SCIENCE

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THE COMPARATIVE METHOD OF STUDY.[1]

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WE are all acquainted with the word evolution as used in natural history to express the doctrine that many different forms of animal and vegetable life have been derived from a common ancestry. The use of the word in a more general sense in astronomy and sociology is almost as well known. Philosophers, historians, and inventors, as well as naturalists, have discovered in the present generation that evolution, defined simply as the theory which recognizes not only the formal and external connection and correspondence of entities and events, but also the causal connection,— so far as that may exist, — is not only true but is also exceedingly useful and fruitful as a method to guide thought and investigation.

If we would make the most rapid progress on the current of modern thought, we must be in the current and know its trend, and to determine its trend we must know both its present condition and the previous conditions through which it passed to reach the present; just as in determining the direction of a river current we must use floats to show the path traced by the surrounding water, and in determining a comet's orbit we must use several positions to compute its future course, so in all subjects which involve human personality and social progress there are certain well-determined positions formerly occupied, which, compared with the present, will indicate the future.

A good historian, for example, is not satisfied with his narrative until he has shown the events in their proper relation to each other. Indeed, the true scholar, the man of profound mind and practical learning, is not he who has apprehended and remembered the greatest number of great and useful facts; it is he who has a systematic, correllated knowledge of facts. Let us consider one or two illustrations.

In some sciences it seems as if human thought moved in a kind of cycle, so that by going back far enough a period or phase in the history of the science or doctrine will be found which is very much like its present condition, or like any other condition which we may be considering. Even back to the time of Solomon, we have his authority for the proverb that there is nothing new under the sun, and if it was true then it must be true more particularly at the present day. This does not teach that there is no real progress in human knowledge, nor that there are no new combinations of public events such as constitute history. But it is evident that all motion and change in human thought, all changes in national life, all movements in literature, art, and even science, are not progressive. Indeed, there is very much intellectual motion to only a little progress. In this respect the human mind may be compared to the limbs of a child. A little girl, when she is excited and hurried, will jump up and down and make very little forward motion, notwithstanding — or rather because of — her eager desire to do so. She wastes a large amount of energy simply in crossing a room. Her movements are not properly co-ordinated; she does not know what muscles to use in order to attain the desired position. How true this is of the intellectual movements of men!

A man in his anxiety to get ahead rapidly in the world, to acquire more money, to get some fame or honor, position or power, will make many senseless and useless actions which do not at all hasten the attainment in view. We all do it more or less; a man would be supremely wise or fortunate who was not occasionally humiliated by discovering that his most carefully laid plans and most deliberate actions had very unforeseen effects.

[1] Abstract of a paper written for a popular audience.

To regard the world as a stage and all the rest of mankind as players is an instructive as well as amusing way of contemplating our fellowmen. To see politicians standing in a high place and reaching forward and upward to grasp more power and influence, and in their eager and irrational motions losing their foothold and falling prostrate, is a spectacle which is constantly before our eyes, at least the reaching is constantly before our eyes and the falling is periodically manifest at election time.

But the same disposition is seen, and similar accidents happen, to men in all walks of life. That is to say, that the child who is learning to walk, and the man who is learning to control himself and other men, go through many motions and actions which are not really helpful for the purpose in view. But these misguided actions are educational in their results, so that if a man lives long enough he is likely to become measurably wise by virtue of his own mistakes.

Men often act with very little sound theory or experience to guide them. In many respects we are like a man blindfolded, who hears some noise but is doubtful from whence it comes; if he has the opportunity to explore the room in all directions he is likely to find the right corner before long, even though his hearing at first directly misleads him. And so in all human knowledge, if we only have opportunities to make enough mistakes we are likely to have ultimately some measure of successful intellectual progress. We need not experiment with what is dangerous, nor carelessly make mistakes, but when we have no sure knowledge to guide us we should learn as much as possible from the experiments made by ourselves and others; thus, proving all things, we may hold fast to that which is good.

Very much of vaunted human progress is at best only up along the arc of a helix, so that there is much motion to only a little rise; and, after making a complete turn or cycle, society is found just where it was before, except that it is a little higher in experience and therefore enjoys a wider horizon and clearer view. As mountain railroads wind in grand loops and horseshoe curves around the valleys and up to the passes, making miles of road to gain a few hundred feet in altitude, so human knowledge moves in a kind of cycle such that it is possible to stop at any point and look back and down at the corresponding point in time past.

Does any heretical doctrine arise in the Church? The expert in ecclesiastical history will have no difficulty in telling us when the same heresy long ago produced a similar dissension, and quite likely he will be able to show that again and again the same doctrine in only slightly different form has been the ground for divisions in the Church. Where several of these recurring phases can be definitely located it might be possible to investigate the law of their recurrence or, as the physicist would say, to investigate the period of the vibration or undulation. The weather prophets, who employ themselves and amuse the public by predicting when we shall have the coldest day of winter and the hottest day of summer, might, by the use of some statistics and mathematics, derive formulas designed to express the periods of moral, social and intellectual movements.

One reason why such formulas are impracticable is because they would contain an infinite number of terms; that is to say, the time of recurrence of any sociological phenomenon is a function of an infinite number of conditions. But most of these conditions are insignificant compared with a few of the most important ones, and so we could apply to this problem the method of finding approximately the value of an infinite but rapidly converging series.

For example, consider a financial panic, which is never the result of a single cause. At certain times the failure of a great bank is enough to precipitate a widespread and disastrous panic;

at other times, when the wave of public confidence is high and strong, such a failure has no perceptible effect beyond those immediately concerned. To predict the time of the next panic it would be necessary first to determine the periodic laws of speculative eras, expansion and contraction of the currency, over production, and other principal causes, and then combine them to find when like phases coincide. Just as two rays of light of opposite phases may by interference annihilate each other, so two social movements or tendencies, both of great power and effect, may, when they enter as terms in the formula of another movement, cancel each other by reason of their opposite signs or phases. On the contrary, all of the greatest movements of the social world, such as the founding and spread of Christianity, the fall of Rome, the Reformation, the colonization of America, and the French Revolution, have been the result of the synchronous combinations of many causes or terms of the same sign and phase, so that the sum of the whole — even if we neglect the infinite number of small terms — is one of transcendent magnitude.

The great advantage of the philosophical study of history is that by this method the constituent elements of events and the movements to which they belong are made apparent, and for this purpose we must be provided with the data for expressing the trend and phase of all the political, philosophical, and religious movements to which they are related. The complexity of the problems involved is indicated by the fact that different scholars arrive at such contradictory conclusions. Nevertheless, it is believed that this modern method of investigation will revolutionize all the social sciences as it has already revolutionized political economy, and that after the method has been more systematically applied to modern statistics, and the number of terms considered has been increased, the conclusions or results reached by different authorities will be less and less discrepant, and that thus we may hope ultimately to reach a certainty and precision, in the social and metaphysical sciences, which will be comparable to the precision of physical data. If we throw a pebble into the air we can express mathematically the motion of the earth toward the pebble as well as the motion of the pebble toward the earth, and we might perhaps express in a similar way the effect which the repair of a roof in San Francisco would have upon the prices of building materials in New York, and *vice versa*. More than this, is it not possible that a new psychology will be able to weigh and measure the volitions, tastes, and emotions of the mind, so that this science as well as history and political economy may become partly quantitative?

The methods of mathematics can be applied to the metaphysical sciences more extensively than has been done heretofore. These methods have already been applied, in a limited way, to all subjects having much statistical data, also to logic. Indeed, mathematical forms and analysis may be used in any science, as chemistry, which is subject to quantitative treatment. The qualitative analysis must always precede the quantitative analysis in any science, but most subjects are now so fully developed that it is time for original research to be directed to the quantitative treatment. This is being done in a kind of tentative way at several universities, and it is believed that the comparative, quantitative method of investigation will be as useful in other sciences as it has already proved to be in political economy and philology.

NATURAL SELECTION AND USE-INHERITANCE.

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EVOLUTIONISTS will be extremely gratified to learn that Mr. Spencer has resumed the discussion of the subject of the factors of organic evolution. Since the publication, several years ago, of Mr. Spencer's controversial essays on this subject, the so-called pure-Darwinians have practically enjoyed a monopoly of the field; and some of the more rash biologists have even allowed themselves to advance the claim that the use inheritance hypothesis was utterly discredited. Mr. Spencer's unsatisfactory state of health, it was understood, necessitated his neglect of this and many other "unsettled problems" and the concentration of his attention on ethical questions,— the part of his synthetic philosophy rightly regarded by all as the crown of the whole. Students of evolution were anxious to hear "the other side," the answers to the formidable objections of Professor Weissman and his disciples or co-believers, and the announcement of Dr. Romanes's "Darwin and After Darwin," a part of which work was to treat elaborately the question of the number and relative importance of the factors of organic evolution, was received with great pleasure. But no one realizes more keenly the transcendent importance of the question of the inheritance of acquired characters than Mr. Spencer, and he is to be congratulated upon the kindness of fortune that has enabled him to spare some time and energy to the further consideration of the subject, use-inheritance *vs.* sexual selection. It will conduce to firmness of grasp and clearness of understanding to quote here certain passages from Mr. Spencer's preface to his "Factors of Organic Evolution."

"Though mental phenomena of many kinds," wrote Mr. Spencer, "and especially of the simpler kinds, are explicable only as resulting from the natural selection of favorable variations; yet there are, I believe, still more numerous mental phenomena, including all those of any considerable complexity, which cannot be explained otherwise than as results of the inheritance of functionally-produced modifications. What theory of psychological evolution is espoused, thus depends on acceptance or rejection of the doctrine that not only in the individual, but in the successions of individuals, use and disuse of parts produce respectively increase and decrease of them.

"Of course there are involved the conceptions we form of the genesis and nature of our higher emotions; and, by implication, the conceptions we form of our moral intuitions. If functionally-produced modifications are inheritable, then the mental associations habitually produced in individuals by experiences of the relations between actions and their consequences, pleasurable or painful, may, in the successions of individuals, generate innate tendencies to like or dislike such actions. But, if not, the genesis of such tendencies is, as we shall see, not satisfactorily explicable.

"That our sociological beliefs must also be profoundly affected by the conclusions we draw on this point, is obvious. If a nation is modified *en masse* by transmission of the effects produced on the natures of its members by those modes of daily activity which its institutions and circumstances involve, then we must infer that such institutions and circumstances mould its members far more rapidly and comprehensively than they do if the sole cause of adaptation to them is the more frequent survival of individuals who happen to have varied in favorable ways."

The above expresses Mr. Spencer's view of the profound importance of the indirect bearings of the purely biological argument upon the factors of organic evolution. Now that we have refreshed our memory on this point, let us proceed to give a brief but careful summary of Mr. Spencer's latest contribution to the controversy, to be found in an article, entitled "On the Inadequacy of Natural Selection," in the *Contemporary Review* for February. We preserve as far as possible Mr. Spencer's style.

Students of psychology are familiar with the experiments of Weber on the sense of touch. He found that different parts of the surface differ widely in their ability to give information concerning the things touched. By actual measurements he showed that the end of the forefinger has thirty times the tactual discriminativeness which the middle of the back has. Between these extremes there are gradations. The inner surfaces of the second joints of the finger can distinguish separateness of positions only half as well as the tip of the forefinger. The innermost joints are still less discriminating, their power being equal to that of the tip of the nose. The palm of the hand and the cheek have alike one fifth of the perceptiveness which the tip of the forefinger has, and the lower part of the forehead has one-half of that possessed by the cheek. The crown of the head is far less discriminating, and the breast still less.

What is the meaning of these differences? How, in the course of evolution, have they been established? If "natural selection" or survival of the fittest is the assigned cause, then it is required to show in what way each of these degrees of endowment has