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THE DUTY OF SCIENTIFIC SOCIETIES TO AID IN
PRACTICAL SANITARY WORK.

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Gentlemen: I suppose that I owe the honor of an invitation to read a paper "upon some topic of sanitary science" on this occasion to the fact of an official position as secretary of the State Board of Health. I feel the less hesitation in accepting because it is to address a body of gentlemen from various departments of thought and work, associated together in the common study of man and his surroundings from the standpoint of science.

Students in science have to learn very early that their individual efforts, and often their united work, is slow in yielding what the average citizen understands to be "practical" results. It is natural to be impatient of the tedious collection and collation of facts which must precede the attempt to deduce principles of action. So true is this that very much of the best and highest scientific work is, in the popular sense, fruitless and apparently objectless. As you know, such real effort

is sustained by a faith—at times the highest scientific exercise of that faculty—that honest, conscientious work always results in good, though the worker may not, at the time, see just how it can do so, or what the result may be.

The true scientific faith is an humble one, well stated by a worker of our early time, Dr. Benjamin West. "There are," says he, "mites in science as in charity, and the ultimate results of each are often alike important and valuable."

It is given to but very few to contribute to the treasure-chest of practical science the thousands of her coin, which buy at once great results in the amelioration and advancement of the race. The most striking living example is that of the great Frenchman, Pasteur, whose study of the microscopic "*materies morbi*" has developed, at last, a method of extending the principle of vaccination to other diseases than small pox, and opened a field of vast extent and great importance for this hitherto unfruitful study.

To the vast majority of workers, however, it is permitted only to earn isolated facts—the mites—the least of scientific coin. But it is a consolation, that any one result of such honest, single-hearted effort is adding to the valuable treasure which science, through her myriad workers, is accumulating, not as a miser accumulates and hoards, but to be royally spent again in making life longer and happier; more productive and valuable to every man, woman and child of the race. You can find no more striking illustration of this than the history of sanitary science in the last half century, and, in fact, since the time when the father of medicine first laid down the great truth that it is better and wiser to prevent disease than to cure it.

I need but refer, before this audience, to the practical work already done by the public and private use of hygiene as a help to better living and more efficient doing by "all sorts and conditions of men." But to form any just idea of its

real claims, they must be regarded in its two divisions, as a science and as an art; for it suffers, as do other departments of knowledge, from a very common popular confusion of these two sections of the subject to which it relates. Such confusion is unjust, and so bewildering to the average intelligence as seriously to impede progress in any direction.

The distinction between the science and art of public health, for example, involves two entirely different conceptions of the subject. The science is always far in advance of the art. All other sciences contribute their quota to its needs. Its end is the art of preserving health and preventing disease. That art is as yet far from what it might and ought to be. At present, for example, it is such use of the science as is determined by act of legislature or by the knowledge, skill, and disposition, of the members of the body empowered to execute the law. In the opinion of the average citizen existing legislation covers the necessities of the case, while to the student of the subject or to the active health officer, it is evident that legislation and health boards are alone incapable of bringing public health as an art, up to the full exercise of the functions which, as a science, it demands.

Then, too, social forces, may aid or impede sanitary work. It is a trite saying that many a good law is for lack of their support, a dead letter in the statute book; and as respects hygiene, public and private, their influence is a real and important fact.

Probably no one who hears me to-night will dispute the statement that the whole class of zymotic diseases (small-pox, diphtheria, scarlet fever, typhoid fever and the like,) may, by thorough sanitary work, be practically driven from a community, i. e. their number and fatality be reduced to the level of what are known as non-infectious diseases, and even below many of them.

It is now as disgraceful for a city to suffer an epidemic of

typhoid fever as it used to be to permit an epidemic of small-pox, and one need not be a prophet to foresee that it will be speedily true of other members of the class.

Still it is equally true that the change will come by slow and hesitating advance in professional and popular opinion.

Diphtheria has been almost epidemic in our state for several years. I cannot better illustrate the operation of these social and other forces than by a brief reference to the efforts which have been made, and are now making to stay the progress of that fatal disease.

The law, as you know, provides for the organization of boards of health, not only in cities, but in every township in the state. It confers upon such boards very arbitrary power in dealing with infectious diseases. It requires a report of the action of such boards to the state board of health, and finally, gives to that board powers, in the interest of the people at large, whom it represents.

But despite this authority to act and the abundant necessity for action, it is a fact that there are very few efficient local boards of health in the state. The most persistent efforts of the state board have failed to induce any local board of health to live after the epidemic of small-pox or diphtheria has passed, which called it into life.

It is found that it is only in towns where there is an active medical man as health officer, with well-defined powers, and sufficient compensation, that any steady sanitary progress is made. It is the common experience of physicians that the only disease that, till very lately, would stir a community to its depths, was small-pox, a disease which, thanks to vaccination and revaccination, is now the most easily controlled of all infectious disorders.

As respects diphtheria, which has been and still is, so widespread and fatal, it has been possible in but three or four in-

stances to secure a vigorous execution of the law, and of the dictates of common sense, in an effort so stop it.

In the greater number of infected localities the disease has run its course. It is still very common to find cases, not only in rural districts, but in cities, which are under no public surveillance; where visiting, even of children, is permitted; public exposure of the corpse; even kissing of the dead; and children selected as bearers to carry the infected and infecting body to the burial.

We are not doing what we might easily do to make the art of hygiene correspond to the science, and were it not for the support of a vigorous few of physicians and an increasingly large number of non-professional men and women, the workers in practical hygiene might be discouraged.

The state board of health has issued in pamphlet form the conclusions of science and experience as to the proximate cause, and the best means of prevention of this dreaded disorder, which more nearly resembles in its obstinacy and fatality the black death of the middle age, than any other of our time. Of these circulars we have distributed more than 10,000 by mail and personally. They have been called for by all classes of our population, notably by many anxious mothers. They are printed in the English, German, Norwegian and Swede languages. By articles in the daily and weekly press; by personal visits to centers of pestilence; by the kind and hearty co-operation of many medical men who have helped by pen, tongue and example, no effort has been spared to create a popular demand for organized local effort. Despite these means and others, we have repeatedly failed, even in infected districts, to secure enough combined resistance to offer any obstacle to the plague.

In this struggle with diphtheria, as with small-pox and typhoid fever, we have learned to rely more upon education of the masses and upon active, intelligent men and women than

upon legal measures. These last are necessary and they have been used, but great help has come in other ways. First in the rapidly growing interest of heads of families in the question of sanitation. Much aid has been given here by faithful physicians, who have dared prejudice and misapprehension in the effort to help their clients in the right way. The clergy of the different denominations are awakening to their duty in the matter. In fine the social force of public opinion is working round to the support of systematic hygiene. The state board of health are thoroughly awake to their duty. They will not cease the agitation till diphtheria has been driven outside our borders, nor until the same course is taken with other contagious diseases. I say driven, advisedly, for it is becoming more and more evident that in no other way can it go except to exhaust the stock of young victims, among whom its average mortality is from 25 to 50 per cent.

We have already accumulated, in our own state, a mass of evidence, and it is constantly increasing; enough, one would think, to persuade the most skeptical that believe what they may as to the essentia of disease cause in any of the affections of the so called zymotic class, whether it be vegetable or animal, specific or not specific, its first operation, local or constitutional; whether it spread in the air or water; in clothing, in secretion or excretion; or in any other way, a few plain facts are left beyond dispute. These are, that no so sure bar to its progress or means of its prevention are to be found as those which the science and skill of the earliest and latest time have combined to afford, and which the hygiene of our day is attempting to enforce.

These are simple, as they are efficient. They apply to all diseases suspected of infection. Seclusion for the sick, with quarantine of all things infected, whether living or dead; in addition, the use of disinfectants, of which light and fresh air are the most important. Air of the temperature of 260° F. and

sulphurous acid are the best for clothing, rooms, and the like.

But I beg pardon for so long a digression from what I intended to be the subject-matter of my paper. My excuse is that these very social and other forces whose operation I intended in this way to show, are so powerful for good or for evil; so much superior to mere law and legal constraint as motives to action, that I have learned to seek for every help which can make them instrumental in the work of practical hygiene.

I turn now to certain features of the science of public health, or rather, I should say, to certain work for its furtherance, in which it is very desirable that the aid of scientific men and societies outside boards of health should be secured.

From the stand-point of your association the most interesting work of the sanitarian is, perhaps, that which concerns the study of the microscopic animal and vegetable growths so generally believed to have a direct relation to the causation of ill-health and specific disease. There is certainly not a department of natural science which offers a more inviting field to the microscopist or the student of that mysterious border land between non-living and living matter where the principle of life may possibly begin; where, at any rate, it exists under the simplest conditions, and can, therefore, be studied with the surest prospects of success. It is in this border-land that the microphytes, made up of numerous varieties of the bacteria, are found. In this class reputable observers believe they have discovered the essential cause of yellow fever, ague, cholera, diphtheria and even leprosy. Other competent observers dispute their claims, and the battle is waging as fiercely over the object-glass of the microscope as over the theories of the treatment of the diseases which these minute vegetables are claimed to induce. There is some intimate relation of construction or destruction between the extremes of organic life, in man and the bacteria. Enough has been learned to

indicate the importance of the study. The field is new and open to all who will enter and possess a portion of it. These and other almost formless shapes of living matter are found in our drink and food and in the air we breathe. They have been studied in many ways, but the mystery which surrounds them seems to deepen as we go on.

One of the most distinguished of American microscopists, on showing me a photograph of bacteria magnified about 1,500 times, asked what they looked like. I could only reply, "big drops of rain on a pane of glass." There was no evidence of organization. He said, as he put the picture away, "The farther we go the more uncertain we are."

He stated a positive truth, for the lack is not of positive data as to what has gone before, but of any way of studying or comprehending this vast field whose horizon seems more distant the farther you advance into it. Great numbers of ardent students are at work in it and very many exhibit the natural disposition to generalize on an insufficient basis of fact. As a consequence we are already flooded by the theories of special students, and worse than that, by practical propositions growing out of them. Truths, which all concede, are so obscured by the dust and confusion of controversy that those of us whose business it is to take established conclusions as foundations and indices for work, are, at times, greatly at loss how to proceed.

And what is still worse, popular appeals are based upon some of these obscure investigations in such ways as to mislead, and in the end, disgust those who read with a view to practice, only to discover that when tried the specious propositions fail to meet the needs of the case.

Look for a moment at the questions which the microscope is called upon to help solve in the department of hygiene. The relations of microphite to the etiology of all diseases of the zymotic class and possibly of others! If they do not stand in

the relation of cause, what are their functions? Are they in any sense evidence of the presence of dangerous elements in the fluids or gases in which they are so abundantly found? Very many like questions readily occur in thinking of the matter, the solution of which we can easily see, would put us nearer certainty where is now doubt. It is because of its difficulty and its probable or possible importance that even practical workers have no alternative but to go on. But what we most need are more men and more women, too, familiar with the microscope, the micrometer and micro-photography, who will honestly study and picture what they see which will add, in the least degree, to our stock of knowledge of this difficult and fascinating study. But we want more than this. In fact it leads to another method of study of this same subject. I mean the propagation and cultivation of not only the suspected forms of lower organic life, but of others, and the experiment of the inoculation of lower animals with well recognized forms to test their action as causes or modifiers of disease. All who have studied this department of the subject are watching such experiments with intense interest. Some have resulted in a modified form of disease in certain animals, and even in plants, which give promise of the amelioration, perhaps extinction, of what may be called the parent disease. They encourage to hope that there will yet be discovered disorders, standing in the same relation to others of the zymotic class, that vaccine occupies as respects small-pox.

I firmly believe it will yet be done, and the discovery may very likely come in the combination of those methods of accurate observation and record, with well-ordered and carefully accurate experiment. Why not? and why cannot a share of this work be done in Minnesota, in Minneapolis, if you please, as elsewhere. The material is unfortunately too abundant everywhere. We are hardly prepared to admit poverty of talent, but we must admit lack of special training in the use of

instruments, and in experimental work. Fortunately good microscopes are abundant and cheap. The special literature of the subject is very rich in methods of work. There are all through the country an increasing number of teachers and students, and therefore all we have to do is to begin.

There is abundant opportunity, and demand too, for the coarser microscopic study of meat parasites and food adulteration, in which there is still room for original work, so that no one capable of any such effort in this direction need complain of lack of opportunity.

The state board of health have felt the need for more such workers, and the conviction has taken the practical form of prizes which are to be offered the university students for certain kinds of effort in this department. The intention is at first to stimulate the study and increase the number of workers; and then when special interest is developed it will need but little encouragement to go on to such a degree of excellence as may result in original research of great practical value. Our chief end is, however, to foster the love for this kind of study. You know from personal experience how delightful a change from your every-day pursuits your special scientific hobby, as it is called, is; and your labors in the library, museum and transactions prove that first-class original results not unlikely come out of such work pursued merely as a recreation. There is no truer missionary work in a seething center of population and business activity such as Minneapolis is, and is proud to be, than the furnishing to wearied brains and bodies just such rest and refreshment as the study of natural sciences in one or another of its departments affords. It is really a department of hygiene, a means of literally re-creating one's energies by relaxing the strain upon one class of activities and replacing the ambition of professional or business success by the quieter and refreshing pursuit of studies whose reward is to know for the mere sake of knowing, to discover

new beauties in, and receive new impressions from, the world of nature below, within and above us. It is a genuine form of culture in the true sense. A means of broadening one's field of thought and activity, of learning something of others' work and others' needs, of cultivating the finer elements of our nature which the stress of our civilization seems at times to threaten with atrophy or destruction. I put the matter feebly enough, but still I think strong enough too, to emphasize the request that you come individually, and collectively as a society, to help make this work as living and helpful as other like associations have done. Why should you not offer stimuli to workers in this department of science; establish a prize or prizes for original work; supply to each student the latest literature from your library; to encourage the doing of original work by honorable mention, by pecuniary reward or by the publication of his researches in your transactions?

I trust you will pardon the practical direction which my contribution to the papers of this meeting has taken.

My official duty for the last eight years has brought me so constantly the evidence of the great help which such associations as yours can give to hygiene, both as a science and as an art, without in the least interfering with the more immediate ends of your organization, that I cannot help the appeal or avoid making it strongly. Science is the field common to all of us. None are satisfied to cultivate exclusively any one department, but most of us are confined chiefly to one. It is, therefore, all the more necessary that in the practical application, when all departments, as it were, converge their forces to a common point, we should unite in common efforts at doing the good which the knowledge we are commonly supposed to possess enables us to do, and vindicate in various ways the claim that scientific training is one of the best preparations for any form of doing, and that its student may most surely be found fighting, not for the theories, but with the strong logic

of hard facts, striving for the highest welfare and the truest happiness of man.

I find that I was expected to say something more than I was prepared to say respecting diphtheria, which is at this time common in your city. I can only add that it should be treated as an infectious disease, that so long as one well marked case exists in any locality there is danger to others. There is no specific for its prevention or for its cure. Ceaseless and untiring surveillance, with the use of all recognized means of disinfection are the only methods.

It is the every day commonplace, and common-sense, efforts which succeed best. There is little opportunity for brilliant strategy or sudden and startling effects. The end is public good, and is best attained by the use of the local and State boards of health in their respective spheres of action. Individuals are practically helpless and families greatly weakened in the struggle, without their help. United and intelligent action will surely win. These boards are public servants, but popular support, sympathy and hearty co-operation are their strongest helpers.

SOME OBSERVATIONS ON LIVING CELLS.

PROF. S. CALVIN, STATE UNIVERSITY OF IOWA.

Something like fifty years ago the microscope finally settled the question in favor of the view that vegetable tissues are made up of cells. A little later this was followed by the more important generalization that all organic structures, whether animal or vegetable, are constructed of similar microscopic units. The so-called cell theory, that life resides only in cells