The Popular Lecture ON THE PHYSICIAN: NATURALIST, TEACHER, BENEFACTOR.

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BY

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SOME years ago at a dinner in this city I was called upon to propose the health of a distinguished company of physicians, and in doing so I recalled an incident that happened long ago during one of my early expeditions in South America. I had arrived in the country of a tribe of primitive red men and was engaged in the preliminary work of getting our relations on a satisfactory basis. One day I found myself traversing one of the great swamps of the region alone with one of the most potent members of the tribe. We arrived at a particular spot, and he indicated that he would fish: he bent the swamp vegetation out of the way so as to make a little clear pool a foot or two in diameter; then he baited his hook and patiently waited for the fish to nose their way into the pool through the surrounding vegetation. There we remained for an hour or two in silence, he from time to time pulling out a fish, while each of us regarded critically the other, sizing one another up, as the slang expression has it. And as we communed together—that naked red-skinned savage and I, a callow graduate of Cambridge—there gradually crept across my mind the thought that there beside me was a fossil man—a living fossil—the medicine man of the tribe, the evolutionary ancestor of our two professions, that of the naturalist and that of the physician, and of the priest by the way as well.

That after-dinner speech had—as perhaps most of my after-dinner speeches have not—a good effect, for one of the subsequent speakers made known to me that charming and scholarly address entitled, "The Physician as Naturalist," delivered by Sir William Gairdner when President of the British Medical Association in 1888. Indirectly, too, it was the cause, when I had the honour of being invited to deliver to-night's lecture, of my choice of title.

What I propose to do, then, is to glance at the physician in his rôle as a citizen of our community and to say something about three different aspects of him and his work—that of the naturalist, that of the teacher, and that of the benefactor.

THE PHYSICIAN AS NATURALIST.

The professional biologist or naturalist (I use the two words as synonyms) has necessarily a strong fellow-feeling with those who follow the profession of medicine, for in these days it is generally recognized—with every year it becomes more definitely recognized—that medicine is a branch of applied biology. The profession of medicine is the one great learned profession in which it is officially recognized that a training in the elements of biology, and an elementary knowledge of the methods and principles of that science, must lie at the foundation of professional training if that foundation is to be well and truly laid. And it is extraordinarily fascinating to watch the evolution of medical science, and see how more and more its problems become recognized as problems of natural history.

Take the general mechanism of the body. We see it in its simplest form away down in the protozoa of freshwater pools—single cells leading a solitary existence, or it may be attached to one another in little groups that blunder about in their watery environment. As evolution proceeds, bigger and bigger groups of these cells remain attached together, but as the cell community increases in size its movements become more precise, its activities more definite: it develops more and more strongly an individuality of its own. It evolves at length into one of these marvellous cell communities exemplified by the body of one of the more complex animals, such as a butterfly, a bird, or a man.

How does such an individual compare with the simple protozoan individual? In the first place, it is composed of an enormously greater number of cell individuals. In the second place, these cell individuals are no longer all alike; they have become specialized for different functions—some to form a rigid supporting skeleton, some to form muscles to move the parts of the skeleton on one another and so to

bring about movements of the body as a whole, some to absorb food or oxygen, or to get rid of poisonous waste materials. In the third place, the enormously increased size of the cell community renders it necessary to have a special co-ordinating mechanism to knit the whole together into a coherent individuality—the nervous system. And, lastly, there is a point which is very usually overlooked—the primitive protozoan was aquatic; its surface was bathed directly by the water in which it lived. I said water, but of course it is not water in the precise chemical sense of the word. Water—pure water—is a substance which no one has ever seen: If it could be produced it would not remain for an instant of time: other substances instantly dissolve in it. If it falls as a drop of rain the gases of the atmosphere pass into it; if it trickles on the ground it dissolves other material as it goes. What we call water, then, in ordinary life is really a dilute watery solution of many different substances.

Now, as the animal body has proceeded along its evolutionary path, the majority of the cells composing it have become shut away from the external medium; it may be, as in the case of the butterfly or the man, that that external medium is no longer water but air. But yet we find that the cells of the body are still leading their ancient aquatic existence, for the body has enclosed within it a certain amount of water—what was called the internal medium by the great French physiologist Claude Bernard—and this bathes the surface of every constituent cell. The ancestral watery pool was affected in composition by its living inhabitants, the more so the more crowded they were; they absorbed from the water oxygen and food material, while, on the other hand, they discharged into it the various waste products of their bodies, both food material and waste products being liable to differ according to the particular type of creature. And so also with the internal medium of the body. It bathes the surface of the myriad members of the cell community. Each takes from it the food that it needs for its special activities; each discharges into it the particular waste substances which happen to be the product of its own peculiar activities.

It follows, then, that the internal medium of the body is a fluid of extreme, although ordered, complexity, and the cell individuals are adapted to live in a medium of this particular complexity, just as one animal is adapted to live in fresh water and another in salt. The composition does not remain absolutely without change—nothing does in the living body—it is liable to alteration from time to time, as one or other type of its cell inhabitants is more or less active in what it discharges into it or takes away from it. And these little fluctuations in the composition of the internal medium are actually made use of in the normal activities of the body: they set going the appropriate reactions of the body necessary to meet the ordinary contingencies of life—for example, if the proportion of carbon dioxide becomes increased by ever so little it at once serves as a danger signal to the respiratory centre in the brain, and this instantly causes the breathing movements to be accelerated; or again, a little change in composition which normally follows the taking in of food at once brings about formation of the necessary digestive juices. While the reactions to these commonly occurring little changes in the composition of the internal medium form part of the ordinary life of the individual it is otherwise when changes of greater amplitude occur. Then uncomfortable, and it may be disastrous, effects are produced on the cell inhabitants, and the condition becomes pathological in place of physiological; it may be that all members of the cell community alike are affected, but more usually the ill effect will vary in different parts or different tissues of the body, according as the particular set of cell individuals is more or less exposed to the influence of the internal medium, or, on the other hand, more or less sensitive to the particular change that has taken place.

The modern physician, however, has come to be interested not merely in the natural history of the body of man in itself. He has been given cause to interest himself in the biological relations of man with the other living organisms of the world around him, for these relations affect in the most intimate way the health of mankind. How better could I illustrate this than by the familiar case of malaria? Reckoned in its direct and indirect effects the most destructive of all diseases, it has been estimated to cause one-half of the entire mortality of the human race. It is only a comparatively few years ago that the method to be adopted to combat malaria formed one of the most insistent problems confronting medical science.

I had the curiosity to look up the article "Malaria" in the ninth edition of the *Encyclopædia Britannica* to refresh my

memory as to how this problem was regarded in the days immediately preceding the time when it found its solution as a problem of natural history, and this is what I read:

"The most prevalent hypothesis of malaria is that it is a specific poison generated in the soil. Perhaps not every soil is capable, under circumstances, of causing malaria, but it is difficult to assign limits to its potential presence. There are seemingly well-authenticated cases of malarial disease appearing during the making of railway cuttings, canals, and other excavations, in places where malaria had not previously been known; and there is sufficient evidence that malaria has appeared in the track of cultivation in the Western States of America, and that it follows the upturning of virgin soil, and even of soil that has been long fallow. Attempts have been made, without success, to separate a malarious poison from the gas generated by swamps, or from the air of malarious localities. Still more attempts have been made to discover the hypothetical poison among the numerous minute vegetable organisms that occur in the soil. . . . Another hypothesis is that malaria is a 'telluric intoxication,' generated by the vegetative power of the soil when that power is not duly exhausted by plant growth. Lastly, there is an hypothesis that malarial fevers are caused by the excessive and sudden abstraction of heat from the body under the influence of cold and damp. . . ."

Does it not seem *incredible* that these words fairly represent the views regarding the malaria problem that were current as late as the "eighties" and "nineties"—blind gropings without a suspicion as to the true solution?

How different to day: the problem solved in almost every detail—so that there is no disease which medical science can combat more effectively than malaria. And how has all this come about? Because the malaria problem came to be tackled as a problem in natural history. As you all know, it turns out that malaria is a possession not of man alone, but of a dual partnership—man and a particular type of mosquito. Man catches the disease from the mosquito: the mosquito catches it from man. If man were exterminated in a particular locality it would conduce to the health of the local mosquitoes: they could no longer catch malaria. If, on the other hand, the anopheline mosquitoes were exterminated from a particular locality, then the human inhabitants could no longer catch malaria. In the solution of the details of the problem many workers were concerned, but the all-important part—the demonstration of the relationship between the malaria type of microbe and the mosquito—was the work of our own countryman Ronald Ross, and it was that demonstration that pointed the way to the anti-mosquito campaigns by which Ross and his followers have been able to diminish, or even to clear out entirely, malarial disease in many of the most deadly spots in the warmer regions of the world.

I have mentioned malaria because it affords an extraordinarily striking case of a medical problem finding its solution along the lines of natural history. There are many other cases similar in nature, though less impressive in the scale of size. To us in Scotland naturally occur in this connexion the names of David Bruce and William Leishman, and of their younger followers such as Leiper and Muriel Robertson.

Instead of taking the case of a specific disease like malaria I might very well have taken some of the more general processes of the body in which medicine interests itself, such as, for example, the general protective mechanism of the body against microbes. As we have seen, the body consists of a cell community or cell republic. Its constituent cells are protected from the assaults of alien and hostile cells by their enclosure within an elaborate defensive envelope, the skin. Certain types of microbe, however, possess the power of making their way through the skin, while in any case the skin is liable to be breached by accident, the way being thus opened to hostile invasion.

It follows, then, that the cell republic of the body requires internal defensive arrangements to deal with invaders that have passed the outer defences, and the investigation of these defensive arrangements admittedly constitutes one of the most important chapters in modern medicine, associated as it has been with immensely important practical developments in the science of healing. But they also constitute one of the most fascinating chapters in modern biology, and perhaps the name to which posterity will accord the highest position in the history of these developments is that of a professional zoologist, Metchnikoff. In his early days Metchnikoff had worked at the embryology of a great variety of the lower types of animal and published a large mass of important embryological work.

In various of these simply organized creatures, on which Metchnikoff worked, he came across a phenomenon which we

still call by his name, phagocytosis, and the recognition of this constituted one of the chief steps in his work on the defensive mechanism. This phagocytosis is really a primitive kind of feeding on the part of the individual cell. If you watch the simplest and most primitive of the protozoa—the creature called Amoeba, which is to be found creeping about in freshwater pools—you can sometimes see it feed. The soft protoplasm of its body simply flows round and engulfs the smaller creature which it devours. It may be that it is subsisting on these tiny plant cells which we call bacteria. These individually are too minute and too little resistant to be engulfed singly in the ordinary way, but a peculiar waste substance given out by the amoeba's body possesses the remarkable property of causing the bacteria to adhere together into a sticky mass which the amoeba is then able to devour in the ordinary way. The bacteria so taken in are destroyed (digested) within the protoplasm of the amoeba: a case of what is called intracellular digestion—digestion taking place within the protoplasm of an individual cell. Metchnikoff's great discovery was that certain of the cells in animals higher in the scale than protozoa retain this ancient power of intracellular digestion. These are the cells to which he gave the name phagocytes; and these phagocytes he found constituted an effective defence force in the animal body. He introduced little foreign particles into the body of a young starfish and saw how they were devoured and disposed of by the phagocytes; he studied a fungus disease which affected water fleas, and was able to see, as he watched the transparent body of the water-flea through his microscope, how the spores of the fungus which had found an entrance to the body were fallen upon and usually destroyed by the defence force of phagocytes. It would be fascinating to trace out how Metchnikoff proceeded from his basic studies on these lowly organized creatures into the domain of human pathology, but it will perhaps suffice if I say that this great figure in the history of modern medicine, whose foundation work was pure zoology, continued to the end of his days to be a naturalist in his methods and in his outlook.

But it is not merely these great outstanding figures in medicine, when they are tackling its outstanding problems, that show themselves to be naturalists. In the familiar problems of his everyday life the physician finds himself confronted at every turn with problems of natural history, and in grappling with them he uses at every step those methods of observation that are those of the naturalist. He remains, in fact, throughout his working life a naturalist.

THE PHYSICIAN AS TEACHER.

The physician of to-day is, then, like his far back forbear amongst primitive man, a naturalist. The point that I would next make is that in a human community like ours this fact confers upon the physician peculiar power and peculiar responsibility as a teacher. The physicians of to-day constitute the one big section of our citizens who, through their training and their daily work, have acquired a grasp of biological principles. To them, as to no others, falls the task of spreading these principles among their fellow citizens.

Human communities are organisms. Here and there, in remote and secluded corners, you may find them lingering on in early stages of their evolutionary progress—each little nomad company composed of only a few unspecialized individuals who readily dissolve partnership under the stress of circumstance. While still lingering on here and there in remote spots, where they are free from the pressure of competition, these little primitive communities are on the verge of disappearance. As time goes on they vanish away, often without leaving a trace behind, yielding their place to other communities that have reached a higher grade of evolution.

What, now, are the distinguishing characteristics of these more successful communities? They are precisely the same as those that characterize the more successful, or as we human beings usually call them the higher, types of animal organism. The community is composed of an enormously greater number of individuals, and these are not all alike but have undergone specialization for different functions in the community, and finally the individuals are knit together by a highly evolved social organization, so that the community is able itself to act as an immensely powerful individual of a higher order.

This organization that knits the individuals of the community together and that plays such an important part in rendering the community efficient is naturally exceedingly

complex and involves many potent though often elusive factors which work beneath the surface of our civilized society: factors which make for the smooth running and efficiency of the social mechanism; factors which have to be appreciated and fostered by the teacher of good citizenship; factors such as self-abnegation—the subordination of the interests of self to those of the community, patriotism, loyalty to comrades, Christianity.

Now the physician, naturalist, in daily touch with living processes, spending his life in the study and treatment of live human beings, knowing so well their frailty and their strength, an optimist, realizing how infinitely commoner is warm-heartedness than cold-bloodedness: *who* is there that can teach these principles of citizenship with such understanding and sympathy as he? And *who*, again, is in the position of making his teaching so effective as the physician? Coming into each house on his errand of mercy he necessarily establishes relations of such humanness and such intimacy as to give his words unparalleled power. In these days of unrest, when the air is filled with the discordant street cries of every kind of fad-monger, do we not greatly need the physician as teacher?

No one who interests himself practically in social problems can fail to realize to what an extent social trouble and friction are due simply to ignorance. The uneducated mind that is blank and yet receptive stands ready to absorb unquestioningly whatever is put before it. But, most unfortunately, the only members of the community that as a rule put anything before it are the extremists. Sometimes these extremists are inspired simply by evil and greed, but far more often—and these are the more dangerous—they are inspired by perfectly honest but lop-sided idealism. They use the simple arts of the demagogue; above all, the classification of their fellow men into sharply demarcated categories. Most usually these are only two in number. They may call them the saved and the damned, or they may use some other pair of adjectives nearly as sweeping; but whatever the pair of adjectives are, they connote respectively agreement and disagreement with the speaker. Those included in the one category are wholly good, those in the other category are wholly evil, and anything in the way of fair and calm judgement is rendered completely impossible.

The physician is eminently qualified to diffuse an atmosphere of sane common sense into the troubled discussion of social problems; his whole work conduces to sanity and common sense. He is accustomed to judge humanity unclothed. He is accustomed to strip off the clothing of humbug and pretence. His interests are with the real man himself, and he has learned that, apart from sex, Nature does *not* group human beings into absolute categories. He sees his fellow men all fundamentally alike with infinitely varying little differences in detail; he sees through all the same dominating strain of goodness, the same disturbing little elements of evil. Realizing always that men are human he appreciates what a factor in social trouble is the regarding them as so many soulless machines. His constant intercourse with men when they are in trouble makes him kindly and tolerant; at every step he is in touch with phenomena that he cannot comprehend—how much there is even in the simplest living body that no man understands!—and this makes for humility of spirit.

The physician has, then, in a community like ours, vast powers as a teacher of these principles that mean so much to communal society. He can do much by spreading these principles and also by spreading knowledge of what is really meant by science and the scientific method. He has these powers, and I for one believe that he is constantly, even if unconsciously, exercising them. He may not do ten minutes' formal teaching during his whole life, and yet as he goes about his daily work he is insensibly diffusing around him an appreciation of these principles and these interests. The great majority of our fellow citizens are steeped in the most profound ignorance of what these terms mean, and the result is incalculable loss to the community in all kinds of ways.

THE PHYSICIAN AS BENEFACTOR.

In ordinary life we are familiar with the benefits we owe to our medical man. He comes in and helps us in emergency. We pay him his fee, and to many a man that ends the matter. He does not feel constrained to be grateful; he feels he has bought the assistance that has been given him; he has paid for the advice and help of his doctor as he might pay for some material commodity or as he might pay for expert help in any skilled operation, such as a bit of

engineering work. But what he is apt to ignore is that in the big things of medicine the monetary payment bears no relation whatever to the value received. If I am at death's door and am saved by an operation the fee that I pay is simply an honorarium graduated according to my means; it in no sense expresses the value of the life that has been given back to me. If I had to assess that value I should probably mention some figure of a totally different order; I might be willing to pledge all my future earnings in return for continued life.

I think we laymen are apt, as individuals, to forget this aspect of medicine—but how much more do we as a community consistently forget it! Just think of the value to the community of the work of a great pioneer in medicine. I will mention two because they happen to appeal to me particularly.

Lister.

Twenty-five years or so ago I had to read a paper of mine to a scientific society. The society was the Royal Society, and in the presidential chair there sat a man who, to my young, impressionable eye conveyed the impression not so much of overpowering greatness as rather of infinite kindness and goodness. There was no oppressive sense of vast knowledge; there was rather the humility of the man conscious of his contact with the infinite unknown. That man had been once a professor in the University of Glasgow. Thirty years before he had been responsible for what is probably the greatest event of world history that has ever happened in Glasgow. He worked in the Royal Infirmary, and there—his big mind able to grasp the practical possibilities that rested on the work of Pasteur—he laid the foundations and erected the main framework of the magnificent edifice of modern aseptic surgery. Most of us here, I dare say, know that grimy old building in which Lister worked—that priceless possession of the Glasgow Medical School, that sacred shrine to which in future ages pilgrims will come from the ends of the civilized earth.

What mankind owes to aseptic surgery can be realized vividly by anyone who cares to read of the horrors of hospital wards in pre-Listerian days. In the hospitals of London, Edinburgh, and Glasgow the death rate of amputation cases averaged about 40 per cent. During the Franco-Prussian war of 1870-71 there were slightly over 13,000 amputations recorded by the French military authorities; of these cases just over 10,000 died. One of the most skilful Prussian surgeons records an unbroken series of thirty-six amputations at the knee-joint, each one resulting in death. In the Munich State Hospital it is recorded that in the year 1874 80 per cent. of all the surgical cases were either killed or badly crippled by hospital gangrene.

However, it is hardly necessary to refer to these old records, for I suppose we may take it that to-day every educated man or woman realizes in a general way what the development of aseptic surgery has meant; most people probably realize that the total destruction of human life in the great war becomes almost insignificant when compared with the total saving of human life which we owe to aseptic surgery. I will therefore not dwell longer on Lister's work: I will pass on and give an example of benefit rendered to mankind from the other side of medical science. I cannot do better than take as my example the case of the mosquito-borne diseases, the successful combating of which we owe above all to Ross.

Ross.

Earlier in the lecture I referred to malaria as being declared by competent authorities to be the most destructive to human life of all known diseases. The malaria death rate in the United States was estimated as late as the year 1908 at about 12,000; the annual economic loss due to it as not less than twenty million pounds.

Now what has been the result of the Ross treatment where it has been applied? In the Panama zone the malarial death rate in 1881 was reckoned at over 2 per cent. of the population; in 1911 it had been reduced by the anti-mosquito campaign to less than 1 per thousand. A particularly interesting case is that of Ismailia. In this town, surrounded by arid desert, there was no malaria until the year 1877, when it was introduced by infected immigrants. In 1900 there were no less than 2,284 cases. Ross himself went out to supervise an anti-mosquito campaign, and the disease was completely eliminated so far as fresh infections were concerned. The general position now is that within any restricted area malaria can be completely controlled. Scattered all over the warmer parts of the world are localities that up to twenty

years ago were deadly to the white man from the prevalence of malaria and in which now the disease has either been completely abolished or reduced to such infrequency as to become practically negligible.

But malaria is not the only one of these mosquito-borne diseases. Yellow fever is another. From time to time this disease used to make its appearance in epidemic form and do dreadful damage. The epidemic of 1821 in Barcelona cost 5 000 lives; that of 1850 in Rio cost 4,160; that of 1853 in New Orleans cost 7,970; that of 1857 in Lisbon cost over 6,000. In Brazil during a period of thirteen years the deaths caused by yellow fever were estimated at 28,078; but in the single year 1899 that country lost 35,557. It was this disease which was the most terrible enemy of the French engineers at Panama; it was impossible to estimate the total number of deaths, but the scale of loss may be imagined from such a simple fact as that "in one ship eighteen young French engineers came over and in a month after their arrival they were all dead except one" (Howard).

Now what was the result of anti-mosquito measures? In New Orleans epidemics occurred in 1853 with 7,970 deaths; in 1858 with 4,854, in 1867 with 3,093, in 1878 with 4,056. Again in July, 1905, an epidemic made its appearance, and by August 12th there were 105 cases. This time, however, anti-mosquito measures were adopted, though no doubt far less efficiently carried out than they would be to-day, and the total number of deaths was kept down to less than 500. In the Panama Canal zone after the Americans had taken it over Gorgas was able to report in 1908 that as a consequence of the anti-mosquito work not a single case of yellow fever had developed during the preceding three years.

I am well aware that to some of my audience to-night these facts that I have been quoting are all well known—they are bits of an old familiar story; why, then, should I take up your time with them? It is because I think they require driving home into the minds of the lay public, not once but again and again and again. If I had my way there would not be a child in this country allowed to emerge from his school days without facts like these being drilled into his ears until they form a permanent part of his mental equipment.

Would it not, indeed, be an immense step forward in our educational methods if we could replace what at present forms so much of the teaching of history in our schools—the more or less legendary tales of the doings of long dead kings and chiefs—by the kind of history that really matters, the history of the intellectual achievement that marks off civilized man from savage? There are no tales more fascinating, more calculated to grip the interest and the imagination, than the stories of how some of the great advances in human knowledge have been made; the stories of how the heroes of science have carried on towards their goal, undeterred by failure and discouragement, it may be in circumstances of great personal discomfort and danger. The advantage that would accrue to science is, of course, obvious: with greater knowledge would come a fuller appreciation on the part of the public of what science really means, and the whole attitude of the community towards science and its encouragement would become entirely changed.

But would there not come also an immense gain to the individual himself? Could he possibly avoid being ennobled and made into a better citizen by being brought into contact with the lives of those who have toiled and fought, not for personal glory or wealth or power, but only for truth and for the good of their fellow men?

However, my purpose just now is not to make out a case for modifying the school curriculum so as to include these chapters of what I regard as *real* history. It is rather to continue to urge the less lofty, but in a commercial age necessary, argument, that the great pioneers in medicine have conveyed to mankind possessions of untold *material* value. What exactly that material value is can, of course, never be gauged. Our vision is limited. We see only what is close at hand. And our vision lasts only during the instant of our own lives. But still can we not in imagination project our minds back during these last few decades and on into the unbounded future, and become at least dimly aware of these unnumbered invisible hosts whose individual debts are their lives, or at the least their working efficiency? Suppose we had never received the benefaction of aseptic surgery. Suppose we transport ourselves back in imagination to the days of pre-Listerian horror. And suppose that by some supernatural means we became aware of aseptic surgery existing in another planet and of all that it meant—and that it was

available to mankind for purchase after a fair valuation. What would a fair price be—a million pounds, a hundred million, a thousand million? I wonder. Is not any one of these sums obviously ridiculous?

No, the price of each one of these great benefactions of medicine is beyond all the rubies of the world. It is a price that can never be paid, that can never even be fairly assessed. But the benefaction is there: it is ours: and surely it is right that we should occasionally allow our minds to dwell for a little in very reverent gratitude upon the Physician as Benefactor.

I have finished. What I have said this evening hardly merits the title of lecture. It is little more than a group of headings: The Physician as Naturalist; The Physician as Teacher; The Physician as Benefactor. But if you will bear these titles in your memory they may at least serve as pegs upon which to hang future thoughts. And even a clumsily fashioned peg is sometimes sufficient to support a rare and wonderful work.

NINETIETH ANNUAL MEETING

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PROCEEDINGS OF SECTIONS.

SECTION OF MEDICAL SOCIOLOGY.

E. ROWLAND FOTHERGILL, M.B., B.S., President.

DISCUSSION ON ALCOHOL AS A BEVERAGE AND ITS RELATION TO CERTAIN SOCIAL PROBLEMS.

(Continued from page 207.)

ALCOHOL AND INDUSTRIAL EFFICIENCY.

BY

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In some introductory passages Professor Collis stated that he accepted the definition of alcohol set forth by the expert committee¹ appointed during the war by the Central Control Board (Liquor Traffic)—namely, that alcohol is used to mean ethylic alcohol C_2H_5OH , prepared by the fermenting action of yeast upon sugar. This is the basis of all alcoholic liquors, whether the beverage is consumed immediately after fermentation or at some later period, or whether, as in the case of brandy, whisky, gin, or rum, the spirit is subsequently distilled. Preliminary considerations might be summarized in the statement that alcohol is a substance which can supply the body with a limited amount of easily assimilated energy, but is a narcotic drug or intoxicant capable, if the dose be pushed, of acting as a poison. Alcoholic beverages have a pleasant taste and may be consumed convivially or industrially, but industrial drinking is seldom found dissociated from convivial. When consumed in high concentration the drug effects of alcohol are most pronounced.²

"Industry" is a word generally applied only to physical work connected with some particular form or branch of productive labour, or with some trade or manufacture. Productive labour and manufactures represent man's effort to modify his environment to his needs. Efficiency in industry means the carrying on of this productive labour with a minimum expenditure of energy, whether that energy be physical or mental, or be represented by wages paid to the workers for expending energy or by money expended on raw material or on necessary plant. Industrial efficiency is adversely affected if the return for wages paid is inadequate; if raw material is spoilt during manipulation; or if the plant is not tended so that it works to best advantage.

The subject for discussion, then, is whether the consumption of alcohol exerts any influence, and if so in what direction, upon these matters; we have also to distinguish between convivial and industrial drinking.