any one region of the earth. The river-drift men are found impartially scattered from tropical India through Europe to North America. If their distribution was by the northern approaches of the continent, it must have been in pre-glacial times, because, as Dawkins shows, an ice-barrier must have spanned the great oceans in northern latitudes.

It seems an almost fruitless speculation, to inquire into the manner of their dispersion, yet one is tempted to surmise that if they originated in the tropics, then submerged continents must again be restored to offer the necessary means for such a dispersal. If, on the other hand, their home was in the north or south temperate zone, and the distribution circumpolar (and this seems more probable), then we have another evidence of the wide separation which the race had acquired, at that early day, from its tropical relatives the apes. Whatever the facts may ultimately show, this unparalleled distribution of a people in the lowest stages of savagery proves beyond question that man must have pre-existed for an immense period of time; for, with the known fixity of low savage tribes, the time required to disperse this people over the whole earth can only be measured by geological centuries.

The farther we penetrate into the past, and ascertain some definite horizon of man's occurrence, other observers in widely different regions of the earth bring to light traces of man's existence in equally low horizons. The evidence of the remoteness of man's existence in time and space is so vast, that, to borrow an astronomical term, no parallax has thus far been established by which we can even faintly approximate the distance of the horizon in which he first appeared. From this fact we are justified in the assumption that the progenitors of quaternary man, under different genera possibly, must be sought for in the tertiaries.

Science will not gain by the erection of any theoretical barriers against tertiary man, until such definite forms are met with that shall reasonably settle the beds in which he first occurred. We know in what rocks it would be obviously absurd to look for his remains or the remains of any mammal. So long, however, as forms are found in the lowest beds of the tertiaries, having the remotest affinity to his order, we must not cease our scrutiny in scanning unbiased even the rocks of this horizon, for traces of that creature who, until within a few short years, was regarded as some six thousand years old, and who, in despite of protest and prejudice, has asserted his claim to an antiquity so great, and a dispersion so profound, that thus far no tendency to a convergence of his earliest traces has been demonstrated.

SCIENTIFIC METHODS AND SCIENTIFIC KNOWLEDGE IN COMMON AFFAIRS.[1]

ECONOMIC science and statistics can hardly do less than to promote the use of scientific methods, and disseminate scientific knowledge in common life. Science has had a hard struggle with ignorance. A host neither small nor amiable has been arrayed against it. What wonder, then, that it has first intrenched itself where the use of instruments of precision and the demonstrations of mathematics separated it from the critical issues of man's every-day conduct? Nevertheless, history may in the remote future express surprise that in America, where the power and conduct of man are so important, science has so long neglected the rugged issues assigned to this section.

There is now no good reason why scientific men should neglect to apply scientific methods to the economy and statistics of every-day life. If mathematical principles and processes are applicable to the statics and dynamics of physics, why not also to the statics and dynamics of society? If useful in economics, why not in personal and domestic life? True, in all questions of conduct, we must include man's free action of will, and leave room for doubt or for alternatives or for contrary choice; yet how many questions of daily life are left to the merest conjecture, to superstition, or to the wild estimaginings, and how large a percentage of blunders might be avoided! We smile that a pagan commander moved his army by the flight of a crow or by the aspect of an animal's entrails; but how many merchants sail their ships, and agriculturists plant or harvest, by the guesses of charlatan weather-prophets, or how many actions are determined by seeing the moon over the right shoulder, or by confidence in a horseshoe! Myriads of groundless notions to-day affect the conduct of personal and public affairs. It is time for science to enter. Many a juggler would then lose his business, many a prejudice have to be given up. Pockets, policies, and politics are involved in the issue. The disposition to revel in the marvellous, to dally with uncertainties, and to treat all mystery as concealing the superhuman, would be disturbed. The phrases 'we guess,' 'we reckon,' are giving way to the phrases 'we will inquire,' 'we will try to know.'

Sir William Thompson has said, "Accurate and minute measurement seems to the non-scientific imagination as a less lofty and dignified work than looking for something new;" but he adds, "Nearly all the grandest discoveries of science have been but the rewards of measurement and patient, long-continued labor in the minute shifting of numerical results." Thus the methods of economic science are the same as those of other branches of science, while the latter also yield statistical results.

It is unfortunate that scientific men aspire so exclusively to original research. We need men to couple love of science with love of mankind. Livingstone desired to explore Africa for science, but as much so for the civilization of benighted Africans. Is science for man, or man for science? Is not benefit to mankind the real measure of the good that is in science?

Doubtless Stephenson was more perplexed with the mood of the parliamentary committee than with the questions of improving his steam-engine. From a

[1] Abstract of an address before the section of economic science and statistics of the American association for the advancement of science, at Philadelphia, Sept. 4, by Gen. JOHN EATON, U. S. commissioner of education, Washington, vice-president of the section.

member of that committee came the absurd question, 'Would it not be a bad fix if the engine should meet a cow on the track?' 'Yes,' said Stephenson, 'it might be bad for the coo.' The dissemination of truth is as scientific as its discovery. Sometimes scientific men act as if truth could not be expressed in the vernacular, — indeed, as if it cannot be truth unless dressed in their terminology. College men used to feel that their triennial would lose character if deprived of the dignity of Latin — though it was often bad Latin. All this foolishness is fast passing away. Already it is an honor to scientifically *teach* science, as well as to advance its domain. Still it is rarely met with, and far less understood than scientific research. Here is a great field for immediate occupancy.

The scientific method of communicating truth recognizes the fact, that in early life man's powers are shaped, and too often the bulk of his knowledge acquired. Hence its fundamental rule must be simplicity in the use of language, and in the presentation of each truth in the concrete. This scientific method is needed even to preserve classic learning from disgrace and disuse. Adopted in the whole domain of scholastic instruction, it would bring new votaries to science, and new benefactors even to the support of pure science. A better taste for all kinds of literature would result. Low writing would be at a discount. We should thus cheapen scientific literature, and increase museums for object-teaching. We may never destroy the taste for low and degrading prints by inveighing against them and thus advertising them, but we may create a taste for valuable reading which will not be satisfied by the vile. This literature cannot be the same for all persons, but the scientific method should pervade it all. Morals would not be excluded, but enforced; the imagination not neglected, but purified and elevated. The body of information could not exclude any truth of service to mankind. Every great subject would bring its contribution shaped to scientific methods and adapted to all minds, — the earth as influenced by the sun and the starry world, its surface of land and water, of mountains and streams and valleys, of barren and productive soil, the plant life that dwells upon it, the animal life it supports, the circumambient atmosphere and its phenomena; and man, the scientific animal who makes all this ado, and for whom it is made, and to whom it is given to possess. The Adam of this period of scientific thought might call up his several sciences, and direct each to yield what it possesses for this correlation of economic thought, for human instruction, guidance, enjoyment, and betterment, for this evolution of science, for the greatest good of man by doing its utmost for the common things of daily life. Gravitation weighs alike the most volatile particle and the vastest of far-off stars. The laws of economic science are the same to the lowly as to the great man: by them he measures the price of his salt, and the safeguards of his liberty.

Towards this gathering-up, for man's daily use, of all the lessons of nature, the progress of the race is tending. Steam, the telegraph, and the telephone focus all thought and action. We shall yet demand of every department of knowledge, 'What good for man?' Each science will have its body by itself, and yet fill numerous relations to every art, and yield its practical lessons to every man according to his understanding and preparation. Data thus correlated will meet the child,— nay, will guide the paternal influence and action in its behalf. But now the child, in its greatest dependency, is met with the destructive follies of ignorance. Neglect, mistakes, or downright violations of nature's laws, often consign him to the grave, or plant in him the seeds of permanent disorder. Physicians may relieve his colic, or cure his disease; but how rarely can they so direct the nursing and training as to assure health! If the impairment is mental, and we go to insane-asylums for advice, we learn what per cent of the cases under treatment could have been prevented, and efforts will be made to cure. But we want prevention, not cure. We want information upon questions of food, of raiment, of shelter, of air, of vocation, of occupation; not for one man, or one class of men, but for all men in all conditions.

The era of this diffusion of knowledge has already actually commenced. Men not engaged in scientific pursuits are gradually coming to feel the necessity of gathering, grouping, and generalizing the data which give them a clearer measure of health, comfort, pleasure, as well as the profit and loss involved. As balance-sheets are studied in business, so are questions of finance, of taxation and public expenditure. Great operations, like those in corn, in coal, in cotton, in wool or silk, leather or lumber, in iron or gold or silver, and of all the great industries, — agricultural, mechanical, commercial, professional, — demand and have their collections of statistics, and their vast accumulations ready as contributions to economic science. But the correlation of all these and their actual results have not yet been reached. Nevertheless, money sees the profits of this wisdom, and is more willing to pay for it. Expert investigators are in demand. Public action requires it. The idea of a republic in which all its citizens shall act patriotically and virtuously, from free choice of the right course and on their own knowledge, demands it. Napoleon I. said, 'Statistics mean the keeping of an exact account of a nation's affairs, and without such an account there is no safety;' while Goethe declared, 'I do not know whether figures govern the world, but this I do know: they show *how* it is governed.' America has accepted the responsibility of reporting its operations, and of disseminating information for the benefit of all the people. Boards of health, of charity, of education, and bureaus of statistics and labor, are demanded by state and nation. They are becoming potent in reducing to order the chaos of data so long without form and void.

The character of the information demanded marks the progress of the age. During how many ages was the counting of men and the measure of their condition undertaken solely to prepare for war! Even our own colonial census was taken for this purpose.

The constitution of our fathers provided for representation in congress and in the electoral college according to population. This has led to vast results. A magnificent world of data is now spread before us by the census. Every man, woman, and child, and their interests, enter into it, and it has its lesson for each in all their various capacities and relations; but not more than a hundred thousand can possess it, and few can master the whole of it. It would be too much to come annually, and therefore cannot be frequent enough to meet every condition. Many statements should be annual. Our system of government affords an excellent opportunity to perfect a system of statistics parallel to the decennial census, and fitted to meet all demands.

Publicists have said much of the importance of the town-meeting as found in New England. An important characteristic of it is the bringing of all questions of public taxation and expenditure and policy to the consideration of all the citizens. This attention of all the citizens to the details of municipal action in large cities is impossible: therefore there are public reports and manifold statements. But should the town system of reports be everywhere adopted, and these be followed by county and state summaries, the nation could group these so as to give a variety of form and result sufficient for each according to his interest. The student and statesman would find them falling into appropriate classes, of sufficient frequency, and in connection with our decennial census of the nation would discover us in the very front rank with respect to knowledge of ourselves as a people. This is now done measurably for the subject of education. Each institution publishes its report or catalogue, most towns and cities their reports; many states gather up the data; and the national bureau, carefully avoiding improper complications, and solely for the purposes of information, issues an annual volume. The result is unique in the history of voluntary statistics. Were this system carried into every other great field, and the whole distilled into a single volume, and should each nation do the same, we should see the beginning of a solid foundation for internationalism, and the scientific method at last pervading the world of thought. It would determine the most far-reaching generalizations, and have an effect upon common life not now possible. Childhood would be ushered into new conditions, and alike the humblest and the highest would more easily find the truth.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE MATHEMATICAL AND PHYSICAL SCIENCE SECTION.

THE session of the British association in Montreal might be fairly designated as a 'section A' meeting, in view of the leading position in British science occupied by the representatives of that section, and the prominence which was accorded them and their section in the general meetings of the association. The retiring president of the association, who was to have been present, but was not, was a distinguished member of the section. His few duties were gracefully performed by another distinguished member of the section, Sir William Thomson, who also presided over the sittings of the section during the meeting. As representing the retiring president he introduced his successor, the president for 1884, in the person of Lord Rayleigh, another of the 'strong' men of section A. Two of the three evening lectures were given by members of the section, on subjects connected with physics and astronomy.

When it is remarked that the place of meeting offers no especial attractions to students of mathematical and physical science, it will be admitted that the roll of the section presented an unusual array of great names, including as it did such as Sir William Thomson, Lord Rayleigh, J. C. Adams, J. W. L. Glaisher, Henrici, Dewar, Preece, James Glaisher, Lodge, Rev. S. J. Perry, Osborne Reynolds, and many others.

As might be easily inferred from a glance at the above list, a large majority of the papers presented had to do with physics rather than with astronomy or pure mathematics. By a judicious action of the sectional committee, and one worthy of imitation, the papers were very fairly 'bunched' by subjects so that one was not required to remain during the entire week in order to listen to the treatment of a particular topic.

The first notable physical paper to be presented was, of course, the address of Lord Rayleigh as president of the association.

This address has already been placed before the readers of this journal, and no extended reference to it will be necessary. Although historical in the main, it was rich in valuable and timely suggestions such as could come only from one as thoroughly familiar with the topics referred to as its author. As a sample of these, may be quoted the remarks concerning the theory of the action of the telephone, which was declared to be "still in some respects obscure, as is shown by the comparative failure of the many attempts to improve it;" and in considering some of the explanations that have been offered, Lord Rayleigh said, "We do well to remember that molecular changes in solid masses are inaudible in themselves, and can only be manifested to our ears by the generation of a to-and-fro motion of the external surface extending over a considerable area. If the surface of a solid remains undisturbed, our ears can tell us nothing of what goes on in the interior."