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RECENT ADVANCES IN MEDICINE AND THEIR INFLUENCE ON THERAPEUTICS.

The Annual Address delivered before the Norfolk District Med. Society, May 10, 1871, by JOEL SEAVERS, M.D., Boston. Published by vote of the Society.

MR. PRESIDENT AND FELLOWS,—Having had the honor to be invited to address you to-day, I shall examine somewhat superficially, as time will compel, the question whether recent advances in medical knowledge tend to strengthen a belief that by the use of remedies we may prevent, arrest or cure those functional or pathological changes in the bodily organs which constitute disease, or a belief in what is called, *par excellence*, rational medicine. The latter is, perhaps, well enough defined in the following extract from an "Address on Medicine," by Dr. Gibson, before the British Medical Association, in August, 1870, and quoted by an admirer in the Boston Medical and Surgical Journal of the following month.

"Diseases have," he says, "so to speak, a life-time of their own, with its periods of growth, maturity, and decline. They are the passing tenants of the body, which they occupy often with great injury for a limited time. Treatment cannot change their nature, cannot expel them at once, cannot quench them, cannot materially shorten or prolong their existence."

O. W. Holmes calls it "the old question between Nature and Art," as if it were not as much a process of nature for a drug to have a certain effect on the system, as for chickenpox to get well in a certain length of time. Dr. Bigelow believes that most of the acute diseases cannot, when they have once gained a foothold in the system, "be eradicated or abridged by art." Many others have followed out these doctrines still further, until many practitioners and theorizers can more readily believe in any miraculous effect of imagination, diet or climate in disease, than in a removal of it by medicine or medical appliances.

Vol. VIII.—No. 8

These disciples of the school of "rational medicine" claim still further that they constitute the leaders in science, that they are the party of progress, and that a belief that diseases are ever cured is old fashioned and unworthy of men acquainted with the developments of modern research. "The more positive knowledge we gain," says Prof. Holmes, "the more we incline to question all that has been received without absolute proof. The solemn skepticism of science has replaced the sneering doubts of witty philosophers." This by Holmes, the very prince of "witty philosophers."

Much of this skepticism is, however, not so much the product of advanced culture or superior intelligence as the result of fashion, or personal, or national peculiarities. The French school, even before the time of Louis, has led the way in much of this line of thought, and we have adopted it as we do many of their fashions in dress, with little attention to its propriety or fitness for our needs. Dr. Holmes says "the French, a not wholly uncivilized people, are in advance of the English and ourselves in the art of prescribing for the sick without hurting them." It might have occurred to him that his old foes the homœopaths were still farther in advance in the same art. What J. R. Lowell says of the French with regard to poetry may with slight alterations be applied to their medical characteristics. "The French mind is always strong in perceptive and analytic qualities, loving precision, grace, and finesse—prone to attribute an almost magical power to the scientific regulation, whether of politics or religion—its ideal is to combine the appearance of careless gayety of thought with intellectual exactness of statement. The eternal watchfulness of a wit that never sleeps has made it distrustful of the natural emotions, and the unconventional expression of them; and its first question about a sentiment is, 'Will it be safe?' about a phrase, 'Will it pass the Academy?'"

And so it has been with them in clinical matters; no isolated fact, no personal ex-

[WHOLE No. 2273]

perience is allowed to contribute to the stock of knowledge if opposed to the deductions drawn from tabulated records. Wise and witty, but more than all sensitive to ridicule, many a French savan would prefer never to be right rather than be held up to derision in believing that which cannot be proved.

As with national so with personal peculiarities; whether a man shall be skeptical or credulous may depend somewhat on his position or education, but still more on the constitution of his brain. Lowell says, "There were born Popists or Wordsworthians, Lockists or Kantists"—so physicians are born into the homœopathic school, the school of expectant treatment, or the school of active medication. The mind of one, keen, watchful of facts, fertile in expedients, striving to make the most of his art, earnest that every human being under his treatment shall have the advantage of all the advances in science or resources of art, feels sure that cases of disease which would otherwise have gone on from bad to worse have been benefited by the remedies which he has applied; and he is indignant when other similar cases are allowed to go on untreated, possibly to the grave.

The mind of another, generalizing upon masses of men, the sum total of diseases, the inexactitude of methods of proof, and the multiplicity of grounds of error, argues that there is on the whole more probability that we are wrong in ascribing cures to remedies than we are in crediting them to general laws. Yet the hard logic of strong facts and personal observations is often too much for even these persons, and flashes of belief illumine even their clouds of skepticism. Almost every one believes in something. The author of "Self-Limited Diseases" believes that syphilis is cured by mercury, and that certain inflammatory attacks apparently yield to seasonable depletion. The author of "Currents and Counter-Currents in Medical Science" believes in opium, wine, specifics and anæsthetics; and most of all, apparently, that scraping the tongue cures typhoid; and the author of "Nature in Disease" believes that water-melon, taken in cubic half-foot doses, cures cholera morbus and diarrhœa. Margutte, in Pulcis poem of Morgante, the giant, acknowledges that

———"to tell thee truly
My faith in black's no greater than in azure,
But I believe in capons, roast meat, bouilli,
And in good wines my faith's beyond all measure."

With this lengthy preface, then, I propose to look into the issue as between Na-

ture and Art, or the expectant school and the school of treatment, not hoping to solve the long vexed question, but only to take up some of the recent advances in medical science, and see in what direction they point so far as they bear on this question.

Amongst the most important of these advances is that in the physiology of the nervous system, commenced, we might say, by Marshall Hall some twenty years ago, in his studies upon the phenomena of reflex action, but infinitely more fully carried out within the last fifteen years under the lead of MM. Bernard and Brown-Séquard; who by their experiments on the section of the great sympathetic nerve, taught the influence of the ganglionic system over the blood supply, and the bodily temperature, and gave us a knowledge of the pathology of nervous diseases never before approached; investigations also by microscopists into what is called the "germ theory," and the nature of contagion; researches in the minute pathology of embolism and inflammation; and the examination of the physiological action of drugs. All these have a bearing on our question, and I shall consider them, not consecutively but incidentally, as they may conveniently present themselves.

Microscopists, in investigating the causes of the spread of contagious and epidemic diseases, have been struck by the fact that in bodies affected by certain of these are found various minute organisms, which are supposed to have had a part in the production of those diseases. These germs, or micrococci, or microzymes, as they are called as explained by Dr. Burdon Sanderson, are spheroidal particles which are associated with the commencement of decomposition of nitrogenous substances, putrefaction being the continuation of the same. They are, in general, exceedingly small, not more than $\frac{1}{25000}$ of an inch in diameter, and known to be living organisms. They tend, under certain conditions, to elongate into rod-like bodies, called bacteridia, which are endowed with a peculiar progressive and oscillatory movement, called amœboid. They consist of cells rounded like a short cylinder, and multiply by constant division into two.

Of their connection with various maladies, Dr. Salisbury was the first in this country to declare his belief that measles were propagated by fungi, or their spores, generated in mouldy straw; he afterwards became of opinion that intermittent fever was the result of similar spores which abounded in low lands, and made similar

discoveries with regard to still other diseases. In cholera discharges, organic bodies have long been found. These researches have been much extended by eminent men abroad, as Chauveau, Davaine and Hallier of Vienna. The latter finds in the alvine discharges of a healthy child with common diarrhœa "numerous moving and motionless micrococci," which resemble those of cholera so closely that they may be regarded as identical with them. In the alvine liquid of dysentery colonies of micrococci are found in great numbers, together with conidia, the contents of which are transformed into micrococci, "which have a strong resemblance to those of cholera." The stools of enteric fever "teem with minute organisms." This micrococcus is much larger than those of cholera and diarrhœa; is frequently furnished with contractile processes and endowed with active oscillatory movements. In recurrent fever, micrococci exist in the blood; they infest the colored blood corpuscles, and are also furnished with cilia. In measles they are found in the sputa. In smallpox and cowpox they are found in the contents of the pustules, more numerous in the former than in the latter. In scarlet fever "the blood contains micrococci in extraordinary numbers; there is, indeed, no disease in which they are so abundant." They occur both separately and in colonies, and often infest the blood corpuscles. In syphilis "the blood is densely filled with them." They are also found in the gonorrhœal discharge and in that of soft chancre.

Whether these organisms are of vegetable or animal origin, whether they are really the cause of the diseases they accompany, either by the activity which they exercise as living organisms, or by the products they give rise to, whether they are actually the contagious power, is a question still *sub judice*. Dr. Sanderson shows conclusive experimental reasons for declaring that each "contagion," as regards its physical form, consists essentially of extremely minute solid particles, and argues on grounds scarcely less certain that these effective particles are living, self-multiplying organic forms; in other words, that they are in every respect similar to, if not wholly identical with, the organisms referred to.

Lionel Beale, while he opposes Hallier and denies *in toto* that the contagious germs are fungi or parasites, or in any degree derived from the vegetable world, believes them the cause of disease, and declares, 1st, that the contagious corpuscles are living and growing matter; 2d, that they are not produced in the system of the

affected person, but are introduced from without; 3d, that they are capable of growth and multiplication in the blood; 4th, that the particles are so minute that they readily pass through the walls of the capillaries; and, lastly, that they can live and grow at the expense of the various tissues, and retain their vitality even after the original germinal matter has ceased to exist.

The similarity of these micrococci in different diseases, and the multiplicity of diseases in which they are found, has led to some incredulity as to their being the contagious virus or specific cause of those diseases; but Hallier maintains that although the microsynes of two different affections may be the same, the higher forms to which they severally unfold are or may be specifically distinct, and claims that from those higher forms, obtained by cultivation, he has been able to reproduce contagious microsynes. He claims, also, to have seen microsynes produced at the expense of the large reproductive cells of certain endophytes; but his opponents declare this to have been the result of the changes of decomposition in the protoplasm itself as putrescible matter.

Dr. Nichols, of this Society, in a communication to the Boston Medical and Surgical Journal, quotes from *Virchow's Archiv* an account of experiments made by Dr. Semmer, of Dorpat, in which true charbon was produced in a colt by the injection into its jugular veins of water containing bacteria and micrococcus cells from an animal with charbon.

Now this theory of living germs as the origin of contagious, infectious, or epidemic diseases, so far as it is proved or made probable even, has an important bearing on the question whether modern science can, by the use of remedies, do anything for the prevention or removal of disease. If disease arises from the entrance of these organisms into the system, and is extended by their communication from one to another, it at once becomes a vital problem how we shall either prevent their entrance by destroying them outside of the body, or limit their ravages when they have gained an entrance by so acting upon and modifying the tissues or fluids of the body as to render it an unfit habitation for them.

"It seems rational," says Angus Smith, "to treat the agents of disease existing in the air exactly as the Egyptians treated their dead, by the use of antiseptics; and unquestionably if organisms infect the air, they will die in the presence of these agents as animals and vegetables die, and be pre-

served as mummies are preserved, until washed into the soil. But if any one fears that the disease is only allayed by these means to burst out again, let him remove the disinfectants from the mummies and he might almost as soon expect them to return to life."

An instance of what may be done in the arrest of disease by acting upon the teachings of these investigations in microscopical pathology, is referred to by Professor Huxley in his Inaugural Address as President of the British Association for the Advancement of Science. In 1853, a disease broke out among the silk-worms, and went on with such violence that in 1856 the silk crop was reduced to one-third its previous amount. The result of the inquiries of eminent naturalists, as MM. Quatrefages, Filippi, Lebert and Pasteur, was that the disease was in almost every respect comparable to the cholera in mankind—that there was in the blood of the affected worms a multitude of cylindrical corpuscles, each about $\frac{1}{600}$ of an inch in diameter, which they called Panhistophyte, because they swarmed in every tissue of the body, even passing into the undeveloped eggs of the female moth, and that the growth and multiplication of these was the cause of the disease. Hence it became evident that to check the disease one must either prevent the occurrence of the conditions under which the generation of Panhistophyton arose, or else get rid of and keep away the germs from which it springs. M. Pasteur devised a means of effecting the latter, which was successful in extirpating the Panhistophyta and stopping the disease; and recent numbers of the *Comptes Rendus* of the French Academy of Sciences confirm this success, and contain votes of thanks and congratulatory addresses to M. Pasteur from various Italian Associations in acknowledgment of his services.

A still more pertinent illustration is perhaps this: Prof. Helmholtz, who had yearly for twenty years been a sufferer from hay-fever, discovered vibrios of a peculiar character in the secretions of his nose. After reading the experiments of Dr. Binz (which I shall again refer to) on the power of quinine over these lower organisms, he injected into his nostrils a weak solution of quinine, and the symptoms disappeared. The next year, as soon as the symptoms reappeared, he again used the same injection, and with equal success.

In Mr. Crooke's Report on the Use of Disinfectants in the Cattle Plague, he says: "In tracts of land, to which sewage disin-

fecting with carbolic acid has been applied, the sheep are free from foot-rot, the potatoes from disease. Obnoxious insects, such as the turnip-fly, gnats and dung-flies, are absent, and grubs, larvæ, and the lower forms of animal life, and infusoria, the invariable accompaniment of putrefying matter, disappear, while vegetation becomes remarkably healthy and luxuriant."

The germ theory has, it may be, still many points which remain in doubt; eminent men differ from each other with regard to results, but the whole evidence apart from special points of disagreement indicates clearly that an advance has been made in our knowledge of the ætiology of contagious and epidemic diseases, and a broad field been opened for the application of remedies, old and new, for the prevention and cure of these diseases, and no amount of theorizing as to the inadequacy of remedies for the cure of such complaints can absolve us from the duty of using them.

Modern science has also been fortunate in discoveries on the minute pathology of inflammation, and the causes and course of dilatation or contraction in, ruptures of and stoppages in the small arteries; and, *pari passu* with these researches, have been made studies upon the physiological action of drugs; and I will now examine somewhat into them to see what their results indicate. Clinical experiences must be omitted in this review, as their results are so incapable of exact proof as to be always open to cavil. Leaving them out, then, I shall consider now such experiments only as have been made in connection with the microscope, or other physical means of exploration, by vivisection upon animals, and other similar investigations almost as capable of direct proof as the results of inorganic chemistry.

The foundation of all these rests primarily upon that knowledge of the functions of the sympathetic system that we have already referred to as initiated by the studies of recent physiology, and of which an account may be found in Dr. Edes's Prize Essay on the "Physiology and Pathology of the Sympathetic or Ganglionic Nervous System." When it was found that by various sections and other testings of the nerves, their functions and those of the ganglia were revealed, some partially and others with great exactitude, experimenters naturally turned to the study of the effect of drugs upon these parts, endeavoring not only to learn their general action, but the special tissues affected by them, and the order in which they became affected. The discovery that nerves connected

with the sympathetic system exercised an influence over the walls of the arteries (whence they were called vaso-motor nerves), and modified the amount of blood sent through these vessels, became of increased importance when it was discovered that these nerves could be excited or be paralyzed by the irritative or sedative action of certain drugs.

Thus it has been found that ergot of rye has the power of exciting contraction of the involuntary or unstriated muscular fibres of the uterus, bladder, gullet and stomach, bronchial tubes, ducts of some glands and the middle coats of arteries. Dr. Brown-Séquard observed that the vessels of the pia mater became much smaller under its influence and the reflex action of the spinal cord diminished.

Belladonna, or its alkaloid, has a like action on the involuntary muscles, but manifests its power on a different set of organs, as the pupil, the breast, the bowels and the vesical sphincter. Its action varies greatly with the dose employed: in small doses diminishing the calibre of the capillaries; in larger doses, or continued too long, paralyzing the vaso-motor nerves, causing the vessels to dilate, thus producing cerebral congestion. In therapeutic doses it increases the activity of the excito-motor functions of the spinal cord, and in larger doses may even produce convulsions; but its effect (as mentioned by Dr. Amory) in this respect is intermediate between strychnia and bromide of potash, the former producing an exaltation of these functions of the cord, the latter diminishing their activity. It accelerates the action of the heart by paralyzing the terminal extremity of the pneumogastric nerve, which restrains that action.

Bromide of potash. is another drug especially brought to notice by experiments on the nervous system. It is a vascular sedative, repressing local congestions of the brain or other organs. Dr. Amory declares its effects to be produced by its direct action on the bloodvessels themselves, or the nerves controlling them. Dr. J. Russell Reynolds infers that it acts as a sedative on those nerves, reducing such morbid activity as may lead to the spasmodic narrowing of the vessels. Dr. Laborde states that it produces a progressive diminution and even complete abolition of the reactionary movements of the limbs, as produced by various artificial excitations.

Digitalis is found by Dr. Brinton to induce contraction of the capillaries, and thus increase the arterial tension. It both stimu-

lates the action of the heart and increases the capillary resistance. Drs. Fagge and Stephenson consider its effect on the capillaries secondary to that on the heart. It strengthens the cardiac contractions, and at last tetanizes the heart, causing its complete stoppage, with contraction of the ventricles. Other observers, Legroux, Wunderlich and others, agreeing upon these general phenomena, think the effect on the sympathetic system the primary one.

The calabar bean, or *Physostigma venenosum*, another of the paralyzers, has also been largely experimented upon. Its effect in contracting the pupil is well known. Herman Roeber, of Berlin, believes its chief action to be a complete destruction of the motor and reflex activity of the spinal cord, at the same time producing insensibility to pain without impairing the sense of touch, or the so-called muscular sense. It also has a special power over the heart, retarding or arresting its action according to the dose. Dr. Fraser states that the chief phenomena following its use are diminished reflex excitability and an increase of the secretions. It also diminishes the number of the heart's contractions, but lessens the duration of the systole, the heart finally ceasing to beat in the diastole.

Opium and its alkaloids, as tested by Dr. Baxt, of St. Petersburg, are declared to have two characteristic actions—narcotic and tetanizing. Each of the alkaloids has one or the other of these exclusively, or a blending of the two. As narcotics they rank in the following order:—papaverine, morphine, narceine and codeine, &c. (and inversely as convulsive agents), up to thebaine, which, holding the highest place in this respect, is equal to strychnia. Papaverine and morphine act first on the peripheries of the sensory nerves, and control pain when applied locally.

Among the most interesting results of this nature are those which have been made on quinia by Drs. Binz, Scharrenbroich and Adolph Martin, tending to prove that it has a direct influence in diminishing the number of the white corpuscles in the blood, and checking their passage through the walls of the vessels—doing this by impairing the vital properties of the existing corpuscles, hindering the generation of new ones, and restraining the dilatation of the vessels. It is also proved to have an influence as an antiseptic, checking the vital movements of vibrios and other organic bodies in the secretions. Experiments on this point, carried still farther, prove that other medicines also

have a similar power on the vital movements of organic bodies, among which are alcohol, the mineral acids, the chlorides of mercury, camphor, arsenic, &c., but they are not of so general application as quinine, either from their greater poisoning qualities or their more rapid decomposition in the blood—quinine remaining unchanged in the system often for two days, and being generally so harmless even in large quantities.

The nitrate of amyl is a remedy introduced into the *materia medica* by Dr. B. W. Richardson, of London, from its similar power over unstriated muscle and the sympathetic system. Its action is said to be exerted on the ganglionic nervous tract; it paralyzes so that the nervous control over the minute vascular system is impaired and the muscles thrown into relaxation. Hence it is recommended as a remedy in spasmodic affections, and has been used successfully in tetanus, spasmodic angina, colic, asthma, &c.

But of all the remedies introduced into practice on theoretical grounds, none has been so generally used, or with such satisfactory results, as chloral. Three tons of it are stated to have been imported into England from Germany during the last year, and more than twenty-two thousand pounds passed through the hands of a single dealer. It was argued, on chemical grounds, that it ought to produce certain effects on the system, and it has wonderfully justified the experiment. Its clinical effects are so well known as to require no mention. It is said to contract the arterioles, and thus produce sleep by bringing about an anæmic state of the brain. Sphygmographic tracings in the sleep caused by it indicate an elevation of arterial pressure, and a perceptible chilliness and dryness of the skin of the extremities was also observed.

I have thus briefly reviewed some of the best ascertained facts with regard to several drugs, not so much attempting to present a *résumé* of all that has been discovered with regard to each, as to give some idea of the accuracy and care with which these studies have been made, and their extremely interesting results. Before these observations it would have been declared extremely improbable, if not impossible, that any one should have produced by medicine such an effect as the lessening of the supply of blood to a weak or diseased organ; but it now seems practicable not only to do this, but, for instance, to paralyze the extremities of the pneumogastric nerve without injury to the nervous

centres, to give tone to those nervous centres when failing in structure, to act upon the muscles of organic life as a whole, or over some special set of these muscles alone, and to diminish or increase the temperature of the body, an important effect of these drugs to which time has not allowed me to refer. But much of this is now as completely demonstrable as the forty-seventh problem of Euclid. Therapeutics has thus far been for the most part a merely empirical art, and medicine consequently one of the most inexact of sciences. The counting of cases, gathering of statistics, and summing up of the averages of results, have been almost the only means of judging of the effects of remedies. But when we know, as we begin to, something of the ultimate pathology of the changes wrought by certain diseases, and when we know, as we are beginning to, the real unquestioned effects of certain medicinal agents on the parts affected, a ray of light falls upon the healing art, and the practice of medicine begins to be something more than the observation of cases, begins to be the application of remedies to the prevention or removal of morbid changes. The expectant treatment, and the treatment of symptoms must yield, and be followed by the scientific appliance of remedies whose effect can be predicated to the removal of diseases, whose pathological conditions we have ascertained. Prof. Geo. Wilson used to say, as we learn from the *Edinburgh Medical Journal*, that if all the sciences related to medicine were represented by a group of boys playing at leap-frog, therapeutics would figure as a very lazy boy whom no compulsion could prevail upon to take his leap. I am inclined to think that this was because it was a game "he did not understand," and that, like the "heathen Chinee," he has at last consented to join in the play.

One of the most striking facts to be observed in this summary of the effects of drugs is their variety. The cursory observer deems the results very similar, and declares that they only prove that a certain class of drugs have a certain common effect over the nervous system; but carefully examined and analyzed they reveal a most wonderful complexity of detail. One drug manifests its power first on the muscles, and this either by direct irritation like the scratch of a pin, or by affecting the nerves that control them; another acts on the spinal cord, another on the brain; one acts on the *peripheral* extremities of certain nerves, another on their *central* origin; one acts on the heart, an-

other on the voluntary muscles ; one on the motor, another on the sensory nerves. This complexity of action is still more curiously shown when we compare them with reference to their antidotal or their auxiliary action upon each other. One may directly oppose a *certain* effect of another and yet increase its activity in another direction. Cufare and conium, very similar in many respects, differ, in the fact that the former is not poisonous when swallowed, but only when introduced under the skin ; conium poisons in either way. Calabar bean stops the action of the heart by lengthening the diastole, so that the cardiac functions cease during the diastole ; other drugs prolong the systole, and the heart stops in the systole. Even the different alkaloids of opium have, as we have seen, a very various action. Physostigma stimulates the third nerve, atropia the sympathetic ; the former contracts the veins, the latter the arteries ; antagonistic in their effects on the pupil, they are not so in their action on muscular life, both being paralyzers ; but atropia acts by destroying muscular irritability, physostigma by paralyzing the spinal cord ; atropia destroys, physostigma increases the sensibility of the sensory nerves. Atropia increases, physostigma retards the respiratory movements ; the former produces excitation of the cardiac ganglia, the latter paralyzes them.

Atropia differs also from other vascular remedies. In contracting the muscular fibres of arteries, it stimulates the flow of blood in the organs and assists their functions, and may even produce active congestion. Nicotine produces a lasting spasm of the vessels, which is followed by dilatation only when the nervous power is exhausted ; and bromide of potass. causes a permanent contraction and anæmia of organs, its action being more intense and longer in proportion to the amount given.

The relations of opium, belladonna, conium and hyoscyamus to each other have been fully described by Dr. Jno. Harley, too fully to admit of being curtailed for our use, but showing how the effects of either are modified by being given with another, and how difficult if not impossible it is to neutralize all the effects of one by what seem to be the opposing effects of another.

From his studies and those of Drs. Crum-Brown and Frazer, of Edinburgh, it is shown that the action of two or more drugs, given in a combined form, is in many instances not a combination of the effects of those drugs ; that is to say, the effect of one plus that of the other, but is often

markedly different. These gentlemen experimented upon strychnia, atropia, conia, and their bases, and discovered that when joined with compounds of ethyl or methyl their effects were strangely changed. Thus, strychnia affects the spinal cord itself, producing more or less tetanic convulsions, but when converted into its ethyl or methyl compounds it produces paralysis of the terminal ends of the nerves. Atropia causes not merely paralysis but spasms, partly clonic and partly tetanic, while the compound of iodide of methyl with atropia prevents the occurrence of the spasms, but is far more deadly in its poisonous qualities. So conia, in its normal state, is said to have no spinal action, but the hydro-chlorate of methyl conia paralyzes the motor nerves and spinal cord, and produces death much more quickly than the conia from which it was prepared ; while the iodide of di-methyl conia was found less active than either, and entirely devoid of spasmodic and spinal paralyzing action. These researches, says a reviewer, open to us a new field of inquiry, so unexpected are the facts developed. "How could we anticipate, for instance, that the addition of such substances as ethyl or methyl to a powerfully poisonous alkaloid like atropia would eliminate all the convulsive and tetanizing force of the latter ; and even if we could suppose that, how could we suppose that the lethal activity of the alkaloid would be simultaneously increased to a very great extent ? And again, the observations on the relative effects of a large and small dose of a drug, and the exact reversal of these effects when combined with methyl. Thus are we warned against the hasty generalization so common, viz., the assumption of *complete* antagonism between two drugs which oppose each other in certain striking *particulars*, and the assumption that small doses of a drug must produce effects which are a faithful reproduction in miniature of the action of large ones." Now all these results, although they teach us how limited is our knowledge of the actual and intimate resources of these drugs, show us plainly that their powers have not been over-rated, and that we have in the armamentarium of the *materia medica*, not the Queen's arm and old Columbiad merely of obsolete days, but modern weapons of every variety, adapted to the most complicated emergencies of modern warfare, or modern pathology. Polypharmacy, so often abused, becomes a matter to be studied in *both* its senses, either as the employment of very many kinds of different single drugs in different pathologi-

cal conditions, or the employment of combinations of drugs, when we know more, as we soon may, of their modification of each other's action.

In conclusion, then, to sum up what seems to be taught by the recent advances in medicine, on germs, spores or other organisms in the causation of disease—on the pathology of inflammation and the transudation of the white corpuscles of the blood through the walls of the vessels, their multiplication and abundant reproduction in various pathological states; on the influence of the ganglionic system over oligæmia and hyperæmia of various organs; and the phenomena produced by the exhibition of various well-known drugs, is this:—that we can, by well-known antiseptics, destroy in the air or elsewhere these parasites, thus preventing their entrance into the human system; that we can by drugs, as proved by the experiments of Binz and others, directly check the zymotic process in the blood, and the vital movements of these organisms; that we can also arrest the inflammatory process by checking the migration of the leucocytes, or white corpuscles, through the vessel-walls into the tissues of the membranous and parenchymatous organs; that we can lessen the number of these leucocytes, and can also relieve anæmia or congestion of organs, and the various organic changes which follow the narrowing, dilatation or rupture of the capillary arteries. All this we can, or seem likely to be able to do by the direct action of drugs, the wonderful complexity and hitherto unknown variety of whose resources we have also briefly shown.

These advances, then, seem to place in our hands, if we are but willing and skilled to use them, the power of modifying to a very great extent the vital functions, and indicate a tide of progress that will one day sweep away that superstitious fear of interfering with the resources of nature, which has allowed so many to perish unaided by those into whose hands they had so trustingly placed their lives. While our clinical experience was denounced as untrustworthy, and every recovery ascribed to a process of Nature, while we could do nothing to prove to the skeptical that remedies had a capacity to do that which we desired, it may have been that our first duty was to do no harm. When we know, as we are likely to, with a great degree of certainty, the organs, or the minute anatomical parts, that will be altered functionally or otherwise by our remedies, then, although he may still be a great physician who is great

in diagnosis, he will be still greater who, having made his diagnosis, knows what remedy or what combination of remedies to use to remove the diseased state.

One other matter to which I wish barely to allude in passing is this, that what has been called the empirical use of drugs, and that which we had *assumed* that we knew of them by clinical experience, has not been subverted by these advances in knowledge. The belief that certain old-fashioned remedies "are good for" various diseases, some for asthma, some for malarial disease, some for epilepsy, &c. &c., has been for the most part justified, and confirmed by an increased knowledge of their action; and it seems probable that we shall finally have not merely an excuse for our belief, but valid grounds on which it may rest. The present indications of these results are that it will be shown that the men were right who gave certain drugs to cure certain diseases, and they wrong who laughed at their credulity and declared their treatment was nothing if not injurious.

It need not be claimed that this is already accomplished, that these results are lying completed before us. Many of these researches are incomplete, some are even conjectural; I speak only of them as indicating in their *unfinished* state what they may hereafter *prove*, namely: that the practice of medicine is not merely a philosophical study into the causes, progress, and result of diseases, under the most favorable conditions of hygiene, diet, and nursing, but is all this plus the use of remedies to modify, to arrest, or to prevent the changes that disease works; and that the tendency of modern scientific research and discovery in medicine is not to *limit* curative agencies and remedial appliances, but to *multiply* them—not to prove that disease is to be watched, to be guided into safer paths merely, but to a certain and large extent is to be treated and cured; and that drugs which, with one or two exceptions, were to be thrown into the sea, that fishes and not men might be hurt by them, are to be administered, and made use of, with their almost infinite variety of powers, in the care, the relief, and the cure of the sick.

HEROIC MEDICAL STUDENTS.—It is worthy of record that the fine old cathedral of Notre-Dame was saved only by the courage and perseverance of a handful of medical students from the Hôtel Dieu, who frustrated the incendiary efforts of the Communists.