THE SCIENCES AND SOCIETY

'BUSINESS FORECASTING,' far from being a science with any valid claim to predict future trends, amounts to little more than the art of plausible guessing, with or without the aid of statistics. This, substantially, is the conclusion of Professor Edwin B. Wilson of the Harvard School of Public Health, in an address, 'Are There Periods in American Business Activity?' delivered before the American Association for the Advancement of Science and published in a recent issue of *Science*.

Professor Wilson begins by pointing out that the fundamental problem in the study of any complex series of events, such as weather, rainfall, wholesale prices, or stock and bond movements, is to determine 'whether the behavior of phenomena is no more than might be expected of a chance series.' In other words, if, in a long series of throws a coin begins to run heads in sequence, are we justified in predicting a similar run at the termination of a second long series of throws, and a third, fourth, etc.? For the statistician (and increasingly for the scientist in every field) phenomena must be studied with reference to the factor of probability; if the events are of a recurring type, forecasts or predictions can have scientific validity only to the extent that it has been possible to discover periodicities, as with the seasons, the tides, or the properties of chemical elements. Much the same point was emphasized by Bassett Jones in his provocative article on 'Science and Economics,' which appeared last year in THE LIVING AGE: 'A scientific theory,' he wrote, 'is a logically related group of propositions as to the relational orders found to endure in a certain class of facts.'

Asking himself the question, 'Are periodic elements discoverable in those groups of phenomena making up our industrial and business cycles?' Professor Wilson carefully analyzes 'the longest index of business activity we have'—that of Leonard Ayres. Despite the fact that this series of records covers, by months, a period of 140 years, from 1790 to the present, it was discovered, through the application of Sir Arthur Schuster's 'periodogram analysis,' 'that there were peaks in the curve suggestive of periods of business activity, but that these peaks were not in the same places for the whole data . . . indicating that at best there might be no sufficient definiteness and constancy of the periods to make them useful for forecasting.' It is true that the time covered by the records is much too short to permit of sound inferences and that a few minor predictions were based on it (predictions, moreover, which have led to no adequate control over current conditions or future trends); the stubborn fact remains that not even an elementary criterion of the known fluctuations has been developed. Thus, in the 42 complete swings from peak to peak that Professor Wilson discovered in Ayres's Index, one swing required an average of 40 months, but this average varied from a few months to eight years! To understand what this enormous margin of doubt means, imagine a navigator attempting to make port on the basis of tidal forecasts from two to twelve hours wrong . . . Professor Wilson minces no words: 'We infer,' he writes, 'that there is no more and no less periodicity in Ayres's Index of American Business Activity than there is in a random rearrangement of its component individual full swings.'

EQUALLY SKEPTICAL of the value of so-called business forecasts were S. L. Andrew and H. M. Flinn, statistical experts of the American Telephone and Telegraph Company. And Alfred Cowles, 3rd, reporting in the official journal of the Econometric Society, was even more emphatic: he deliberately stated that professional forecasts of stock-market trends

were actually worse than random guesswork. Inevitably, this brings to mind the astounding performances in this field of Irving Fisher, to say nothing of recent efforts to predict a 'Coming American Boom.' With respect to Fisher, the following comment by Professor Wilson is so revealing and constitutes so severe a criticism of the works and ways of the 'economystics' that it is worth giving in full:—

'So far as I can see, Fisher in 1929 missed foreseeing in any respect the greatest economic disturbance of this country, possibly the greatest of a century. He "explained away" the stock-market crash; he did not see what it meant. It is difficult to see how anybody could have been much more wrong. Neither statistics nor economic theory saved him, indeed it is difficult to avoid the impression that his statistics and his economic theory did but serve to blind him the more completely to what was impending. If he were so wrong then, what is the chance that he is right now, when the New Era economist has become a New Deal economist and when he who was so loudly assuring us of the permanently high level of stock prices has become as loud an advocate of reflation? And what but discouragement can this kind of behavior be to social science or to those social scientists who believe that valid science, that science which is real science, whether in the social field or any other, must have some relation to what happens somewhere else than in the mind of him who elaborates it?'

THAT HAY FEVER is not a fever at all but a consequence of an excessive loss of body heat through dilated blood vessels or impaired blood circulation is one of those paradoxes in which the medical sciences abound. Dr. Harry S. Bernton, of the Georgetown University Medical School, in a recent 'Science-Service Radio Talk,' thus explains what happens to people whose nervous system 'can't take it'—whether from pollen and other toxic irritants or from sudden changes in external temperature:—

'When cold air strikes the skin, there is an immediate loss of heat. The warmer body radiates its heat to the colder environment. One of nature's inexorable laws is the conservation of body heat. This is effected by the contraction or shutting down of the blood vessels in the skin—a mechanism that is quite analogous to shutting off the heat from a radiator by closing the valve. A diminished volume of blood now courses through the skin, whereas the excess of blood finds its way in part into the mucous membrane of the nose. Herein'—note the mechanical ingenuity of the device—'herein are located the so-called turbinate tissues or "swell bodies," which act very much like the ordinary sponge. Their volume varies with the volume of contained fluid. The engorgement of the turbinate causes the familiar sniffing, and the consequent pressure upon the nerve endings in the nasal mucous membrane gives rise to sneezing . . . The congestion of the "swell bodies," irrespective of cause, is indicated by sneezing, fullness of the nose, and nasal discharge. These reactions of the nasal tissues are more marked in the case of hay-fever subjects due to impairment of nerve functions. Therefore, the effects and symptoms are more lasting than in the normal person.'

BODY TEMPERATURE, its conservation, mechanism, and the disturbances to which it is subject, is so vital in the whole life process that a lucid and detailed account of it by a thoroughly qualified authority should be welcome. Such an account is to be found in the first Lettsomian Lecture of 1934, delivered before the Medical Society of London by Dr. C. E. Lakin, a Fellow of the Royal College of Physicians and the Royal College of Surgeons. Under the heading, 'Combustion and Heat Production: Some Elementary Considerations,' the British medical journal called the *Lancet* thus reports

Dr. Lakin's admirably clear presentation of basic physiological facts:—

'When a candle burns in an enclosed space occupied by air, the air loses some of its oxygen, becomes richer in water vapor and carbon dioxide, and also becomes hotter. This latter fact is simply an example of the universal law that no change, chemical or physical, can take place without energy being either absorbed or liberated in the process. In the example we have chosen, energy is set free in the form of light and heat. Even when iron rusts, a little heat is produced, but so slowly that it is dissipated before it can heat the iron. Similarly, when we breathe in air, the oxygen is taken up by the hæmoglobin of the blood and carried to the tissues where the oxygen joins with the protoplasm of the tissue cells, with the result that the heat accompanying this chemical change is sufficient to keep our bodies warm even on a cold day.

'To continue the comparison, the air we breathe out is warmer and more moist and contains less oxygen and more carbon dioxide than the air we breathe in. If this were all that happened, the cell protoplasm would soon become deprived of its carbon, but there is a constant supply of fuel in the form of carbon compounds arriving from the alimentary tract. The complex molecules contained in food are broken down in the process of digestion into simpler constituents, which, after absorption, are built up into the protoplasm of cells: where, again by a process of oxidation [burning], they provide a constant supply of heat and energy. This cellular activity we speak of as metabolism. In states of heightened metabolism more heat is produced, while in conditions of lowered metabolism the production of heat is lessened. The functional activity of the thyroid and adrenal glands plays a further part in influencing metabolism and heat regulation. It may be said that energy is used up every time a muscular action is performed, every time the stomach digests or the brain thinks.'

BECOMING MORE SPECIFIC, Dr. Lakin discusses the heat and energy producing capacities of different parts of the human body. He cites Dr. Pembrey's figures showing that, of a total of about 1,700 kilogram calories of heat produced daily by an average male adult in repose, the distribution works out as follows; from the heart, 70 calories; respiratory (breathing) muscles, 150 calories; liver, 368 calories; kidneys, 74 calories. Remaining over are about 1,000 calories, and these are inferred to be produced almost entirely in the major network of skeletal muscles. But, although the muscles appear to be responsible for the largest absolute quantity of heat (and energy), relatively to their weight they are much less active as heat producers than, for example, the glands, which make up only about 4 per cent of the body's weight yet play so vital a rôle in maintaining what Professor W. B. Cannon has called the *homeostasis* (balance) of the body processes. As for the factor of 'efficiency' (the amount of heat actually transformed into useful work) Dr. Lakin states 'that about 5 per cent of the total heat loss is expended in warming the food and inspired air, about 15 per cent in the evaporation of water and carbon dioxide in the respiration, and about 80 per cent by radiation and convection and the evaporation of sweat from the skin' (compare this last figure with what has been said above on hay fever). As a result of all these technical heat losses it would appear that a man doing only a moderate amount of work has available for this work only about one-twentieth, or five per cent, of his total metabolic energy on a daily basis.

THE PROBLEM, 'Is energy consumed in mental effort?'—as contrasted with physiological effort—has recently been thoroughly canvassed by Dr. Francis G. Benedict and Mrs. Benedict. Dr. Benedict, one of America's best known and most competent authorities on physiology, is director of the Nutrition Laboratories

of the Carnegie Institution of Washington, under whose auspices he has conducted many notable researches. In an experimental study on 'Energy Consumption in Physical and Mental Effort' the Benedicts have reached the rather surprising conclusion that 'mental effort, *per se*, is without significant influence upon the energy metabolism' of the human machine. It is important that this statement be correctly understood in order to avoid the further—and quite unscientific—conclusion that there is any form of effort (in this case mental) that can be effected without the expenditure of energy, however slight. What the Benedicts set out to do was to determine, on the basis of carefully controlled metabolic experiments, what effects mental effort had upon the heart rate, respiration, oxygen and carbon dioxide factors, and general heat production. Seven subjects, one a woman, were tested in each of three states: awake but mentally vacuous; with reasonable mental attention; and during sustained, intense mental effort. The Benedicts thus summarize their results:—

'From a consideration of the various factors measured in our investigation it is concluded that sustained, intense mental effort causes an increase in heart rate; an insignificant, hardly measurable increase in respiration rate; a marked alteration in the character of the respiration; a considerable increase in the apparent total ventilation of the lungs; a small increase in the carbon dioxide exhalation; a smaller increase (on the average, 4 per cent) in the oxygen consumption and heat production; and a slight increase in the apparent respiratory quotient.'

Bear in mind that all of the above changes are physico-chemical in nature and as such testify to very definite energy transformations initiated by sustained mental effort. The fact that these changes express themselves through physiological processes, however slight and insignificant in themselves, and that they are often followed by what the Benedicts describe as an 'almost overpowering fatigue in both mind and body following sustained intellectual activity' simply demonstrates that, in respect to work performed, the brain is as definitely an energy-consuming device as are the muscles, glands, stomach, or the nerves. What we do not yet understand (Dr. and Mrs. Benedict are quite clear about this) is how the brain can accomplish so much 'activity' with so little measurable an effect upon the general metabolic processes of the entire body. The fact that the energy content of half a peanut, or a gram of cane sugar, or 1½ grams of white bread, or in 4 grams of a banana is sufficient to provide the brain with driving power for 30 minutes is remarkable enough. The more significant fact is that even this minute amount of energy will carry no further than half an hour, unless the effort be slowed down meanwhile.

FURTHER DATA on the influence of climate over health (discussed last month in this department) was presented by Professor C. A. Mills before the American Medical Association meeting in Philadelphia. Professor Mills has shown that, of every 100 cases of acute appendicitis handled in hospitals, the fatality rate is almost twice as high in the South as in the North, due primarily to the lowered resistance caused by moist heat. Similar climatic correlations are believed to prevail in acute nephritis, tuberculosis, colds, and certain kidney troubles. The answer—as Professor Mills suggests—is to install proper air-conditioning plants in hospitals and sanatoria, with further provision for the control of atmospheric pressure in such cases as it would benefit. Assuming that all these changes are made (and they would be very costly), there would still remain—as Dr. McKinley pointed out—the 'factor of nutrition' and of general economic security. Against these the medical profession, working alone, is helpless.

—HAROLD WARD

AS OTHERS SEE US

Canada Takes Over the U. S. A.

COLONEL SIR THOMAS A. POLSON, K.B.E., C.M.G., has contributed a brief essay in historical prophecy to the *Saturday Review* of London entitled 'Why Canada Leads the Americas.' With the full weight of a retired British cavalry officer, he ridicules the idea that the United States will ever annex Canada but prophesies instead the possibility that Canada will have to take over the U. S. A. Here are his concluding paragraphs:—

How right was Bismarck when he insisted that only by consideration of the 'imponderables' could future events be foreseen and advantage wrested for one's own country. To many, balanced against the solid weight of bar gold, the sense of nationality and of tradition may seem an 'imponderable' indeed; yet it was this sense alone that made Marathon famous and glorified the manhood of Albert, King of the Belgians. And it is this sense that is the strength of the Dominions of the British Empire. The old European countries were welded into nations by common dangers and by warfare long withstood; the new countries, lacking the pressure, cannot attain the cohesion. For the United States, the lack is probably permanent, but the Imperial Dominions have inherited national sense, and the links of Empire have nurtured it, while the new lands have, at the same time, bestowed upon them a new, strong freedom.

It is not the fate of Canada with her slower, deeper growth to 'go up like the rocket and come down like the stick.' She has no negro problem, nor has one of *her* cities become a byword throughout the world. Toronto and Montreal cannot claim the fame (?) of Chicago or the political scandals of New York. Instead of these, Canada possesses in her eastern provinces a sturdy, rooted population of men to whom the ancient virtues of *civitas* are not unknown. Her history has not been, like that of her neighbor, simply a long series of 'booms' and 'depressions' with their resultant social instability, and her vast natural wealth has even yet been but partially explored.

The ultimate fate of the United States has yet to be outlined, but that which is looser and less stable cannot absorb that which is rooted and has permanency and lacks not one whit of the former's material power. Were a reverse of such a situation suggested, it would be less surprising; and England's daughters may well inherit the mother country's capacity for surprise, last-minute, but enduring, triumphs.

Laski on Sinclair

HAROLD LASKI has recently devoted one of his weekly 'Pen Portraits' in the *Daily Herald* of London to a sketch of Upton Sinclair, to whom he pays tribute as the Democratic candidate for governor of California:—

Heaven knows that he has grave faults. He is vain, he is theatrical, he is quarrelsome. He fights wildly sometimes. He tends to think that an honest critic is a dubious enemy. He is something of an artist in attitudes; he tends to live his private emotions in public. There is a real sense in which he is still, in late middle age, the playboy of the western world of journalism. He tends to confuse his private autobiography with historic events.

When all this is said, the American people owe him a very great debt. It is impossible not to respect his courage. It is