Original Articles.

VIVISECTION IN HARVARD MEDICAL SCHOOL.—A REPLY.

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It is well known that a bill to restrict experimentation on living animals was brought before the Massachusetts Legislature several years ago and was rejected after a number of full and impartial hearings, in which the attempt was vainly made to show that abuses existed in the work of our higher educational institutions. This year the same effort is being renewed, and should be opposed, not only by professional investigators but also by physicians and laymen who are conscious of the debt that the community owes to those who labor in the important fields of physiology and experimental pathology.

One of the most liberal of the supporters of the previous movement, Dr. Leflingwell, has recently distributed again, in pamphlet form, under the caption "Does Science Need Secrecy?"¹ a letter originally published in the *Boston Transcript* of September 28, 1895, as a reply to one by Professor Porter, of the Harvard Medical School, which had appeared two days before, and in it he makes a number of statements which should not be allowed to pass without notice, the more so because the fact is ignored that some of them had already been publicly shown to be erroneous. It seems to be as inevitable as it is unfortunate that the discussion should become public, — unfortunate, because so many persons in the community have shown themselves, again and again, ignorant of the value of the ends which are sought, and therefore unable to recognize how amply they justify the means that are used to gain them.

My objection to Dr. Leflingwell's pamphlet is not that it is critical but that it is unjust. It is an attempt to make it appear that men intentionally deceive who do not intentionally deceive; that men are cruel who are not cruel; that systems are in vogue which are not in vogue; that suffering is inflicted which is not inflicted; that the practical results of physiological research are of trivial value, whereas without them the splendid edifice of medical science could never have been built. The "practical" physicians who are so proud of the fact that they have exchanged the ignorant and brutal empiricism of the past for treatment based on a relatively accurate knowledge of the body in disease and health owe that knowledge, to an extent they often fail to realize, to the discoveries of these men, which have been incorporated like the "water of crystallization" into the working forces of the medical art.

It must not be forgotten by those who hold that it is wholly wrong to seek knowledge through experimentation on living animals (though we may make them suffer pain for our protection, our sport, our convenience, and our food), that Dr. Leflingwell is himself an avowed supporter of such experiments.

He says² "As a physician, I have never been able to go to the extreme of denouncing all experimentation upon animals whatever, even though from first to last no pain be felt. Between the total abolition of

all sacrifice of animal life for scientific purposes demanded by many humanitarians and that absolute freedom to inflict torture without restraint claimed by some physiologists, there must be a middle ground." In another place he says,³ "I am not an antivivisectionist, for I believe in the practice, when it is rigidly guarded against all abuses, limited to useful ends, and subject to public criticism and the supervision of the law."

No physiologist, so far as I know, claims freedom to "inflict torture" either with or without restraint: so that the main difference between Dr. Leflingwell's position and that of his colleagues with whom he disagrees is that he thinks the best safeguards against abuse, and the best way of limiting experimentation to "useful ends," to be "public criticism and the supervision of the law," while we trust far more in the character, traditions and training of the men who have this serious and important work in charge. If Dr. Leflingwell were only carrying out, as a practical physiologist, the carefully guarded experiments which he sanctions, he would be more ready to see the value of this latter guarantee, and less ready to endorse by implication the accusations of cruelty which he knows his pamphlet will lead the thoughtless public to bring against these men, in spite of their honorable records. Do these recitals, which, to those who read them, paint a scene of horror, really help the untrained reader to form a fairer judgment?

"Judge the people by their actions,
Is a rule we often get;
Judge the actions by the people,
Is a nobler maxim yet."

—JAMES FREEMAN CLARKE.

If there is any subject that public-spirited men should treat soberly and dispassionately at the present day it is surely this subject. For every one must admit that within the past fifty years there has been a vast and rapid change in sentiment throughout the civilized world with regard to the infliction of pain, and that now and then the new wave takes on the character of an inundation. The bare mention of "abuses" in prisons, in asylums, in schools, in army discipline, excites a rush of indignation based on vague pictures of the days, not so long distant, when prisoners and witnesses were put to torture, and knowledge was conveyed at the rod's end, and lunatics were chained and punished. For this reason it is easy for leaders of reform, if they are willing to use such methods, to change a noble and useful sentiment into an hysterical and indiscriminating passion. And this is done when in the reckless determination to enlist public sentiment it is made to appear that the methods used by the most humane American physiologists are no better than those used by the least humane European physiologists; or that the customs which marked the research of half a century ago are the customs of today; or when by any means an uninformed public is encouraged to believe that our medical schools are dens of iniquity. Those who write upon these subjects are bound to hold themselves responsible not only for the words they use, but for the sense, so far as they can foretell it, in which their words will be taken.

It is not easy to realize, until one looks at the matter closely, what a powerful and even unreasonable influence this feeling has become. Anglo-Saxon communities are peculiarly affected by it, and the public

¹ Fifteenth thousand. Does Science Need Secrecy? A reply to Professor Porter and others of Harvard Medical School, by Albert Leflingwell, M.D., Cambridge, Mass.; with statement concerning Vivisection, by Prof. W. T. Porter.

² Leaflet, Does Vivisection Need Concealment?

³ Reply to Dr. Porter, p. 21.

has therein a stronger guarantee against physiological cruelty than any law could secure. Most of us approve of taking the life of animals for food, but even this is permitted only with the tacit understanding that the details shall be kept from our shrinking sight and ears. This is a pardonable sort of cowardice, but other forms are less pardonable.

It must indeed be admitted that indifference to others' pain is to be found everywhere, even in every home. But it is daily becoming rarer, and there is no country in the world where it is so rare as in ours. Let no one suppose that the flood of modern compassionateness and sensitiveness to the suffering of man and animals has left untouched the students and teachers of physiology. Humane physiologists would be as glad as any one could be, no doubt, to see the abolition of cruelty and the abolition of pain. But they are in better position than most persons to realize that their labors tend to the abolition of pain, both of men and animals, by increasing our knowledge of the conditions which underlie health and disease.

For my own part, although not a physiologist, I have been for more than twenty-five years a frequent, and at times a constant, visitor at the Harvard physiological laboratory, and familiar with the men who have raised it to its present position of usefulness, and the contrast between the impressions which I have received and those suggested by Dr. Leflingwell's pamphlet is so striking that I feel bound to testify to the untruthfulness of the picture which the latter draws.

No one would assert that in a quarter of a century there have been no instances of thoughtlessness, or that nothing has been done which has given cause for regret. Yet no unprejudiced observer could see a year's work at the laboratory without being compelled to admit, after due study of the conditions, that he had seen no evidence of real abuses, excesses, cruelty, or even of any considerable suffering. More and more effort has been made to increase the comfort of the animals, and they are now cared for in commodious quarters, and are removed from influences, such as solitary confinement, which might excite vague impressions of danger. They live as comfortably as those kept in well-regulated menageries or circuses.

I know, also, from conversation with Professor Bowditch, that he has studiously avoided, for many years, the class of experiments referred to by Dr. Porter in his letter as being distinctively "painful, and yet needing to be done without anesthetics."

It is obvious that the best sources of information as to the amount of pain suffered by animals used for the purposes of experimentation are the hospitals where men and animals receive surgical treatment; for the operations done by the surgeon are closely parallel, so far as the infliction of pain is concerned, to those done by the physiologist. Any unprejudiced person who will visit such a hospital will find that signs of severe pain are rare, and that the animals suffer much less than men. I do not, of course, refer to the suffering from the diseases for which the operations are done, but only to that which the operations induce.

Operations on the internal organs usually cause but little pain, so that, for example, as I have learned by personal inquiry, no anesthetic is needed, from first to last, for the removal of the ovaries from the mare, or other large animals, unless temporarily, if the skin has to be cut. Horses' teeth are usually pulled without an anesthetic, and I am told by a prominent veterinary sur-

geon that although this operation takes a relatively long time and requires the use of great force, yet the horse is so little affected by it that he instantly afterwards begins to eat, as if nothing had happened. This is worth remembering in connection with incidents like that reported by Dr. Bowditch in his address.⁴

Where operations requiring an anesthetic are to be done upon horses, chloral is commonly chosen, instead of ether, because of the struggling which the latter induces, and it is found that when a large dose of chloral is given the animal may sleep quietly through the entire period.

The operations of surgery are closely parallel to those of physiology, but the surgeon has few or no critics because the community understands and sympathizes with his aims. It excites no denial when the statement is made that patients suffer but little after even severe operations. Let it be assumed, however, for argument's sake, that this sympathy did not exist, and let the reader consider whether a description like the following would aid or would hinder him in the formation of a just opinion. "Of what use is it that you, the self-interested surgeon, tell us that the struggles of your half-etherized patient at the first plunge of the knife, the turgid and purple face, the groans and cries, are not indications of pain? You cannot persuade us that after these terrible mutilations of the deeper organs and cavities of the body, in which blood flows in torrents; this tearing out of the sensitive nerves of the face; these deep sections and lacerations of the brain and spinal cord; this crushing and scraping of diseased bones; that after these prolonged abominations the patient wakes in comparative comfort and indifference. We will not believe that the surgical wards of a hospital are habitually the abodes of cheerfulness; that the brain and most of the internal organs are nearly devoid of sensitiveness; that patients who have had injuries of the head involving serious destruction of the delicate mechanism of the parts within, or complete destruction of the spinal cord, may lie wholly conscious yet practically without pain, and not needing any anesthetic." Yet these statements are true, and it is also true that the work of the surgeon is the analogue and the counterpart of the work of the physiologist, but with the difference that the surgeon deals with the most sensitive and highly organized animal known, while the physiologist deals with those far lower in the scale of capacity for pain.

Let us look a little more closely at some of the special reasons that made it seem to Dr. Leflingwell so necessary to bring these charges against our teachers and our college.

I. He says (page 10): "In the first place Professor Porter does not well when he denies (as he seems to do) that the practice of experimentation upon living animals has ever led to abuse."

Dr. Porter's letter contains no such denial. It would have been an idle and uncalled-for statement, and one such as no one would think of making, even for surgery. Dr. Porter's letter was written to defend the experimentation which he and the Harvard Medical School represent from the terrible abuse which had been poured upon it, and if any reader doubts whether he was not within the mark in speak-

⁴ At the annual meeting of the Massachusetts Medical Society in 1896, Prof. H. P. Bowditch gave an address on *The Advancement of Medicine by Research*, which was printed in the *Boston Medical and Surgical Journal* for June 11 and 18, 1896, and can now be obtained, with appendix, in pamphlet form.

ing of the "long-drawn lists of atrocities that never existed," let him study the records of the hearings before our own Legislature; let him even read Dr. Leflingwell's own pamphlet, and see if he thinks the expression overdrawn.

II. In the next section grave distrust is expressed as to the truth of Dr. Porter's words (reiterated by Dr. Bowditch at the legislative hearings) as to the work at the Harvard laboratory being done "within open doors," and the counter statement is made that "no feudal castle of the Middle Ages was ever more rigidly guarded against the entrance of an enemy than physiological laboratories are secured against the admission of unwelcome visitors." As a matter of fact, the agents of the Society for Prevention of Cruelty to Animals have several times called and witnessed experiments, with Dr. Bowditch's full consent, and he authorizes me to say that any one who applies in a spirit of serious inquiry will be welcome in the future as in the past.

Possibly some reader of Dr. Bigelow's address of 1871, of which such liberal use is made, may think that through him they obtain a real look behind the closed doors of the Harvard laboratory, and for that reason I pause to call attention to the fact that when this address was delivered the Harvard laboratory did not exist, and that Dr. Bigelow's knowledge of vivisection was derived entirely from acquaintance with the French methods of half a century ago. To him, however, at least, the doors of our laboratory were surely never closed, and yet it is not known that either in private or public he ever made a protest against its establishment or its development, or uttered an unfavorable criticism of any act done within its walls. Moreover, this laboratory was established at a time when Dr. Bigelow was the most influential member of the Faculty, and it could hardly have been established without his consent. Thousands of students, since that day, have passed through the Medical School, with full power to know every detail of the work of the physiological laboratory, and no one of them has been found ready to endorse any charge of wanton cruelty, or the other statements contained in Dr. Bigelow's address.

III. In the name of scientific accuracy, Dr. Porter is taken to task for his statement that through the discovery of the tetanus antitoxin tetanus is taken out of the list of incurable diseases. Dr. Leflingwell points out that many patients with tetanus used to recover before this discovery was made, and that even in spite of it many now die. Both of these facts are too well known to have needed restatement by either writer, and Dr. Porter's remark, in the sense in which it was obviously written and in which any candid reader would understand it, is certainly correct. Before the use of tetanus antitoxin a great many patients with tetanus recovered, it is true, but the physician stood almost helpless. He could sometimes mitigate the symptoms a little by narcotics, and could help sustain the patient's strength, and that was all. But with the discovery of antitoxin the treatment of this terrible disease entered on a new phase. Henceforth, and for the first time, the disease could be met by a rational weapon, and the actual accomplishment, though far less, when Dr. Porter wrote, than it is now, seemed even then the earnest of a far greater accomplishment in the future. The "disease" had been shown not to be "incurable," and the demonstra-

tion was one to call for grateful rejoicing. Dr. Leflingwell's criticism appears all the more unwarrantable when it is remembered that Dr. Porter obviously referred to the antitoxin of tetanus only as one of various agents by which physicians, under the lead of the experimental physiologists and pathologists, are now able to make some head against contagious disease. He might equally well have chosen the diphtheria antitoxin for his example, and would then have had a more impressive array of statistics to drive his argument home. Virtually, however, the two cases are parallel. Many patients with diphtheria used to recover; some still die in spite of antitoxin; and there are not wanting authorities who could be cited as disbelieving in the new treatment, by any one that wished to minimize its importance. Yet there is now a great flood of testimony to its value, prominent among which is that from the contagious wards of our City Hospital.

Under IV and V, Dr. Leflingwell deals with the question of "anesthetics" and "narcotics," and denies the justice of the claim which Dr. Porter makes, that animals are kept from suffering any considerable⁶ pain, by such means, when operated on at the Medical School. Here, again, the difficulty of securing from any large number of people the same consideration for the physiologists' view that is accorded freely to the arguments of its opponents is so great as to justify a special appeal to those who would be fair to let careful thought and study precede judgment. The argument is that ether and chloroform are the only true "anesthetics"; opium and chloral being "narcotics, which excite a degree of torpor, though they do not prevent pain"; while curare only paralyzes movement and does not affect sensibility at all.

These statements contain truth, yet not the whole truth, nor do they show that Dr. Porter's remarks, if taken in the sense in which they were obviously intended, are untrue.

Curare, to begin with, does, in large doses paralyze the sensory nerve-endings,⁶ and is likely, even in smaller doses, to blunt their excitability.

Apart from this, however, I have Dr. Bowditch's authority for saying that curare is rarely employed nowadays⁷ at our laboratory, except in conjunction with other anesthetics, or where a non-painful experiment was to be done which would nevertheless be interfered with by accidental movements.

The object of giving the curare is obviously misunderstood by Dr. Leflingwell and those who write in his mood. The very mention of the word excites indignation, and it is generally believed that it would never be used but to prevent the struggles of an animal in pain. This sentiment finds expression, among other places, on page 4, where he discusses the statement originally made, I believe, by Ludwig, and cited by Mosso in the biography of his great teacher, to the effect that many experiments would be made impossible by the occurrence of pain.⁸ Dr. Leflingwell rejoins that it is not the pain which interferes with the

⁶ I insert the last two words as expressing more accurately what I believe to have been Dr. Porter's meaning, and as, at any rate, illustrating my own.

⁷ See, for example, T. Lauder Brunton's *Pharmacology, Therapeutics and Materia Medica*.

⁸ Mention was made in the earlier part of the paper of a class of experiments which are not now made.

⁹ I do not quote the exact expressions used, partly because I have not had access to the original, but mainly because I am not undertaking to defend Mosso but simply trying to explain a physiological misunderstanding.

experiment, but the movements which the pain excites, and says: "What the Italian physiologist might truthfully have written was this: 'It is an error to believe that physiological experiments requiring the aid of delicate instruments can be performed upon an animal which is not made incapable of muscular effort.'"

This is not at all what either Ludwig or Mosso meant. It was not the movements, but the pain as such, reacting, as pain always does, on the delicate mechanisms of respiration and blood pressure, and the heart's action, which, if present, would have seriously interfered with the careful study of those important functions, and any one who chooses to look into the matter will find this to be the case. The occurrence of pain would have been fatal, likewise, to the success of some of Dr. Porter's experiments on the respiratory nerves, which Dr. Leflingwell criticises.

When curare is used after or during etherization, as in some of the experiments cited, it is because the painful parts of the operation are only at the beginning. For the later stages it is only necessary to use some means of preventing the movements which the animal would make involuntarily or spontaneously on coming out of ether, and which would render the desired observations impossible.

V. It is necessary to turn next to the consideration of the kindred and yet different question, namely, whether it is true that a fundamental difference exists between "anesthetics" (ether and chloroform) and "narcotics" (morphine and chloral), using the terms in Dr. Leflingwell's sense.

The best answer is that it is a matter of common knowledge that both morphine and chloral relieve pains of every sort, and they would unquestionably be "used by the surgeon" for operations, if ether and chloroform were not, for obvious reasons, better adapted to that special purpose.

Dr. Leflingwell insists, on the basis of his citations, that narcotized animals continue to feel. I wish it to be understood, however, that, even if this be true, to feel is not necessarily to suffer. A hypnotized person, to whom it has been successfully "suggested" that the pricking or cutting of his skin will not cause pain, may "feel" what is done to him but he does not "suffer." Similarly, when a person is even heavily poisoned by morphine, so that he is wholly indifferent to most excitations, an especially powerful stimulus will excite a momentary jerk or movement of resistance, quite sufficient to show that his muscles are not paralyzed and that his nerves still conduct impressions. On the other hand, his whole demeanor and his testimony after recovery prove that he was incapable of "suffering."

A few words must be said about the *dose* of chloral used by Dr. Porter. It is certainly the case that rabbits can bear a much larger dose than one-tenth gramme without death, but it must not be forgotten that this quantity would be equivalent to something like sixty or seventy-five grains for an adult man, assuming that a man weighs about forty or fifty times as much as a rabbit. This would be a huge dose, and although rabbits are undoubtedly relatively less sensitive than men to this drug, yet a grain and a half is not for them an insignificant quantity.

Under Section VI, Dr. Leflingwell cites a portion of the details of experiments by Drs. Ott, Walton, Hooper, Ellis, Bowditch and Porter, to controvert the statement

which the latter made about "painless experiments." I stated, at the beginning of this paper, that experiments wholly without anesthetics, or only with curare,⁹ are not now made at our laboratory, and have not been made for many years, and for this reason I omit the discussion of Dr. Ott's investigations, the more so that I have had no opportunity to talk with their author about them.

On pages 16 and 17, Dr. Leflingwell cites the details of an experiment by Dr. Bowditch upon nerves, to show its painful character, though a moment's further reading might have shown him that the nerve was in each case severed from the brain, so that the "stimulation" of it was no more felt by the animal than the stimulation of an amputated limb would be felt by the patient from whom it came. The "curare" in this case was given not to prevent the struggles of a victim in pain, but to eliminate involuntary or spontaneous movements such as any animal, in pain or not, might make, and to prevent the nerve stimulation from causing muscular contractions which would have interfered with the observations on the circulation of the blood.

In Dr. Porter's experiments, also, it was the *peripheral* end of the phrenic nerve which was "seized and torn out of the chest," and before this was done the nerve had been rendered insensitive and incapable of conducting impressions of any kind, even if it were not a fact that the phrenic nerve is a nerve of motion and probably conducts no sensations of pain at all. Dr. Leflingwell might easily have ascertained that the "struggling denoted by the stars," did not occur at the moments when the supposed-to-be painful excitations were made, but corresponded to movements not associated with the excitations at all. He might have found, what Dr. Porter assures me was the case, that in the experiment with regard to which it was not stated that anesthetics were used, they were used as in the other experiments. Any physiologist, any reader, indeed, not seeking merely to find a new point of attack, would draw this obvious inference, or would have written to ask Dr. Porter with regard to the facts.

By similar inquiries Dr. Leflingwell would have found that Dr. Walton's experiments¹⁰ caused but little pain, as surgical experience proves, and that they were undertaken to show that the surgeon, in removing the epiglottis, which sometimes must be done, can save his patient from serious difficulty in swallowing if he takes pains to limit his incision within a certain anatomical line which Dr. Walton points out on the basis of his experiments. Had he investigated further he would not have shown such ungenerous readiness to describe in detail Dr. Bowditch's "clamp," and couple therewith the suggestion that its use indicated the falsity of the statement that anesthetics were habitually employed, since then, he thinks, it could not be needed, for he would have found that it was primarily used as the best means of furthering the production and maintenance of etherization, and, next, as a convenient method for holding in a given position the fully etherized animal.

I shall not follow Dr. Leflingwell into further discussion of the details of these experiments. It is unfitting to paint such pictures for a public untrained

⁹ Except as explained above.

¹⁰ This statement is authorized by Dr. Bowditch, who conducted the investigation with Dr. Walton.

to estimate either the pain suffered or the good accomplished. Those who wish can find them where they are given, with no attempt at concealment, in the physiological literature of the world. Indeed, if the word of men so respected as Dr. Bowditch and Dr. Porter is no longer to be believed, and parties must be formed among the public, representing the two sides of this discussion, it would be desirable that every one who means to form an opinion should read these descriptions carefully and for themselves, not in extracts as part of a revolting picture painted by an unfriendly critic. We appeal, however, to right-minded persons who undertake this task and who value their own opinions and do not wish their consciences laden with the reproach of having helped to check a movement which exists not to increase but to diminish the sum of suffering in the world, to withhold their judgments until they have truly studied the subject of animal pain on the one hand and the position of physiology as a means of promoting the happiness of men and animals on the other. They may profitably begin by reading carefully a book published in London in 1883, called "Physiological Cruelty," from which Dr. Bowditch quoted in his admirable address before the Massachusetts Medical Society in 1896.

I have studiously avoided, in this paper, attacking Dr. Leffingwell's motives in any way that he could consider unjust. I accuse him of nothing but the thoughtlessness of fanaticism and ignorance. But to this charge he certainly is open when he uses the following statement for the sake of making it appear that the late Dr. F. H. Hooper was inhumane in his experimental work: "If one desires to see the picture of a dog 'thoroughly etherized or chloralized,' fastened immovably, its throat cut, and its larynx dissected out and tied up with a string—an experiment from the physiological laboratory of Harvard Medical School—let him consult one of Dr. Hooper's papers."

It is easy to imagine that this picture should excite such a feeling of horror among the ignorant as to deprive them of the power of judgment, but how it serves the interests of truth and fairness is not clear.

Is it possible that Dr. Leffingwell does not know that these animals, being under the effects of ether, felt these manipulations hardly more than a block of stone? Is it possible he does not know that practically the same operation, the removal of the larynx, and others far more likely to be painful, are done by the surgeon and without causing pain? What did he expect to be the effect of the remark that the larynx was "tied up with a string"? It was absolutely necessary for the experiment, and it certainly did not hurt the animal, but the reference to it as certainly did excite a feeling of unreasoning indignation against Dr. Hooper, such as it might have been thought that Dr. Leffingwell would have been glad to see eliminated from this discussion.

It may surprise those whose only acquaintance with Dr. Hooper has been through this reference to hear that he was a man of extremely kindly instincts and exceedingly fond of the animals most used for these experiments, one or more of them being his almost constant companions.¹¹ His keen interest in laryn-

gology, fostered and guided by his physiological studies, had made him a leader in clinical work of the most practical kind. The day will surely come when the painful disease of which he died will yield its secrets to the researches of the pathologists and the biologists. May America not be behindhand in contributing to this great work!

It is difficult to believe that any thoughtful and liberal-minded person can suppose physiology to be able to thrive without the opportunity of verifying hypotheses by experimentation on living animals; or practical medicine to be able to thrive without physiology. It is only by painful and laborious effort that medicine can succeed in reclaiming for health the vast domain of disease, and no auxiliary can be spared that might make this conquest swifter or surer.

We do not want to see our medical schools reduced to third-rate institutions because unable either to teach adequately the first elements of medical knowledge, or to secure the only teachers who are worth having, the teachers who are likewise investigators. We do not want to see American research strangled or given over to inferior men, nor do we wish to see restrictions imposed which annoy without materially restricting.

Those of us who have been interested in noting what physiology has done for practical medicine, and in attempting to gauge fairly the amount of the pain to animals which this sort of research involves, believe that we can see the difficulties which laymen find in forming opinions, and can appreciate and admire the humane feelings which prejudice them against the physiologists. But we believe that they are laboring under serious misconceptions as regards the facts at stake. It is easy for them to understand the arguments of those who think that experimentation upon animals is wrong and painful; it is difficult for them, if they have not specially studied the subject, to appreciate the arguments for the other side. Every one is ready to assume, as a safe principle, and in the interests of humanity, that a manipulation which causes pain to a man causes the same pain to an animal, forgetting or overlooking the fact that the best criteria of real suffering are exhaustion, prostration of nerve force, incapacity for immediate exhibition of the usual appetite, the usual power of enjoyment, the usual interest in familiar occupations, and that, judged by these standards, vast numbers of acts from which men would suffer cause but little inconvenience to animals lower in the scale.

So, again, when the value of such experimentation is under discussion, it is easy for the untrained to appreciate the arguments of those who say that little or no good comes of it all, and practically impossible for them to recognize what is accomplished, unless they are willing to devote themselves with unbiased minds to a careful investigation of the question. And this they should feel bound to do before they lend their names and influence to help cripple a means of study which multitudes of men whom they must respect tell them has been of vast service to mankind.

The demand is often and naturally made that definite results of practical value should be pointed out as immediately flowing from each given series of experiments, and when it is replied that this is not always possible, the motive of "curiosity" is liberally suggested. But let any fair-minded person go to the laboratories of chemistry, or of physics, or to the as-

¹¹ Ludwig, also, who was Dr. Bowditch's teacher, and whom I had the privilege of knowing, not only won by his character and kindness the affectionate devotion of a host of friends and pupils, but earned the gratitude of his townspeople for many acts of public spirit, among which was the instituting of reforms in the treatment of horses.

tronomical observatories, and transfer his demand there, and he will perceive how irrational it was to have made it at all. How often does a single series of experiments in those departments lead to a brilliant discovery? Yet how few great discoveries would ever have been made but for the silent and patient investigations into minor problems that to the untrained observer often seem trivial and irrelevant. Let the motive be called "curiosity" if one chooses, but with distinct recognition of the fact that the "curiosity" of the man whose mind is filled with knowledge, and whose instincts are keen to divine the part that his work will play in the final structure, is one of the greatest forces of progress.

Many of these investigations, in every department, seem to turn out blind alleys, and to end for the moment in nothing. It is inevitable that this should be so, until men have infinitely greater powers than now wherewith to fathom the vast unknown. But discovery comes by study and only so, and many a failure, conscientiously interpreted, proves to be the fingerpost to an important truth. The splendid generalizations, like that with regard to the germ theory of disease, through which the practice of surgery and medicine has been revolutionized, are, to the lay mind, the most obvious triumphs of experimental research. But he who seeks out the sources from which practical medicine really derives its strength will be amazed to find that there are many other achievements just as important as these, though of a different order.

The difficulties in the way of medical progress are so great that practical physicians are under a constant temptation to cease trying to surmount them, and to let themselves degenerate into routine practitioners, or pure empiricists. Even the great geniuses would more often lead us astray, as they have repeatedly done in the past, were it not that the experimentalist is ever at hand to apply the touchstone of criticism or hold up the torch of inspiration and guidance. If the expression "A power behind the throne" was ever justified, it is justified as expressing the relation of experimental physiology and pathology to practical medicine.

It is obviously important that all this experimentation should be conducted according to the most humane sentiments of our day, but also in such a manner that each observation shall yield its due share of benefit, and not be wasted. Surely the best means of securing the observance of these conditions is to support our institutions of learning so that they can secure teachers and investigators with wisdom to desire the highest knowledge, and powers trained to find the surest path to reach it, and characters which would make them incapable of inhumanity. Many a person who is now trying to invent some ingenious method for hampering and hedging the work of the physiologist would recall with a feeling of shame how much suffering and calamity was brought upon this country during our Civil War by the attempts to rule the generals from Washington, and by the foolish clamor of those who wished the struggle abandoned because their narrow vision only let them see the present distress that it entailed. The war against disease is like any other war, and can only be carried on successfully with trained generals, supported by public opinion, and allowed to choose their own methods.

Is it legitimate to use experimentation upon living

animals for the purposes of teaching as well as for the purposes of research?¹² There are many persons who would answer this question in the negative. But let it be remembered, on the one hand, that the students of to-day are the teachers and investigators of to-morrow; and, on the other hand, that even as fitting themselves to be physicians, the knowledge that they derive from actually seeing an experiment is of a wholly different order from that which they derive from hearing about it. Here, also, it is a question of how to make experimentation bear its fullest fruit. It should, of course, be remembered that, so far as warm-blooded animals are concerned, they are always in a state of anesthesia, and incapable of suffering considerable pain when the demonstrations are being made.

The study of medicine and physiology is no child's play. It is a serious business, and a good medical school should see to it that the men whom they graduate realize to the full the responsibilities and problems with which they are to come in contact. If they do this better for having had an important truth driven home by an ocular demonstration upon a narcotized animal, then the demonstration was worth making. The charge that students become hardened to suffering in this way is as baseless as the similar charge occasionally brought against surgeons.

It has not seemed possible, or desirable, to attempt in this paper to enter exhaustively into all the questions that suggest themselves to the mind in connection with this controversy; my main object has been to bear witness to what I have seen. I should like, however, to state that in my opinion the position of those who strive for "total prohibition" is hardly more unreasonable than that of those who, like Dr. Leflingwell, have temporarily joined hands with the total prohibitionists, but really wish only to see annoying restrictions imposed upon men hitherto trusted in all things.

The injustice of legislation like that now in force in England, which admits that experimentation on living animals is justifiable, but attempts to substitute for the conscience and knowledge of the trained investigator the judgment of men no better or wiser than himself and infinitely less well equipped for estimating the probable value of his work, recalls the prolonged attempt to establish a censorship of printing, against which Milton wrote, in 1644, his eloquent protest, "Areopagitica: Defense of the Liberty of Unlicensed Printing." I recommend to every lover of liberty and progress the reading of his manly and invigorating plea.

CHRISTIAN SCIENCE IN MARYLAND.—A bill is now before the State Legislature of Maryland restricting the practice of medicine to duly qualified physicians, and providing that "any person shall be regarded as practising medicine within the meaning of this act who shall attempt to heal, operate on, or prescribe for any ailment of another." A public hearing held last week brought out a large number of Christian Science remonstrants. The wording of the bill is perhaps rather too comprehensive, though it will no doubt tend to suppress the practice of Christian Science.

¹² I do not refer, of course, in what follows, to the question of demonstrations in high and grammar schools, which have already, and very properly, been forbidden by law.