughts that are held for a period of years wane and are discredited, then again they come back into fashion and favor.

Only recently in North Carolina we have had a remarkable instance of the absurdity of the fight on evolution. At a state-wide denominational gathering in which one of the leaders in education in the state was expected to be grilled for his utterances on "evolution," he preached such an inspirational sermon as to carry the convention off its feet. The man who had digested the evolutionary theory had still not forgotten his Bible and his God.

So it must be with any body of educators who endeavor to teach the best that is known to the nation's young. Their mind must not be closed to great truths no matter from what source they may come. Their faith must not be so small as to be shaken by the "generalizations" of modern science.

We must still prove all things, and hold fast to that which is good. The way to accomplish that is by learning all that may be learned and not by rejecting all that can be rejected, else will it be said with the truth, that the blind lead the blind.—*The Asheville Advocate.*

DEVELOPED AND POTENTIAL WATER POWER OF THE UNITED STATES

IN 1908 the Bureau of the Census made a special census of the developed water powers of the United States for the report of the National Conservation Commission (Senate Doc. 676, 60th Cong., 2nd session). The data collected were also published by the U. S. Geological Survey in Water-Supply Paper 234, "Papers on the conservation of water resources." This census showed that there were in the United States 31,537 water power plants of all sizes, whose water-wheel capacity was 5,356,680 horsepower. An examination of the returns indicated that many very small plants were included, as the records showed only 602 plants whose water-wheel capacity was more than 1,000 horsepower. The total capacity of these 602 plants was determined to be 3,900,000 horsepower, leaving 1,457,000 horsepower distributed among 30,935 plants, which thus had an average capacity of only 47 horsepower.

The U. S. Geological Survey, in 1921, made a compilation of data showing the developed water power in the United States in plants of 100 horsepower or more. The data were collected by district engineers of the Survey by correspondence or by personal visits to the plants. Information was furnished by the Census Bureau in regard to the total water power and number of plants in manufactures in the District of Columbia, Kentucky, Indiana, Virginia, Maryland, Delaware and West Virginia. The figures for Maine were furnished by the Maine Water Power Commission. The results of the compilation, which are shown in the accompanying table, are considered to be reliable. The figures given for some of the States, especially Massachusetts, New York, New Jersey, and some of the Southern States may be subject to revision on account of incomplete returns.

The table shows that at present there are in the United States 3,116 water-power plants of 100 horsepower or more, with a total capacity of installed water wheels of 7,852,948 horsepower. Of this total 79 per cent is in public-utility plants and 21 per cent in manufacturing plants. It is of interest to note that the census of 1908, which embraced plants of all sizes, included 10 times as many plants as the present report, which embraces only plants of 100 horsepower or more.

New York still maintains its position as the leading State in the amount of developed water power, with 1,291,857 horsepower; California is a close second, with 1,149,099 horsepower; Washington is third, with 454,356 horsepower; Maine closely follows in fourth place, with 449,614 horsepower, and Montana is fifth with 344,420 horsepower.

To permit a comparison of the developed water power with the total water-power resources a table is included showing the maximum and minimum potential water power of the United States. This table is based on estimates made by the U. S. Geological Survey in 1908 for the National Conservation Commission and revised by the Commissioner of Corporations for his report on water power developed in the United States, 1912, and by the U. S. Forest Service in 1916.

In comparing the figures of developed water power and potential water power for any State or group of States as given in these two tables, the basis for the data in the tables should be kept clearly in mind if gross and absurd errors are to be avoided. The potential water power of the United States was determined by dividing the rivers into sections of different lengths, the length depending on the slope of the channel, and the fall and flow of each section were determined from the best information available. With these factors the potential water power of each stream was determined on the assumption of an efficiency of 75 per cent. in the water wheels. The portions of the streams where the slope is so small that water power can probably never be profitably developed were not included.

The minimum potential water power is based on the average flow of the two seven-day periods of lowest flow in each year of record. This, of course, does not give the absolute minimum flow, but for all practical purposes potential water power based on this flow may be considered as continuous power. The maximum potential water power is based on the flow available for 50 per cent. of the time. The use of storage was not considered in making estimates of either minimum or maximum potential water power. The estimates of both the minimum and maximum potential water power are considered conservative.

It is the general practice in the construction of water-power plants to install hydraulic machinery capable of utilizing stream flow far in excess of the absolute minimum and much in excess of the flow used in determining the minimum potential water power as given in the table. This practice is forcibly brought out by comparing the minimum potential water power with the total capacity of water wheels installed in water-power plants in some of the

New England States. If all the water power of the United States were to be similarly developed, it would probably be necessary to install plants having three or four times the capacity of the estimated minimum potential water power as given in the table. This condition should be fully considered in estimating the amount of potential water power that may still be available in any State at the present time.

SPECIAL ARTICLES

THERMIONIC EFFECTS CAUSED BY ALKALI VAPORS IN VACUUM TUBES

A TUNGSTEN filament was mounted in a vacuum tube in the axis of a cylindrical anode consisting of three parts insulated from one another. In this way, on the guard ring principle, the electron emission from the central portion of the filament could be measured, so that effects due to the cooling by the leads were eliminated. With metallic cæsium in the tube at 25° C. the cæsium vapor forms an adsorbed film consisting of a single layer of atoms completely covering the filament even at filament temperatures of 600° K. or more. The stability of this film appears to be due to the fact that the electron affinity of a tungsten surface (Richardson work function, 4.52 volts) is greater than that of cæsium ions (ionizing potential, 3.90 volts). When a cæsium atom comes close to a tungsten surface, the tungsten thus robs the cæsium atom of its valence electron and leaves it in the form of a univalent positive ion. This ion, however, tends to be held by a strong force to the tungsten surface because of the negative charge induced in the metallic surface by the close proximity of the positive charge of the ion.

The presence of such films is shown experimentally by the very high electron emission and by measurement of the contact potential with respect to a second tungsten filament held at such temperature that the cæsium has evaporated off.

In the presence of minute traces of certain electro-negative gases, adsorbed films of the atoms of these gases are formed on the tungsten, resulting in an increase in the electron affinity of the surface and a corresponding decrease in the normal electron emission (in absence of cæsium). But the tendency of the cæsium to be held by such a surface has thereby been increased, with the result that the cæsium film remains on the surface at an even higher filament temperature. The film then consists of two layers, each of atomic thickness, the first being of electro-negative, the second of electro-positive atoms (ions).

In this way the cæsium film remains intact up to temperatures of about 900° K., and at this temperature (below a visible red heat) emits saturation currents of about 0.3 amperes per square cm. of filament surface. At higher temperatures the cæsium film evaporates off in part and the electron emission falls rapidly. On lowering the temperature the cæsium film reforms and the electron emission returns to its former value. At temperatures below those at which evaporation is appreciable, the saturation current from a cæsium-covered surface is expressed within the probable error of temperature measurement, by Dushman's equation,

$$i = 60.2\ T^2 e^{-b_0/T}\ \textit{amps. per cm.}^2$$

where $b_0 = 16000$ degrees. This corresponds to a value of 1.38 volts for the Richardson work function. It is of interest to note that b_0 appears to be practically the same whether the cæsium is adsorbed directly on tungsten or on the adsorbed electro-negative film. The electron emission thus depends primarily on the nature of the atoms forming the actual surface layer and is not materially dependent on the atoms that lie under these.

When a tungsten filament is heated above 1000° K. in cæsium vapor at room temperature, the electron emission falls to negligible values although a large fraction of the surface may still be covered with adsorbed cæsium. This is due to the fact that there is a linear relation between Θ, the fraction of the surface covered by cæsium, and the logarithm of the saturation current. At 800° K. the ratio between the emission from a cæsium film ($\Theta = 1$) and from a pure tungsten surface is about 10^{20}. Thus every change of 0.05 in the value of Θ causes a ten-fold change in the emission. By the time Θ has fallen to 0.7 the emission at 800° or 900° is negligible.

When the cæsium evaporates from the surface film at temperatures in the neighborhood of 1,000° K. it does so in the form of neutral