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SCIENCE AND ECONOMICS.*

IN science we find the dynamics of political economy, as well as many other branches of human knowledge and human speculation. That eminent prelate and statesman, James Cardinal Gibbons, at the dedication of McMahon Hall of Philosophy at the Catholic University of America a few years ago, said that many were of the opinion that the Mother Church did not welcome the results of scientific research—that there might be something to be feared relative to theology and religion in such research—but he asserted emphatically that the church welcomed all science and all revelations of science as new revelations of religion. His eminence recognized and appreciated the great changes in thought which had come over the world of intelligence during the last thirty or forty years, and that nothing could be revealed by science that did not reveal the hand of the great first cause; that science was God's instrument in teaching His handiwork to the human race.

The conflicts of science and religion, about which we heard so much a generation ago, have no place now in the thought of those who see in science such handiwork. We no longer look upon the earth as the spasmodic creation of a few days. Genesis becomes grand and beautiful poetry in place of alleged history. We see in it the traditions of primitive man in his attempt to account for creation. We see the eco-

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nomic development and evolution that brought into existence, through the slow steps necessary to produce it, what we recognize as the earth; and we appreciate more and more that this is to the greater glory of the first great cause than that formerly assumed method, the result of a literal reading of Genesis.

Science is no longer a menace to religion. It has, to be sure, overturned dogmas, upset superstitions, and changed the theological thought of the world, but it has left with us the evidence of that divine economy in creation which is so essential in considering the works of the Almighty; and as the result of increased knowledge which science has brought us the human race is happier, and more generally recognizes that all things must grow slowly, steadily, surely to that stage of perfection which must mark the works of the Supreme Architect.

If this has been the result in the realms of theology, so long ruled by dogma and artificial tenets, science must have had some influence in shaping those matters which belong to the every-day life of man, his business relations, and his social environment. For the present hour I am to consider what this influence has been in overturning, modifying, and extending the theories of economists, and see whether political economy owes anything to science, or what science must and can do in reshaping and extending the great laws of the business world.

First, we must consider that peculiar and interesting doctrine known as Malthusianism. The doctrine set forth by Malthus comprehended more than his celebrated theory relative to the encroachments of population upon the food supply. These supplemental doctrines involved what is popularly known as the iron law of wages, the wages fund, and the law of diminishing returns, all of which have by scientific thought and investigation given way in large degree to theories more rational and more in line with the facts.

Concretely, Malthus announced the theory that population increased in a geometrical and food in an arithmetical ratio, but after the announcement he contented himself with a more general proposition that population, unless checked by war, poverty and other calamities, tended to increase faster than sustenance. Malthus was supported by other writers. There is, of course, something in this doctrine relative to the pressure of population upon the food supply which must be admitted as containing some truth, and at the time Malthus wrote it was supposed to contain the truth. The author of the theory, however, did not anticipate and could not foresee the great changes which would come in the way of the cultivation of the land and in other ways to increase the food supply relative to the increase of population.

The time may come, to be sure, when the Malthusian theory will be revived, but it is not in our day, nor will it be in our century, for scientific thought almost completely overturned the theory and has relieved it of its strength in exciting the fears of economists or of philosophers that the world was gradually but surely coming to that position where it could not supply its population with food, and that some method of checking population must be the resort. The broadening of the area of supply through discovery and the taking up of vast tracts of land were the immediate means of depriving the doctrine of its force, but later on intensive agriculture and the discoveries of science succeeded in relegating the theory to the past. It is perfectly evident that science has accomplished more in reducing the theory to the minimum than all other forces combined; for transportation and telegraphy, by which famines are avoided or minimized, by which prices are equalized, by which the

markets of the world are known every day, are the direct result of scientific discovery and of the application of the laws of nature.

Of course, Malthus depended upon the dogma of the older economists, that labor is the basis of all values, a doctrine which constituted the ground-rock on which Marx and his associates builded their socialistic structure. Science is steadily, and rapidly too, ridding the world of this doctrine, for, in connection with the Malthusian theory, it shows that labor, while the origin of values, is not and can not be the sole basis of all values.

In the light of present-day conditions there is little place for either the theory of the pressure of population upon the food supply or the theory that labor is the basis of all values. We are now having a wheat crop of nearly 800,000,000 bushels, a corn crop of nearly 3,000,000,000 bushels, an oat crop of close upon 1,000,000,000 bushels, and other crops in proportion. This is for our own country alone, and it gives us the privilege of feeding the world and of relieving it of the fears of starvation or of the conditions of abject poverty; these are conditions which now affect few and exceptional cases, and not the masses.

Closely allied to the doctrine of the pressure of population upon the food supply is the law of diminishing returns, a law which holds now in all works on political economy. Science has not destroyed the law, but has modified it. It is fundamental and all-embracing, but is usually applied to the agricultural industry, although it extends in its principles to all industries, as that law of physics that increased speed is at the expense of power applies to all mechanical contrivances; and yet the law of diminishing returns, through scientific discovery and investigation, has been so far modified as to invalidate largely its relation to the Malthusian theory of population.

Volumes might be written relating to the influence that machinery has exerted in this respect—machines whose construction results in processes that parallel the work of the human brain and the human hand. Modern science shows that such machinery does not have the effect outlined by Doctor Smith in his story of the pin machine. To these machines we apply steam, compressed air, water, electricity. All the great forces of nature are brought into play, and through the ingenious contrivances of man supply the forces by which the law of diminishing returns is modified. In all directions this influence is observed; in a thousand directions we see the doing away with the rule of thumb and the application of distinct, positive scientific principles. The factory itself is a scientific structure, involving the highest mathematical skill. Through these things and the application of new principles in agriculture science overcomes the influence of the seasons by preserving products, by equalizing prices, and by all the other means by which the world is brought into closer contact, one nation or people with another.

The latest discoveries are, of course, the most effective in modifying the law. A gentleman in one of the eastern states has about seven acres under glass. He raises cucumbers, lettuce and other things for the winter markets. A few years ago he found that all the plants on the northern side of his houses grew slowly, lacking that development attained by the plants on the southern side. He alternated by transplanting. Still he found the plants on the northern side developed slowly and unsatisfactorily. Of course, he attributed this to the lack of sunlight on the northern side. When he had about given up the idea of securing any evenness in the growth of his plants the town inaugurated a system of electric lighting, and established along the northern side of his houses several powerful

lamps. He then found that the plants on that side of his houses did as well as those on the southern side, the result being that he introduced electric lights in his houses, so that his plants should have the benefit of such lights during the night. The effect of this was that his cucumbers, for instance, grew more rapidly, with more even development, and with a higher grade of tenderness. He sells about ten thousand cucumbers every winter at twenty cents a piece. This discovery was not new with him, for about that time scientific investigators in Italy and some other parts of Europe were experimenting in the use of electric light to perfect the growth of vegetables.

Afterwards my friend made another discovery, not new to the world but new to him, and that was that by sterilizing the soil he could stimulate the growth of plants to maturity, secure freedom from the growth of weeds and the influence of germs in the soil, and anticipate the market. This he did by putting gangs of steam-pipes in the soil about a foot deep, thus absolutely cooking the soil, killing all poisonous germs and all seeds of weed plants, while insects indigenous to the soil and injurious to the growth of vegetables entirely disappeared. He insists that the soil of any farm, conditions being favorable, can be sterilized in the same way, and at small cost, thus rewarding the farmer by relieving him of much labor now necessary in the cultivation of all kinds of plants and vegetables. Such experimentation must, of course, modify the law of diminishing returns to such a degree as, for a while at least, to rob it of its peculiar influence in increasing cost or retarding the supply from the cultivation of certain kinds of land; but, as I have said, the law remains as a law.

In mechanical productions science has also done much towards modifying the theory, although, of course, there is a limit to the power of machinery and to the employment of people that will always preserve the principle involved in the law; but in these directions—in the Malthusian theory of the pressure of population and its accompanying theory of the law of diminishing returns—science has done much to modify the tenets of the older economists.

The next matter in close relation to the Malthusian theory, and one which has yielded largely to scientific research and the application of scientific principles, is the iron law of wages—that law which provided that the working man should and could receive only that amount of wage which was essential to life merely, just enough to keep body and soul together and to keep the human machine properly lubricated for its daily work. This law was fortified and reinforced by the wage-fund theory. Overcoming the one meant the modification or the complete abrogation of the other. The wage-fund theory did not originate with Malthus. It was suggested by Adam Smith himself, and was developed by his followers; but by the power of modern scientific analysis it is given up to-day, so far as its original form is concerned, by all economists, although many of them assert with some reason that it contains valuable truth, and, when properly stated, the whole truth.

As originally stated, the law is that wages, like everything else, are governed by supply and demand, and in the aggregate depend upon the proportion of laborers to the capital available for employing labor, this capital being denominated a wage fund. Doctor Smith said, in his 'Wealth of Nations,' that the demand for those who live by wages, it is evident, can not increase but in proportion to the increase of the funds which are destined for the payment of wages. Malthus and Ricardo held to this doctrine, but argued that wages could not rise, even by increasing

the wage fund, because if the wage-fund were increased and wages were temporarily raised, population, according to Malthus, always pressing on the limits of subsistence, would be enabled to expand, and the increase in the number of laborers would increase the supply relatively to the wage fund, and therefore lower wages. Ricardo held substantially this doctrine, as also did Senior, James Mill, John Stuart Mill, and most of the older writers of the classical school, though on this subject, as on others, John Stuart Mill later somewhat modified his views, and was, perhaps, often inconsistent.

As a result of more scientific consideration, this theory was practically abrogated, and a new one arose, which, in brief, is the theory that production furnishes the true measure of wages. Curiously enough, this theory was first clearly advocated in our own country, and by the late President Francis A. Walker, when he argued that the wage-fund theory and its socialistic corollary were wholly false; that wages depended upon the productivity of labor and not upon capital. He says, in his work on the 'Wages Question,' that the popular theory of wages is based upon the assumption that wages are paid out of capital, the saved results of the industry of the past. Hence, it is argued that capital must furnish the measure of wages. Walker held, on the contrary, that wages are, in a philosophical view of the subject, paid out of the product of present industry, and hence that production furnishes the true measure of wages, the employer purchasing labor with a view to the product of labor, and the kind and amount of that product determining what wages he can afford to pay.

This view has been very widely accepted, both here and abroad, Mr. Atkinson accepting and urging that the only way to raise wages is to raise the product; and applying his power of analysis, he says that in treating this question it must constantly be kept in mind that money is but the instrument of exchange, that real wages are what the money will buy, and that there can not be more real wages than the whole product less the share of capital. If then, we can even approximate the value of the product and divide by the known number of persons employed, we then approximate the annual measure or average rate of wages in terms of money. In other words, to state it briefly, he says that capital must be paid first in order to induce it to contribute, but it is paid only just what is necessary in the market to obtain it, and the rest of the product goes to wages.

The formula of Adam Smith, indorsed and advocated by his followers, is now revised, and should read, instead of as quoted, as follows: "The demand for those who live by wages, it is evident, can not increase but in proportion to the increase of product which is destined for the payment of wages." There have been many laws promulgated relating to wages, but I think that the scientific attitude of the present-day economists rests upon this theory; and it must stand until science restates it, and restates it in such a way that all or the majority of all economists will accept the formula. Certainly we must claim, and truthfully, that science has either abrogated or very largely modified the old theories relating to wages.

Another line of inquiry suggested by my topic relates to the ever-present, irritating and much-controverted questions in regard to a tariff on imports. As yet science has done but little in this respect, but I conceive that it may and will do much in modifying the extreme views on either side that are held by economists, politicians and statesmen. It may be granted that tariff legislation relates entirely to the question of expediency; that there is little, if any, principle involved in the doctrines of either

free trade or protection. That is the present attitude of men, but the power of science is disturbing the older thought and the older doctrines on this great subject, for it is equalizing conditions everywhere, a process which goes on constantly, and which will help to show legislators the true path to be pursued.

In my own view the tariff question is more sociological than economic. Until the conditions of the different peoples that are engaged in competing industries are more thoroughly equalized, probably both the great political parties in our country, acting together, could not get rid of some form of a protective tariff, but when, through scientific methods and the application of scientific principles to industry on a broad scale, the conditions of the people become more thoroughly equalized, I doubt if both parties together will be able to preserve legislation relative to an expediency now felt to be important. A scientific basis of tariff legislation is sure to be advocated, and when it comes it will be the entering wedge to simplifying the commercial and industrial relations of different peoples. As already intimated, the uniformizing of prices, the expansion of transportation, and all the other instrumentalities for reducing the size of the world from an industrial point of view, are affecting and will affect more generally legislation relative to imports and exports.

Scientific economics will lead the economists to depart somewhat from their older methods of treating the business affairs of the world. We have chapter after chapter, repeated in book after book, on the tantalizing question of rent, interest, etc. Science can do but little towards avoiding the waste pages devoted to these subjects; they will remain, but they are chiefly the subject of discussion as to definition. As President Hadley has stated, political economy is very largely a conflict over definitions. This is harmless, but does little if any good. It is gratifying to see that the later works on political economy are making great steps in advance, are treating world-wide questions of present-day interest. They are recognizing the necessity of applying economic principles to the problems which vex us here and now, and that fine-spun theories as to matters having no interest or value as the days go by must give place to advanced treatment of the real, great questions which constitute the elements of industrial society at the present time.

Some of these questions which science will insist upon being treated will include the utilization of waste products. It is only scientific knowledge that can lead to this new development of values. A saved product is one of the necessities of industry at the present time. This utilization has taken place during the last few years, and it has upset some of the old theories as to cost and the returns of capital. By-products of all kinds are usually the source of profit, and in some cases the chief source of profit, to the manufacturer. This enables him to put out his units of original production at a less cost, and with benefit to the community. Nothing is lost which through scientific methods can be preserved. Many, many instances of this will come to the minds of all, but as one superlative illustration I may refer to the by-products of petroleum, which are absolutely, entirely saved through the practical application of scientific processes. It would be difficult to enumerate the products of petroleum saved by the chemical processes of refinement. The Census Office has published a most enlightening bulletin on this very subject of waste products. This utilization of such products interferes with the full force of diminishing returns, modifying the law as progressing conditions demand.

Strange as it may seem, the influence of science upon the chapters relating to finance has been marked and positive. Professor Charles E. Munroe, of George Washington University, has recently pointed out how technical chemistry invades the domains of economics, politics, and diplomacy, and he cites as a striking example of its effects in economics the settlement of the silver question. The far-reaching influence of chemistry in this particular line is easily understood when we consider the relations of the metals, and how these relations have been changed by the application of the principles of chemistry.

A further economic influence is to be found, as Dr. Munroe states, in the reference of a multitude of railroad administrative problems to the chemist, in the steady increase of his force of skilled assistant, and in the fact that his position in the organization has become second to none in importance. This is seen in the use of lamps, beacons, colors, and all the paraphernalia necessary for the conduct of great railway lines.

Economists have not yet adequately dealt with the great projections of modern times in relation to their influence upon economic development and the conditions of the people at large. Science will compel this treatment, and when our able and astute writers take it up we shall find illuminating chapters in the works on the ever attractive department of political economy. The great engineering enterprises, relating not only to transportation, but to various other channels of industrial activity, must result in such treatment; but in transportation alone engineering science has revolutionized many economic conditions. Standing on the highest point of the Brooklyn bridge there are only three things to be seen—the sky above, the water below, and the vast creations of man filling the field of vision everywhere else. It is the application in every direction of the laws of nature, utilized by the power of science, that presents this scene to the human eye.

The constant effort of science to overcome natural laws as well as to apply them must be recognized. A few years ago, at a meeting in New York, a gentleman was deploring the fact that we did not allow Nature's law to have full play; that we were constantly antagonizing Nature at the expense of the welfare of the human race. Mr. Abram Hewitt answered this pernicious doctrine by saying that if nature had been allowed to take its course grass would still be growing in Broadway.

The sociological results of this conflict are too vast for present treatment; they can only be suggested. Congested cities are being relieved of their congestion, and the great suburban population, the finest in the world, is recruited from the congested districts and from the country. Through sanitary discoveries, and through many other elements which are the direct result of scientific processes, we are reducing the power of disease and delaying the time when one ceases to exist. Rapid transportation and the great lines of transportation are facilitating the accomplishment of these wonderful and desirable results. They are reducing the possibilities of war by increasing its severity; they are making the products of one clime familiar to all climes; they are diffusing intelligence and making all people acquainted. Political economy has a vaster field in massing the facts which pertain to this broad branch of its grand science than it has as yet occupied.

Growing out of this will come a saner and more rational treatment of the power of machinery in its effect upon the employment of the people. The facts already show that in this country particularly the percentage of the whole population em-

ployed in gainful occupations constantly rises. The older economists did not have the facts. They had to draw their conclusions from exceedingly limited observation, but with the data covering the whole people the old views are overturned, and we now recognize, as the result of statistical inquiry, that not only does the percentage of the total number of people employed increase, but that the develoment is along the lines of the most skilled labor and in the higher pursuits of life; that the great body of people constituting the base of the industrial pyramid is constantly being narrowed, and to the benefit of the whole. Scientific inquiry in these directions, added to that concerning the great engineering processes, must lead to but one, and that a scientific, conclusion.

Scientific political economy must deal with the question of alimentation, which is important in all treatment of the labor question, and is one of the most vital subjects to attract present-day thinkers. The physiological chemist is claiming attention, and rightly. He is trying to ascertain just what foods are most important, not only from a physiological point of view but economically, and as relating to the efficiency of labor. Professor Marshall has lately made an appeal for a larger number of sympathetic students who have studied working-class problems in a scientific spirit; under this spirit this question of food and the efficiency of labor as depending upon the quality of food must be one of the problems. What is the amount of nutrients contained in different food materials? The relative expense of different kinds of food? The ratio of relative costs of protein, fats, and carbo-hydrates, as well as the relative proportion of these elements? These facts are being ascertained, and it is necessary to know them and the influence of each upon the muscular as well as the mental capacity and development of the individual.

The economy of food must be treated from two standpoints—the physiological and the pecuniary. These elements can not be separated if we are to understand fully the effects of different foods upon the efficiency of labor and the capacity of labor to sustain itself. These things should form a part of political economy. They are certainly far more valuable than any treatise upon rent or interest. Much has been done, but more must be accomplished. Governments, both State and Federal, as well as municipal, are becoming interested in these subjects, our own Federal Government for some years having carried on investigations relative to nutrition. The Carnegie Institution of Washington has taken up this subject with most friendly interest, and under its direction some of the wisest and most skillful experts of the country are conducting their experiments. The Federal laboratories are auxiliaries to this inquiry, and I feel sure that with the united efforts of governments, of scientific institutions, and of professors in colleges and universities there will be produced a body of facts that will clearly and definitely decide the great question of efficiency of labor, so far as food is concerned.

Going back some years, you will remember that Lord Brassey, when contracting for the labor of men of different nationalities in the construction of railroads, found by actual experience the effect produced by different kinds and qualities of food; that when the food of the Italian laborer was changed from macaroni and other things belonging to his national diet to roast beef and those things which make the British workman so superior, his efficiency was increased *pro tanto*.

It is difficult, through any statistical method or through any method depending entirely upon observation, to treat the labor question in all its elements in a way to secure beneficial results, so far as knowl-

edge is concerned. The statistics of wages have undergone a very decided evolution through the application of scientific methods suggested by economists. It can be learned easily—and has been stated—how many men are required permanently to perform the services of a large number of men employed temporarily. The efficiency of labor relates specifically to this subject. For instance, it was ascertained a few years ago that in a number of establishments producing pig iron 310 different employees were required to carry on the works, but that if the workmen had been employed continuously only 71 would have been necessary; that the average earnings of the 310 individual employees were $169, while the consequent average earnings per employee if the work had been continuous for the 71 men would have been $734 per year. A scientific economic analysis of such conditions would probably show a variance necessary to a true economic conclusion; but political economy has not yet attacked such problems with the same force with which it has dealt with other and less important matters.

The treatment of the labor question must, if there are great results to be secured, be brought under the same scientific methods that are applied in other directions; and there are various other statistical elements which, for the intelligence of all people, both employers and employed, require the application of scientific analysis, for I take it that the relations of employer and employee will not be as fully harmonized as may be desired until such application is made. The employer does not understand fully the conditions of his own work: the employee certainly does not understand the conditions of production. All these conditions are the result of scientific development, and that development, in order to secure the very best results in establishing a rational basis for treatment, must have further elucidation before great results can be expected.

As another instance, the volume of products at different periods, as shown by values, is the prolific source of most pernicious doctrines. Our official statisticians have been wrestling with this subject for many years, and some advance has been made, especially during the last national census. I refer particularly to the duplication of values. We say that the product of the mechanical and manufacturing establishments of the United States is, in round numbers, over $13,000,000,000, but this amount represents the value of raw material and labor, each producer returning the full value of his product, which may become the raw material of other manufacturers all along the line. The deduction of the value of the raw material from the total value of the products, of course, simplifies the problem, but it does not scientifically solve it. Scientific methods must be resorted to, and if the political economists, in connection with their allies, the statisticians, will undertake this problem greater progress will be made. So far hints only are to be found in the books. These hints, of course, are familiar to all statisticians, but the difficulty of securing the true product without exhausting the treasury is one of great complexity.

So in the whole field of sociology, involving crime, charity, benevolence, and all that pertains to the efforts of society to remedy existing evils, we need a new method of treatment. There is such a thing as scientific charity, which is immediately concerned with the economic welfare of the people. The great questions of insurance—how to remedy or provide for the economic insecurity which belongs to the present wage system, the compensation of working men for accidents, and everything of the kind—must be the subject of treatment

by political economists. They will need all the science of the actuary, all the skill of the statistician, and all their own power of analysis.

You may ask what can be done in these respects. The official statistician, who, as I have said, is the ally of the political economists, and who recognizes the scope and the necessity of all that is taught in orthodox political economy, also recognizes the need of the further application of economic analysis in the use of the data he collects. He can not study these questions except from the statistical point of view. His duty is to collect, classify, and publish facts relating to the conditions of the people. Their economic interpretation must be, and largely too, the work of another class.

Professor Simon Newcomb, in a tentative way, has made some suggestions along these lines. These suggestions have been submitted to the Carnegie Institution of Washington, with the hope that that Institution may effectively promote not only research in the exact sciences but the analysis of data that are now in existence. He says that the nineteenth century industriously piled up a vast mass of sociological observations and data, as well as data relating to other branches of science, and that this accumulation is going on without end and at great expense in every civilized country. This proposition we all admit. The problem of working out the best results from these observations, however, is one which is not being effectively grappled with, the consequence being that what has been done toward obtaining results consists largely in piece-meal efforts of individuals, frequently leading to no well-established conclusions. He asserts that another feature of the situation is the gradual extension of the principles of exact science into the sociological field; that it is through this extension, rather than through adding to the already accumulated mass of facts, that progress is most to be hoped for in the future.

He therefore suggests that a body of men be employed, organized into a bureau of exact sciences in general, whose work shall be the development of mathematical methods and their application to the great mass of existing observations. He understands well, of course, the difficulty of securing just the right men who can take up in a sociological way—although his suggestions embody many other branches—the exact scientific analysis and interpretation of facts in existence.

Evidence comes from other sources. Dr. Karl Pearson, of University College, London, in commenting upon Doctor Newcomb's suggestion, states that a man of mediocre ability can observe and collect facts, but that it takes the exceptional man of great logical power and control of method to draw legitimate conclusions from them. He thinks that at least 50 per cent. of the observations made and the data collected are worthless, and that no man, however able, could deduce any result at all from them; that, in the language of engineers, we need to 'scrap' about 50 per cent. of the products of nineteenth-century science; that the scientific journals teem with papers which are of no real value at all recording observations that can not be of service to any one, because they have not been undertaken with a due regard to the safeguards which a man takes who makes observations with a view of testing a theory of his own; that in other cases the collector or observer is hopelessly ignorant of the conditions under which alone accurate work can be done; that such a man piles up observations and data because he sees other men doing it, and because that is supposed to be scientific research.

Professor Pearson feels that sociological observations are of the lowest grade of

value in too many cases; that even where the observers have begun to realize that exact science is creeping into the sociological field they have not understood that a thorough training in the new methods is an essential preliminary for effective work, even for the collection of material; that these observers have rushed to measure or count any living form they could hit on without having planned *ab initio* the conceptions and ideas that their observations were intended to illustrate.

Doctor Pearson is skeptical about the right men or the right man, and he thinks the securing of these men is the chief difficulty in organizing any force for the scientific interpretation of the great mass of data now existing; but he says that when the right man is found he must have been rightly trained; that he is to be occupied in drawing logical conclusions from other persons' observation and data; that therefore he must, in the first place, be an adept in scientific method, a first-class mathematician and statistician and a trained calculator and computator. Such a man will be the man who has the courage to 'scrap,' and to do it relentlessly. Science wants immensely the courageous pruner, but Doctor Pearson feels that such a task is not an enviable one.

Such a work is also indorsed by Lord Rayleigh, of the Royal Institution of Great Britain; and Dr. H. H. Turner, of the University Observatory at Oxford, in sympathizing with Doctor Newcomb's suggestion, does not hesitate to say that no one will be found to doubt the necessity of a far more extended discussion of results; that in the days of Newton, perhaps, observations were scarcer than theories, and it was advisable to set them going, but that now there is no doubt whatever that there is a crying necessity that we should organize the discussion of the masses of accumulated material.

Dr. G. H. Darwin is also in sympathy with such work, while in this country Dr. Fisher, of Yale; Dr. Pickering, of Harvard, and others are agreed that we must utilize the vast collections of data and the results of observation in a more scientific way in order that the conditions of the people in all sociological aspects shall be more clearly defined.

All these suggestions are stimulated by what is known as the new political economy. Personally, I do not particularly like that expression, but I do like the phrase 'social economics,' because while political economy deals with the accumulation, distribution and exchange of wealth —fields perfectly legitimate—and sociology is the science of the relations of individuals and institutions, social economics deals with relations in industrial society; hence it comprehends in a broad sense all that is comprehended by political economy, as well as those other elements of present-day economics which relate to other passions than the passion of wealth. We must agree, however, with Buckle, that 'wealth must accumulate before knowledge can begin,' and its corollary, that 'great ignorance is the fruit of great poverty.' We must also recognize Whewell's utterance, that in all cases the arts are prior to the related science. Art is the parent, not the progeny, of science. The wants of the world have developed science. The old alchemists in their work preceded chemical science. So the empirical investigations and researches to discover remedial agencies have bequeathed to the world great stores of knowledge now systematized.

We must also recognize that during the past one hundred and twenty-five years or so political economy, as a separate branch of philosophy, has sprung into existence. The age has been conducive to its development, for it has been one of material progress. Economics has ruled almost at the

expense of ethics, notwithstanding during the same period the world has been constructing great charitable and educational institutions emphasizing its desire to benefit the human race. These institutions, however, have fallen far short of their true purpose. Much of the charity of the world—unscientific, unreasonable—has resulted in more densely populating penal institutions. The scientific investigations of the present time are remedying this fault, and are showing that economics and such institutions must be considered together.

All the strides civilization has made command our admiration, and its onward steps are marked by numerous and convincing evidences; but such evidences are outside the science of political economy, and are considered by it only as the cost may enter into the distribution of wealth it seeks to create, but not as means for a happier and better condition wherein wealth could be more successfully produced.

Under the spur of this progress political economy has flourished—first, by the patronage and through the admiration of all classes. England did not give it birth, perhaps, but cared for it through its infancy, and gave to the world the more matured growth which we call political economy; but England's writers claim that she owes her industrial position in the past to it. It may be that to a too blind following of later teachings she owes to-day the partial loss of her old industrial supremacy. America, if she desires to occupy the place England is vacating, must take lessons of her mother, and profit by her mistakes and advance her scientific understanding to economic truths and principles.

The old school has been content to teach the laws that regulate the production, distribution and exchange of wealth, and these laws have in large measure, and wholly until more recent years, constituted the science of political economy. It has studiously avoided all other matters, and, in the endeavors of its devotees to constitute it a science, has taken no cognizance of the conditions which, favorable or unfavorable, must attend the participators in the production, distribution and exchange of commodities. It has been content to limit itself to things and their relations to individual and national wealth, more particularly the latter, rather than to include in its sphere of creed the vital relations of men. Even Mr. Mill, perhaps the most brilliant writer of his age, informed us that "political economy is concerned with man solely as a being who desires to possess wealth, and who is capable of judging of the comparative efficacy of means to that end. It makes entire abstraction of every other human passion or motive, except those which may be regarded as perpetually antagonizing principles to the desire of wealth, namely, aversion to labor, and desire of the present enjoyment of costly indulgences. * * * Political economy considers mankind as occupied solely in acquiring and consuming wealth." This statement was made in 1844.

Professor John K. Ingram, in 1879, called this a vicious abstraction, which meets us on the very threshold of political economy, and the strictures of our own Professor Walker upon this saying are too well known to be quoted here.

Mr. Mill's statement represents the tenets of the old school, although the founder of the science, Adam Smith, began his labors in it as a professor of moral philosophy, and taught it as a branch of that philosophy. His followers, in their ambition, for many years strayed far from the doctrines of their great master, and with their departure from him political economy lost the sympathy and even the attention of the wageworkers of English and Amer-

ican communities, the very support it largely needs and should have.

It is most gratifying to know that our modern economists are recognizing the weakness of the old doctrines. They are recognizing the necessity of more scientific treatment, of an analysis of conditions, of an interpretation of facts and observations in considering the great wants of the present day. Political economy, like theology and religion, must change with the thought of the age; it must change as industrial and social conditions change; it must seek to ally itself with all the great sciences in every line of work, and to reach conclusions that shall be of vital importance to the working masses of the world. It is a happy sign, as already intimated, that the newer works on political economy are recognizing these things, and are extending the field of their discussions. Here is the great hope and herein lies the importance of the relation of science to political economy. Science is always ready, when the results of its investigations warrant it, to wipe off the slate of yesterday and turn its face to the light. Political economy has not always done this, but it should be as ready as science has been to follow new revelations and announce new truths.

CARROLL D. WRIGHT.

UNIVERSITY REGISTRATION STATISTICS.

A COMPARISON of the figures in the table with those for 1903 (SCIENCE, N. S., Vol. XVIII., No. 467, December 11, 1903, page 738) will show that the majority of institutions given in the table can still point to an increase in attendance over last year; at the same time, the total increase in enrolment at the combined institutions is not as large as it was last year, and considerably smaller than it was two years ago. It was pointed out in the article of 1903 that the effects of the economic conditions of the country would in the ordinary course of events not be felt keenly until 1904, and the figures seem to indicate that there were sufficient grounds for the assumption. A number of universities, not only in the east, but also in the middle west, show a decrease, which in several institutions is quite marked. The losses in individual schools are sometimes due to an increase of requirements, and the tendency to raise the standard of requirements for entrance and advancement, not only in the professional schools, but also in the academic department, is spreading more and more and is no longer confined to one or two institutions. The press during the past year has commented widely upon the fact that the number of students from the west attending higher institutions of learning in the east seems to be decreasing, but an investigation of the facts of the case will show that while the number of western men attending western institutions is unquestionably increasing all the time, there has been no loss in the percentage of western students enrolled at eastern institutions. At Yale, for example, the discussion has suggested the preparation of a table giving the registration from eight large states of the central west and the northwest, most of which support large universities, the states included being Michigan, Ohio, Indiana, Illinois, Missouri, Iowa, Wisconsin and Minnesota, and the figures show that the number of students from these states has grown from 392 in 1902 to 452 in 1904. At Columbia the percentage of students in the corporation (excluding Barnard College, Teachers College and the College of Pharmacy) from the North Central division has increased from 5.87 per cent. in 1902 to 6.56 per cent. in 1904.

The statistics given on page 914 are with few exceptions approximately as of November 1, 1904, and relate to the registration