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THE UTILITY AND
OF
VIVISECTION

BY
G. GORE, LL.D.,

LONDON:
J. W. EOLCKMANN, 2, LANGHAM
1884

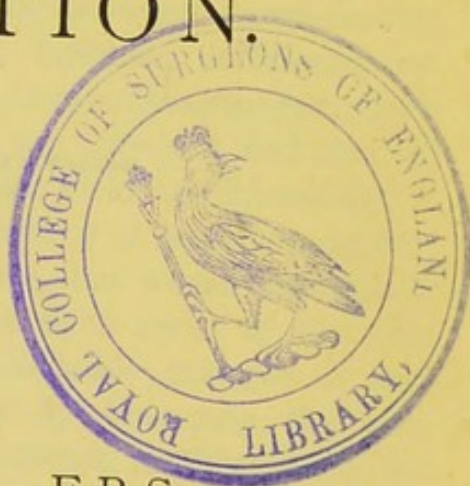
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THE UTILITY AND MORALITY OF "VIVISECTION."*

It may appear strange that, whilst we are surrounded on all sides by practical proofs of the great value of scientific knowledge, in the form of steam engines, coal-gas, photography, electro-plate, telegraphs, telephones, anæsthetics, &c. &c., and whilst every person is continually deriving benefits from science, assertions are widely disseminated that in physiological science experiments are "useless." The circumstance is, however, sufficiently explained by the fact, that but few persons have realized the great truth that the essential properties of matter are universal, and that all properly made new experiments therefore yield new knowledge.

New knowledge is the fundamental source of human progress ; without it mankind could not advance, but would continually repeat, generation after generation, the same series of thoughts and actions. The Chinese are a remarkable example of this. New knowledge is discovered either by observing the phenomena which Nature spontaneously presents, or those which we artificially produce by means of experiments ; and as we cannot create it, we have no choice but to accept it from these sources.

Experimentation is only a method of extending the scope of ordinary experience by means of artificial conditions, and the knowledge obtained by it is only an enlargement of that acquired by such experience. Whilst, on the one hand, Nature presents many phenomena which we cannot artificially cause, on the other hand, experiments enable us to produce innumerable effects which we never see in Nature. We might as reasonably expect an effect to happen without a cause, as hope to settle certain questions without the aid of experiments. If Sir Humphry Davy, or some other investigator, had not isolated potassium or sodium by means of experiments, we should never have seen those metals to this day. If also we wished to ascertain the physiological effect of chloroform upon men and animals, we

* By the term "vivisection" is here meant those experiments to which "anti-vivisectionists" object—viz., all kinds of painful ones on animals.

might wait for ever for Nature to spontaneously produce that phenomenon. As experiments yield us much information which we could not possibly obtain without them, they are indispensable sources of new knowledge.

According to the doctrine of universal causation, the present state of the universe implicitly contains all the future states of the universe, and the latter will be evolved out of the former in accordance with the law of the indestructibility of matter and motion. It therefore follows that if we possessed infinite intelligence, we might logically reason out all the effects of every possible experiment, and actual trial, whether natural or artificial, would not be necessary. But our intelligence is not infinite; on the contrary, it is excessively feeble in comparison with such a task, and we must be content to discover new knowledge by the means allotted to us, very slowly, and with endless toil and trouble, and we must in all cases follow where Nature leads.

New experiments usually impart new knowledge, and the knowledge thus acquired has frequently caused scientific men to think and act in some degree differently from other men; and this difference of belief and conduct with respect to some subjects, especially sentimental ones, has in some cases excited the hostility of unscientific persons, and induced them to oppose the progress of science. As also the new knowledge discovered by the former class of persons, and opposed by the latter, has proved itself to be a great fundamental source of human progress and civilization, we may correctly designate scientific and anti-scientific persons as advancing and retarding sections of mankind. In a wider view of the case, however, we may consider both these classes as being essentially necessary to human welfare; the former to cause human advance and gradual improvement of condition, and the latter to regulate the speed of progress, and insure sufficient stability in human affairs. If all men were scientific, society would be in a state of chaos, caused by incessant change and the too frequent introduction of new ideas; and if, on the other hand, no men were scientific, scarcely any new knowledge would be acquired, and very little amelioration of the physical evils of life would be effected. In accordance with these views, we find that the scientific man who is much in advance of his age, is as surely and almost as greatly punished as the unscientific one who is much behind it. It is quite correct, therefore, to speak of new scientific knowledge as an advancing influence, and ignorance of science as a retarding and regulating one in relation to human progress. Ignorance of science is easily accounted for; most men are fully occupied in getting an income, and of those who have leisure, only a few have natural scientific

ability. There is no disgrace in being unacquainted with science ; men may be rich in other kinds of knowledge and possessions ; no man can do that which is impossible in his circumstances ; and all men are equal in the sense of being equally determined by causes. The conflict between these advancing and retarding sections of mankind is manifested in the Darwinian controversy, the anti-vivisection movement, the opposition of religion and science, and in all the differences of opinion and action of scientific men, and of those who are opposed to experiments and scientific beliefs.

In consequence of these differences of scientific knowledge, in olden times the retarding section of mankind regarded scientific experiments as devilish, and severely punished those who performed them. Subsequently, as ignorance diminished, experiments were regarded as an impious prying into the secrets of the Creator, and the punishment of investigators was restricted to ostracism of them from society. In recent times, since scientific knowledge has extended, the charge against investigators has been still further reduced, and experiments have merely been stigmatized as a useless hobby, fit only to be indulged in by idle and wealthy persons. But even now, notwithstanding the wonderful results of scientific experiments surrounding us on all sides, another charge has been raised, that a certain class of experiments—viz., physiological ones—are “useless,” “cruel,” “worthless,” “not attended with scientific results,” “only pander to curiosity,” and “ought to be totally suppressed.” One reverend gentleman terms animal physiologists “ferocious monsters.” This series of facts shows, that although the opposition to the gaining of new knowledge by means of experiments has gradually diminished, it is even now occasionally resuscitated by bringing new and opprobrious charges against it.

The assertion that experiments in one particular science, and that one alone, are useless—*i.e.*, afford us no useful knowledge—is a startling one ; and as it implies a contradiction of one of the fundamental truths of science, I will examine it by the aid of knowledge obtained during many years of experimental research and of constant historical criticism of the relations of experiment to human welfare.

Even if it were true, it would be impossible, by taking individual instances, to prove that all physiological experiments on animals are useless, because that would be an endless process. It could only be proved by general reasoning, by showing that when elementary substances are combined in the form of living animal tissues, they lose their fundamental properties, and yield no consistent results by means of properly made experiments ; but

this has not been done. The question, therefore, naturally arises, why are experiments in physiology alone considered useless, whilst those in all the other sciences are admitted to be useful? In a pamphlet, of which many thousands of copies have been circulated by "anti-vivisectionists" in this and other countries, the explanation given is, that "no one can urge the slightest ground of objection against the astronomer, the chemist, or the geologist in their ways of working, and the commendation of all other workers is the comparative certainty of their results. But for the physiologist, working upon a living animal, there are two strong objections: that he is violating a strong public sentiment, and that he tabulates results of a most uncertain and often quite contradictory kind."

With regard to a strong public feeling, whatever its origin, whether ignorance or wisdom, it must be considered: either might is right, or right must temporarily yield to might in such cases. If the sentiment is based upon false ideas, its falsity should be exposed. False sentiment must sooner or later yield to fact, and there is great reason to believe that the erroneous notion that genuine physiological experiments are cruel and useless, like that of their being devilish and impious, will disappear by extension of knowledge. At one time it was a violation of public sentiment to watch the motions of the heavenly bodies. Some evidence respecting the falsity of the above anti-experimental sentiment will be given in this essay.

According to the above-quoted statements, experiments in physiology are useless, because the investigator tabulates results of the most uncertain and often quite contradictory kind; and those in certain other sciences are commended on account of the comparative certainty of their results. The question may therefore be asked, do all experiments in physiology fail? does drowning a dog, when properly performed, fail to kill him? is the result most uncertain because the experiment is a physiological one? or is it only in some cases that the results are contradictory? If it is only in some cases, then knowledge is gained, and the experiments are not useless. And if the uncertainty of result is only somewhat greater in degree in physiology than in the other sciences, it is not correct to say that experiments in the former ought to be "totally suppressed."

Uncertainty of results of experiment depend largely upon the degree of complexity of the phenomena. That the various sciences have different degrees of complexity is a recognized truth; and they increase in complexity in about the following order:—Mechanics, acoustics, heat, light, magnetism, electricity, chemistry, physiology, psychology. It is also well known that in each science

experiments of the most varied degrees of complexity and uncertainty are made. Some of the most complex experiments of organic chemistry are much more likely to yield uncertain results than the simplest ones of animal physiology. Many of those in agriculture are very uncertain. In all the sciences, while the proportion of unsuccessful new experiments is large, an abundance of successful ones may be made; and the degree of certainty of the results depends largely upon the skill and perseverance of the operator.

Physiology is most intimately related to all the other sciences. Whilst great manifest differences exist between dead and living things, the elementary substances do not lose their essential properties when they unite to form living structures. All living things are constructed of the same elements as dead ones: carbon, hydrogen, oxygen, nitrogen and calcium, are their chief constituents. All the physical forces—gravity, heat, light, electricity, magnetism, and chemical affinity—are continually acting upon living creatures, as well as upon lumps of metal and pieces of stone. Live animals possess weight, are animated by heat, affected by light, electricity, and magnetism; chemical changes are incessantly occurring within them—foods nourish, and poisons kill them. And as the fundamental properties and forces of different living substances may be influenced in an almost infinite number of ways, it follows as a necessary consequence that living creatures may be made the subjects of an immense number of physiological experiments. As also those properties and forces are universal, and the same instrument—viz., the human brain—is used to investigate them in all cases, the same essential modes of research are adopted, and the same mental processes of perception, observation, comparison, and inference are employed in investigating physiology as in examining all the other sciences. As all physiological experiments upon animals are in all these fundamental respects similar to those of the physical sciences, the assertion that they are “useless” is not a credible one.

It is quite true to say that the more complex a science is, the more difficult usually is it to obtain reliable results by making experiments in it, but that only renders more skill and care necessary. Certainty is a relative quality; experiments of the most varied degrees of certainty may be made in each of the sciences, and sufficiently reliable results may be obtained if the means used by careful investigators are employed: it would be incorrect to draw a line at the science of animal physiology, and say, here ends all certainty. Absolute certainty is rarely attained even in the simplest sciences—many of the results in astronomy are approximations only; we must, however, be satisfied with

what we can get—beggars of Nature may not be choosers. We do not reject evidence because it does not afford us actual certainty. Medical men do not refuse to use chloroform because its action is somewhat uncertain. Even anti-vivisection surgeons have not avoided making experiments in ovariectomy at the risk of causing the deaths of their patients by poisoning them with carbolic acid ; and if those experiments were “useless,” or had not been made on account of the uncertainty of the results, the present degree of success of such operations would not have been attained. The mere effect of fog upon our lungs conveys to us the physiological fact that it influences our breathing, and that portion of knowledge is quite sufficiently certain for some practical uses. The great bulk of evidence even in the simplest physical sciences only yields us probability ; nevertheless “probability is the very guide of life,” and the man who never makes an experiment until he is quite sure that it will furnish an absolute proof, will never make one at all ; and if he was quite sure beforehand what the result would be, he need not make the experiment. Unless, therefore, every experimental physiologist hitherto has been quite an incompetent worker, some physiological experiments on animals must have yielded results as free from uncertainty as many of those obtained “by the astronomer, the chemist, or the geologist.” It has also been asserted that “there is a perfectly parallel dissimilarity between the functions of animals and those of man ;” and this assumption has been used as an argument to prove the uselessness of physiological experiments on animals ; but who would venture to affirm that the physiological fact, that the prolonged immersion of a dog in carbonic acid gas produces death, is not of value as evidence that the same treatment would be almost certain to kill a man or other air-breathing animal ? In such cases we are guided most by the usual results and less by the exceptions. One of the great uses of such experiments is to discover similarities and differences in the comparative physiology and pathology of man and animals ; and this knowledge is of great practical value.

Experimental research is usually a difficult occupation, consuming a large amount of time ; it is no uncommon event for a person to engage in it and soon abandon it on account of these circumstances and of the absence of remuneration. Few persons succeed in it ; persons of great ability in ordinary matters, who have been accustomed to quickly decide important practical questions in daily life, sometimes engage in research, and sooner or later find that questions in it cannot be settled in the same off-hand way. Any one who wants to discover new knowledge must be prepared to pay Nature’s full price for it ; Nature is usually, though not always, ready to yield up her secrets to those who consider them worth the cost. Although scientific research is not a “privileged

mystery," it is, like any other occupation requiring a special combination of abilities, so far privileged labour, that it yields consistent results only to those who bring to it sufficient ability, perseverance, and self-sacrifice. The fact that some persons of ability in other matters, have made series of physiological experiments on animals, and have found that "they only added to the confusion," is either evidence of "incomplete work," or that some researches are not easily made. The relations also of scientific research to public welfare, and the question how such research may be best promoted, have been examined by a Royal Commission, and have puzzled many of the most able men.

Uncertain and contradictory conclusions arise from various causes, and some of those causes are well known to experienced investigators ; such conclusions usually arise from imperfect work, particularly from insufficient perseverance. In many researches in astronomy, chemistry, geology, and physiology, some of the phenomena are difficult to unravel ; nevertheless there usually exist methods of investigating them and of obtaining reliable information from the results. In such cases a greater degree of skill and perseverance is required, and one man may fail whilst another may succeed ; it therefore would not logically follow that because one physiologist had obtained only uncertain and contradictory results by making experiments on animals, that all the results of thousands of such experiments made by other physiologists would be unreliable.

Persons who have had little or no experience in scientific research are apt to conclude that the phenomena of Nature are much more simple than they really are, and it is only by extensive experience in such labour that this erroneous notion is usually corrected. In consequence of this error, persons who have only a smattering of science are liable to make plausible fallacious statements in it, which are believed because they are simple ; whilst truthful explanations, being more difficult to understand, are rejected. These facts are used as a basis of quackery ; the untruthful charlatan, whose only research is for guineas, perceives that by assuming a scientific appearance, and offering to unscientific persons a plausible theory which agrees with their false beliefs, he can obtain notoriety and money. Ignorance regulates the speed of progress ; men are more influenced by appearance and sentiment than by truth and argument ; they long preferred to believe the more apparent notion that the earth was flat, than the less simple one that it is a sphere. The difficulty also of making complex scientific truths intelligible to a general audience, disinclines careful scientific men from placing themselves in the disadvantageous position of publicly discussing such truths with plausible theorists.

Animal physiology is one of the least developed of the sciences ; this arises partly from its complexity and partly from the circumstance of its progress being so largely dependent upon that of the simpler ones. There were many experiments which could not be made, and questions which could not be answered in physiology, until voltaic currents were discovered for stimulating nerves, and the galvanometer and capillary electroscope were invented for detecting muscular electric currents. Until Priestley discovered oxygen, a true theory of respiration was impossible ; and at any future time, other physical discoveries and inventions may be made which will greatly enable physiology to advance.

The present state of development of physiology is only equal to that of chemistry, as the latter was many years ago ; and, like the simpler sciences in their earlier stages, it consists largely of crude statements not yet harmonized by general laws. The assumed contradictions of physiologists respecting the conclusions they have drawn from the results of their experiments on animals, are incessantly quoted, as if they proved the entire absence of any reliable knowledge to be gained from those experiments ; but the history of all the simpler sciences contains plenty of such assumed contradictions. The fact, therefore, that a large number of the results of physiological experiments appear to contradict each other does not necessarily prove that all of them are really contradictory, but rather that their apparent inconsistencies are not all real ones, and that they will be harmonized and their errors eliminated by sufficient research, in a similar manner to the simpler sciences. It is not less experiment therefore, but more, that is necessary in physiology. The results of properly made experiments do not contradict each other ; if they did, successful research would be impossible ; and when such results have been well verified we are bound to accept them as facts whether they appear consistent or not. A cork falls in air and rises in water, a stone sinks in water and floats upon mercury, and these facts at one time appeared irreconcilable, but since the discovery of the principle of gravitation we have known that they mutually confirm each other. These and other similar cases illustrate the truth of the apparently paradoxical statement, that seeming inconsistency of experimental results in complex cases is, when obtained by competent workers, a sign of truth.

Nearly every scientific truth has been gradually evolved out of a mixture of apparently inconsistent facts and error, and if physiological experiments are abandoned because the results of them appear to some persons to "consist of a mass of observations in which each observer contradicts some other," physiology will never be developed at all. Experiments yield truths which no

other method can, and each different experiment yields different truths.

The conviction that every experiment, when properly made and recorded, is reliable and useful, is a characteristic of a really scientific mind; every competent investigator therefore perseveres until he obtains reliable results. It has been with an entire belief in the utility of physiological experiments as a source of knowledge that physiologists have sacrificed their fortunes, their time, and sometimes their health and lives, in the making and publishing of experiments. In this belief, it is recorded that John Hunter expended, in connection with his experiments, no less than seventy thousand pounds in money, besides an immense amount of time and personal labour; and of Harvey it is stated that he spent as much as eight years in research before he published his views respecting the circulation of the blood. He also left an instruction to the College of Physicians, that an oration should be delivered once a year to induce its members "to search out the secrets of Nature by way of experiment." Tens of thousands of physiological experiments have also been made, many of them by men of the very greatest experimental ability, evidently with the most perfect conviction that the published results were useful. The titles of all those researches made since the year 1800, under the names of the authors, may be found in "The Royal Society Catalogue of Scientific Papers;" a large work, the cost of compiling and printing which was about ten thousand pounds.

It is reasonable to infer that as so large a body of physiologists have not observed that all their experiments on animals "led only to uncertain and often quite contradictory results," and as this assertion contradicts the fundamental fact of science, that all properly made experiments yield knowledge, the assertion is incredible.

The belief of the eminent operating surgeon, Sir William Fergusson, has been repeatedly quoted, "that in his opinion nothing had been gained for surgery by experiments on the lower animals;" but he was not an experimental physiologist, for if we refer to the above Catalogue (which was intended and is considered to contain the names of all the authors and the title of every experimental research, both English and foreign, made in physiology and all the other sciences from the year 1800 to 1873), his name does not appear. As he was not an experimentalist, he could not be fully acquainted with the relations of such experiments to surgery.

Also, of the entire thirteen medical men whose "medical testimony against vivisection" has been widely published by "The London Anti-vivisection Society," the name of only one appears

in the above Catalogue as having published any physiological experiments, and that one has publicly stated that the results of his experiments were "untrustworthy." And amongst all the names of the persons who have taken a prominent part in opposing physiological experiments upon animals in this country, I have been unable to find that of a single individual of acknowledged eminence as a scientific experimentalist.

At a meeting of some thousands of medical men from all parts of the world, held in London, August 9, 1881, the following resolution was unanimously passed:—"This Congress records its utmost conviction that experiments on living animals have proved of the utmost service to medicine in the past, and are indispensable to its future progress." And two days afterwards, at a crowded meeting of the British Medical Association, the following resolution was carried with but one dissident:—"This Association desires to express its deep sense of the importance of vivisection to the advance of medical science, and the belief that the future prohibition of it would be attended by serious injury to the community, by preventing investigations which are calculated to provide the better knowledge and treatment of disease in animals as well as in man."

That new physiological experiments really do yield new knowledge is, I consider, abundantly proved; and all new knowledge is good because it comes from the source of all truth. That new physiological knowledge is also useful is proved by the fact that it may at once be used as a means of discovering more knowledge, and also as a source of mental discipline, improvement, and pleasure. Even apparently trivial results, if they are of an essentially novel kind, sometimes lead to the discovery of additional knowledge of the very greatest utility and importance; frictional electricity is said to have been discovered by means of the apparently trifling observation, that a bit of amber, by being rubbed, acquired the property of attracting a feather; and the discovery of voltaic electricity was largely connected with some seemingly insignificant physiological facts observed by Galvani. In addition to these uses, new truths in all the sciences are continually being applied in the form of inventions in the arts and manufactures; also in therapeutic and sanitary matters, the prevention and cure of disease, the regulation of human affairs, &c.; some of these useful applications are made immediately, whilst others are not made until a long time has elapsed. Scientific knowledge also often influences our conduct beneficially when we do not perceive it. It is only when experimental researches are very imperfectly made, that the results are useless, and this is true in every science. The least answerable objection

to physiological experiments is, not that they are useless, but that the results of them sometimes compel unscientific persons to advance more rapidly and to change their modes of thought and action. The anticipation that the advance of science will disturb religious belief and emotional sentiment, is largely the essential and hidden cause of opposition to scientific research.

It has been stated by "anti-vivisectionists" that "your true physiologist, when he dares to speak his mind, laughs at the idea of promoting or thinking of the good of mankind. It is not for that he is working, but simply for science." "Scientific physicians smile at the very thought of cure: that word is relegated to the vocabulary of quacks." "Humanity drops out of sight, and science is all in all. Medicine is no longer humane for mankind; it is scientific. The enthusiasm of science now animates the body medical in place of the enthusiasm of humanity." "The pursuit of physiological and therapeutic science has become the foremost object, and the cure of patients has fallen into the background." In reference to these assertions, as every competent physiologist knows that all physiological truth is good and useful to man, and has quite settled his mind on that point, there is no necessity for him to think about it when he is engaged in abstract research. Whilst also his immediate object is new knowledge, he is quite convinced that the ultimate practical effect of his labours will be relief of disease and pain in men and animals. There is no fundamental necessity for physiological investigators to be also occupied in curing patients; let any one prove, if he can, that there ought not to be the same division of labour in physiology as in the other sciences—viz., one class of persons to discover new truths, and another to apply them.

It has been said with regard to the utility of physiological experiments on animals: "It is a question chiefly of historical criticism, and we must have a conclusive answer concerning each advance which is quoted as an instance: how much of it has been due to vivisectional experiment, and how much to other sources, and this amount must be clearly and accurately ascertained"—the answer also "must be clear and decisive, must be free from doubt of any kind, and, above all, it must not assume the protection of a privileged mystery."

With regard to these large demands: The utility of knowledge obtained by means of such experiments has been already fully proved to the satisfaction of nearly every scientific investigator and medical man, and those persons who are not satisfied with the evidence, and are not acquainted with the great scientific facts, that every properly made new experiment yields new knowledge, and that all knowledge is good and useful, must be left to take

their own course. It requires very little skill to ask complex questions; it is also far more easy to challenge experimentalists to prove their statements than to acquire the ability to understand their proofs. It is not a duty of scientific men to answer every question, because, however much may be explained, there always remain unexplored portions of science for anti-scientific persons to cavil about. Most scientific investigators consider that by making costly and difficult experiments and giving the results of them to the public, they have thereby more than fulfilled their duty in the matter. The usual method also adopted by genuine scientific investigators to obtain conclusive answers to complex scientific questions, is to work for them by making experimental or other research, and to persevere until reliable results are obtained.

It is worthy of notice that when the same persons who have thus demanded of physiologists such "clear," "conclusive," and accurately measured answers to these complex questions, have been called upon by their fellow anti-vivisectionists "to say something on the nine or ten instances in which it is claimed that vivisection has advanced our knowledge and been a practical benefit"—*i.e.*, to *disprove* these same claims—they have only replied, "The subject is so technical that we cannot here go into it in detail."

It is usually not easy to prove exactly how much knowledge has been obtained in a particular case by means of experiment, and how much by means of ordinary experience, observation, &c. The utility of knowledge also is not a very measurable quality, and utilities which differ in kind are still less commensurable. In order to best be able to judge of the degree of utility of an experiment or result, we require to know all the relations and circumstances of the case, past, present, and future, and the latter we cannot obtain, because new utilities continually arise from old discoveries. Physiological discoveries, like nearly all others, usually work for our benefit in indirect ways, such as the following:—A medical man is treating a patient for diabetes in the usual manner, but finding the treatment ineffectual, he remembers that Claude Bernard discovered that by puncturing the fourth ventricle of the brain of an animal, diabetes was produced, and inferring from this that the symptoms may be due to a cerebral cause, he alters the treatment and cures his patient. Numerous facts similar to this are known to medical men, and produce in them the conviction that physiological experiments on animals are useful. It is largely because non-medical persons have not had such experience that they disbelieve in the utility of those experiments.

There are plenty of facts in science which cannot easily be

proved in so brief and simple a manner as to be understood by non-scientific persons. It is a fact that rate of insurance upon cargoes is affected by the discovery of magnetism many ages ago ; that the successful use of the Bessemer steel converter was assisted by Newton's discovery of the refrangibility of light ; that the price of copper is influenced by the results of some philosophical experiments made by Faraday ; and that the dynamo-electric machine and electric light are essentially results of the same experiments. But to give "a conclusive answer concerning each advance which is quoted as an instance, how much of it has been due to experiment, and how much to other sources" (such as practical experience, the energy and capital of business men, &c.), and to "clearly and accurately ascertain this amount" would be a difficult matter. The advance of knowledge and civilization, and the relief of human suffering, by means of science, is, however, none the less real because we are not able to clearly and accurately ascertain "how much of it has been due to experiment and how much to other sources."

It has further been stated that physiological experiments on animals are "mediæval methods for modern research," "hindering real progress ; that if it were utterly stopped, the result would certainly be the search for and the finding of far better and more certain means of discovery ;" also "that we have such splendid and rapidly developing methods in hundreds of other directions." In reference to these assertions, the only great source of knowledge of animals in health and disease equal in magnitude to that of experiment, is observation of Nature, and if "far better and more certain means of discovery, in hundreds of other directions," equal in importance to that of experiment, really exist, it would be an urgent duty and a priceless boon to humanity to disclose them. To find a single "far better and more certain means of discovery" than that of experiment, would itself be the greatest discovery mankind has ever seen.

It has been proposed also that we should limit our sources of physiological knowledge to observation of phenomena which spontaneously occur in living creatures in health and disease. One of the results of this would be to keep mankind in ignorance of an immense amount of information which only experiments on living creatures can supply, including probably that of the great general laws so much needed to explain physiological facts. A second result would be that we should have to wait an indefinite time for Nature to spontaneously offer us knowledge, some of which might be obtained at once by means of experiments. A third would be that numerous diseases and evils which afflict mankind and other animals, would continue permanently, and

others an indefinite period, without remedy or amelioration. The saving of human life by means of the lightning-rod was arrived at, not alone by observing the lightning—for that had been done through all time—but by the experiments of Gray and Wheler, which showed that metals conduct electricity, and by the physiological experiments of Kleist, Cunæus, and Franklin, which proved the identity of electricity and lightning. The use of the Leyden jar, condenser, and induction-coil, for the excitation of nerves and the relief of nervous and muscular complaints, was also arrived at largely by means of physiological experiments upon men and other animals, and would never have been acquired had we limited our sources of physiological knowledge to observation of symptoms in living creatures.

The two fundamental modes of obtaining new knowledge—viz., by observation and by experiment—are usually no more under the control of man to choose to employ them or not when new knowledge is required, than are the movements of the heavenly bodies; the use of them for such a purpose depends upon the unalterable relations of the properties of the human brain and mind to those of external things. Any proposal, therefore, to dispense with experiment in acquiring new knowledge in physiology or any of the other experimental sciences, is a radically wrong conception.

It has been said that certain results of physiological experiments on animals “might have been arrived at” by some better method, and “quite as much was known before.” Although it is not of much use saying what “might have been,” such a remark is not unfrequently made, and is usually uttered by those who either have not the opportunity, the ability, perseverance, or self-sacrifice to make the research themselves. Not alone the discoveries of Harvey, but those of nearly every great experimentalist, Faraday included, have been thus spoken of. It is often easy to make such a suggestion *after* the event, because the results obtained have supplied additional knowledge. Such a remark is sometimes also a mean detraction of the skill, industry, and self-denial of the investigator. We are all of us, however, apt to undervalue the labours of our fellows, because we have not passed through precisely the same experience. Such remarks also usually indicate a forgetfulness of the universality of causation, because a full belief in that law would lead us to conclude that under the existing circumstances events can only happen in the way they do, and if we depart from that principle, we cannot logically stop short until we arrive at the conclusion that the present state of civilization “might have been arrived at” by some better method than it really has, and that even the whole system of Nature “might have been” created perfect, free from evil, sin, and suffering.

The proposal to "utterly stop" physiological experiments on animals is not a minor question, such as whether Ferrier's experiments have enabled medical men to more successfully treat epilepsy and abscess of the brain, but a fundamental one; it is a proposal to stop a most fundamental source of new knowledge, without the possibility of a substitute except in a few cases, and limit ourselves to the more empirical method of observing the ordinary course of Nature in living things. Not only do experiments yield us knowledge unattainable by observation only, but they often give us much more valuable information—viz., knowledge of general laws and principles. By means of experiments also we can often obtain an answer direct to the point, because we can exclude some interfering circumstances; but when we get knowledge by observation of Nature, the effect is often interfered with by conditions which we cannot avoid. Knowledge obtained by observation of natural phenomena also is usually more complex and more difficult to unravel than that obtained by suitable experiments. Each method has, however, its own advantages, and which is the most suitable depends upon the nature of the case.

The cost in pain and distress by the experimental method of physiology is in many cases vastly less than that of waiting for knowledge from simple observation of natural phenomena. Whilst we are waiting, millions of men and other animals are suffering pain and dying prematurely. Disease and pain appeal for help. Death will not wait. A single incursion of an epidemic carries away thousands; cholera its tens of thousands. Nature has sacrificed millions of lives by pestilences, and tens of millions by floods, volcanic outbursts, earthquakes, plagues and famines, whilst man has been waiting for more knowledge; and the information gained by these fearful experiences has been altogether insufficient to enable us to predict their occurrence, provide against them, or prevent or obviate their dreadful effects. The pain and loss of life produced through ignorance is still greater. Even experimental research will only enable mankind gradually to resist such fearful attacks. The manifest inference to be drawn from these facts is, that we must get our knowledge as we get our physical food—viz., from all available proper sources.

If physiological experiments on animals are "utterly stopped," instead of honourably obtaining new physiological knowledge by our own labour, we shall have to obtain it second-hand at the expense of other nations. One result of this will be, that in all the useful and technical applications of such knowledge we shall be behind those nations, and our public health will suffer. We have already been punished for similar neglect of physical and chemical science by the transference of some of our manufactures

and trade to other nations, and it would be wise to take warning from this dearly bought experience.

We now come to the pith of the matter. Each step in life usually necessitates a choice between two evils: either we must go without what we need, or make some sacrifice in order to obtain it; and in such a case, one of the greatest of moral rules is, that of two alternative evils we should choose the least. The painful alternative of the present case is—*either experiments on animals must be made, or the wholesale pain, disease, and slaughter of man and other animals by pestilences, epidemics, small-pox, scarlatina, foot and mouth disease, anthrax, &c., and especially through ignorance, must continue almost unabated.*

Upon this fact depends the entire question. Without the necessary knowledge, remedies cannot be devised; and the requisite knowledge can only be acquired by means of physiological experiments on animals, in addition to that obtainable by observation of Nature. If anti-experimentalists could prove, either that the above alternative is not a fact, or that the necessary knowledge is obtainable by "far better and more certain" means than experiment, it would be a great relief to scientific men as well as to themselves.

Life must be maintained, and knowledge is necessary in order to maintain it. Knowledge is an absolute and indispensable necessity of physical existence, second only in degree of urgency to physical sustenance; mental food must therefore be had. Knowledge is necessary, not only to enable men to preserve their own lives but also those of animals, and that gained by means of experiments on animals is more applicable to the preservation of the lives of animals than of man; those persons therefore who are opposed to experiments on animals are enemies to animal welfare.

The gaining of new knowledge by means of physiological experiments on animals has recently been spoken of by the retarding section of the community in the following terms:—"It panders to curiosity, but adds nothing to practical knowledge;" "a ravenous curiosity which endeavours to find out by vivisection what will turn up;" "useless as an instrument of scientific discovery;" "scientifically worthless;" "hideous curiosity;" "thousands of animals are mangled at random with no other object than seeing what will happen," &c. And the physiologist has been likened to "an awful picture of a man besotted with a lust for knowledge, just as murderers are sometimes besotted with a lust for gold."

In reference to these quotations it may be remarked: New knowledge is a gain to all men through all time; experiments

are therefore transient sacrifices for permanent gains, and a small temporary evil cannot balance an endless good. All intelligent persons crave for knowledge, and the desire is a rational one, and conduces to general welfare. The less a man appreciates knowledge, the more he approaches in nature to a beast. Wilful ignorance is a crime and an offence against morality, because an ignorant man is a danger to society and is a source of wrong conduct. It is well known that in all ages, through deficiency of knowledge, some of the worst of deeds have been committed with the best of intentions. To keep men in ignorance is an injury to the community. Also a great difference between those who love gold and those who love new knowledge is, that the former not unfrequently spend it on luxuries and selfish objects, whilst the latter in nearly every instance publish the knowledge at once for the good of mankind.

It is a waste of energy to oppose that which we cannot prevent ; we must accept the conditions of life as they exist on this planet, whether we like them or not. Pain and suffering are the lot of all living creatures, none can avoid it.

“ Even in the most exalted state,
Relentless sweeps the stroke of fate :
The strongest fall.”

It is largely because life must be maintained that every class of animals live on those which cannot resist them, and the question of pain is a secondary matter. All living creatures suffer pain for the benefit of each other. Men compel each other to suffer pain, and “anti-vivisectionists” are no exception to this statement. Throughout Nature the weaker animals are sacrificed to the stronger. All animals are sacrificed to man. Even men themselves are ruthlessly pained and destroyed in countless numbers by the necessary operation of natural laws during earthquakes, famines, pestilences, &c., and if it were necessary for this planet to fall into the sun, the event would happen, and all living creatures upon it would be destroyed. The amount of pain which men have suffered in consequence of ignorance, however, vastly exceeds that from all other causes added together, yet this is precisely the evil which the retarding section of mankind, with the best of motives, are indirectly using their energies to perpetuate.

The opponents of physiological experiments on animals have also spoken of physiologists in the following terms :—“ Merciless vivisectors ;” “ a new fiend of scientific cruelty come forth from the Pit ;” “ this diabolical vivisector ;” “ human monster ;” “ scientific barbarians ;” “ human demons in a hundred of those

earthly hells ;" "these torturers in pursuit of scientific discovery." And of physiological experiment as follows :—"Vile pursuit ;" "the hideous art ;" "devilish science ;" "ghastly savageries ;" "this debasing cruelty ;" "the horrors of the scientists ;" "cruel quackery ;" "the practice of scientific torture ;" "inhuman as well as criminal practice ;" "this insolent cruelty of modern science ;" "the insatiable demands of a merciless science ;" "the lust of cruelty has its *safe* safety-valve in vivisection, and the respectable party-cry is *Science* ;" "an organized system of barbarity, the only attempted apology for which is the selfish advantage its practisers assert may be gained from it ;" "it will profit worse than nothing to the community to gain the remedy for a score of bodily diseases, while souls are eaten up with the leprosy of selfishness and cruelty ;" "there remains only one course to be adopted as regards this plague of scientific cruelty, and I implore you to take it—stamp it out."

With regard to the above serious charges, pain and cruelty are two different things ; the infliction of pain is only cruel when it is without sufficient justification, and its justification lies in the avoidance of greater evil ; this is recognized in the maxim "spare the rod and spoil the child." The pain inflicted by animals upon each other in order to get food, or by man upon animals to learn how to preserve their lives and his own, or that inflicted by the operation of natural forces, in storms, earthquakes, &c., upon man and animals, is not cruelty, because it is necessary as a means of avoiding greater evils. By the common consent of mankind also, largely including "anti-vivisectionists" themselves, tens of thousands of animals are daily mutilated and subjected to pain, for the sake of sport, pastimes, luxuries, ornaments, social enjoyments, tastes, customs, and other inferior objects of infinitely less necessity than new knowledge, and if the former are justifiable, the latter must be so. It is not animals alone who are caused by necessity to suffer pain ; look at the suffering poor around in all directions, tortured by incessant want of food and fear of starvation, and largely in consequence of ignorance, which the retarding section of mankind unwittingly encourage.

With regard to the charge of real cruelty—*i.e.*, inflicting pain without sufficient justification—if applicable at all to physiologists, it would be to those few whose experiments have, according to their own acknowledgments, led only to "uncertain and untrustworthy" results, because in these cases no new physiological knowledge has been obtained in return for the pain inflicted. The fact also that a single physiologist, who was once a "vivisectionist," has publicly professed to have had "an awakening of conscience," does not prove that all other physiologists are cruel.

One would suppose from the above strong charges of cruelty, that the amount of pain inflicted upon animals by scientific men in this country is very great ; it is, however, comparatively small, and immeasurably less than that inflicted in thousands of instances of common occurrence in daily life for much less justifiable purposes. The pain is small : first, because there are very few experimental animal physiologists, about one to each million of inhabitants ;* and second, because medical students can rarely be induced to engage in original physiological research, chiefly on account of its not being adequately rewarded by enabling them to obtain certificates, degrees, or money.

With regard also to morality, physiologists have thus been characterized by "anti-vivisectionists:" "Desperate cowards;" "cowardly English bully;" "acquaint yourselves, working-men, with this monster;" "the men engaged in this class of research constitute a class dangerous to society;" "no vivisector can either be a man or a gentleman in our English sense of the word." And the morality of physiological experiments they have thus spoken of:—"This iniquity;" "the coward science;" "a base and cowardly crime;" "a new vice;" "this unhallowed and unrighteous thing;" "demoralizing practice;" "the practice is not only immoral in itself, but tends to demoralize those who witness or take part in it;" "for fame only is all this agony inflicted;" "those innumerable and cruel experiments undertaken only from vanity and ambition;" "un-English and cowardly sin;" "a detestable practice, without scientific result, and immoral in itself;" "it is directly contrary to the laws of God;" "an abominable thing and hateful in the sight of God;" "when our country has trodden under foot this evil science, and scorned its bribes of pretended discovery, then will all nations of the world cast out likewise the accursed thing." And the laboratories are described as "those earthly hells called the physiological laboratories of Europe."

In all these quotations it is assumed that painful physiological experiments on animals are highly immoral, but what actions can be more moral than those intelligently directed to relieve all suffering creatures? Whilst "anti-vivisectionists," inexperienced or incompetent in the use of the methods of gaining new knowledge by means of physiological experiments, are kindly trying to prevent pain being inflicted upon a few animals, they are blindly allowing disease and pain to be inflicted upon millions of men and animals in consequence of our deficiency of physiological knowledge ; if, therefore, either they or physiologists are immoral,

* The number of persons systematically engaged in experiments upon living animals in this country did not exceed fifteen or twenty.—*Report of Royal Commission on Vivisection*, p. 8, 1876.

it is themselves. Whilst it is not immoral to make experiments which are imperatively necessary, it is immoral to carelessly remain in ignorance. As also physiological experiments on animals yield knowledge which enables us to prevent and relieve the sufferings of animals as well as those of man, and such experiments cost a large amount of human thought, skill, and labour, it is only just that animals should, if necessary, share in the sacrifice.

It has been said by "anti-vivisectionists," that physiological experiments on animals "belong to the atheistic confession," and a Vice-President of the Committee of the "International Society for the Total Suppression of Vivisection," in a letter dated December 12, 1875, to the Royal Commission on Vivisection, stated: "All that I could say would be what the major part of the kingdom would say, that the practice of vivisection—an abomination introduced from the Continent—is horrid and monstrous, and goes hand-in-hand with Atheism. Medical science has arrived probably at its extreme limits, and has little to learn, and nothing can be gained by repetition of experiments on living animals."

With regard to these assertions, that physiological experiment on animals "belongs to the atheistic confession," "and goes hand-in-hand with Atheism," it may be remarked that it is not so much by means of unenlightened sentiment that men hold communion with the Creator, as by a knowledge of the great laws and principles by which Almighty Power governs all things, and which, largely, by means of experiments, scientific men have discovered. And the men who know most about the powers which regulate the universe and determine human actions are the most likely to know about a Cause of all things. If any men are Atheists, it is those who disbelieve in the Divine origin of knowledge, and encourage ignorance. And as to the assertion that "medical science has arrived probably at its extreme limits, and has but little to learn," it is a fallacy which no person who possesses the least knowledge of the subject believes.

With regard to the results of physiological experiments on animals, the same class of persons also say:—"The result is altogether uncertain; everything about the result is uncertain, but the certain infraction of the first laws of mercy and humanity;" "the argument in its favour is so remote that it is void by its very uncertainty;" "human benefit was only an accidental result;" "as usual, everything is unsettled by these horrible experiments, everybody contradicted, and nothing determined;" "then I ask what has been gained? I do not find that there has been any scientific gain; thousands of animals are mangled at random with

no other object than seeing what will happen ; " " you can never be sure in respect of any one experiment that it will be of any good whatever, or what will be the effect of the experiment performed. There is an element of uncertainty throughout the whole of the practice, and those who adopt it are obliged to endeavour by a series of agonizing experiments to obtain their knowledge, which may or may not be useful to some persons."

Opponents of physiological experiments on animals appear to think that because the connection between a physiological discovery and its useful application is in some cases remote or very complicated, the useful result is uncertain. Neither time, space, or complex relation, however, destroys the connection between a cause and its effect. We are all of us as truly the descendants of primeval ancestors as of our immediate parents. The hindmost carriage of a train is as certainly drawn by the engine as is the tender. The motion of the earth is as surely affected by that of the sun as if the two were one body. The rate of insurance of cargoes is as certainly influenced by the discovery of magnetism ages ago, as if that discovery was only made yesterday. The connection between a physiological discovery and its practical uses is also as sure as that between two of the simplest and most nearly related of physical phenomena. It is not absence of proof, but of the ability to comprehend proof, that causes anti-experimentalists to believe that physiological experiments on animals are useless.

It is also thus objected that physiologists do not know what the results of their experiments will be ; whether they will yield any results, or that they will be of any service whatever, and that such experiments are mere haphazard trials, and ought not to be made. The whole of this discloses a most painful state of ignorance on the part of "anti-vivisectionists" of the fundamental relations of experiment to new knowledge, and of the nature of such knowledge, and its relations to human welfare. It assumes that new experiments in physiology may be properly made without producing new effects or yielding new information, or that new knowledge may be useless ; each of which is altogether untrue and a relic of the dark ages.

We may reasonably conclude that what experiments in physics and chemistry have already done for the welfare of man, is evidence of what those in physiology will probably do for him if he will persevere in making them. We have no alternative but to trust in the laws of Nature, and in the belief that, as all scientific knowledge obtained in the past has proved of value, all such knowledge in the future will also be useful ; and with this conviction we must carefully make experiments, without always

knowing beforehand exactly what they will disclose. But if a man is a practical Atheist, disbelieving in Almighty laws, and says that he will not make physiological experiments until he can make them all upon his own selfish terms—*i.e.*, without pain, or sacrifice, or until he is sure that they will yield him the exact kind and amount of knowledge he demands—he cannot make them at all. It is of no use to attempt to haggle with the Creator; we must either accept the terms offered, or continue to suffer the full effects of terrible calamities and of our own ignorance. New scientific knowledge cannot be purchased at so much per pound.

It has been asserted of physiological research on animals, “that it really is not experiment to verify or disprove theory, which one well-conducted and crucial experiment might do, but experiment *in vacuo*, experiment on the chance, experiment of nothing in particular, but of anything which may turn up in a hundred thousand vivisections, and during the course of a life devoted to them.” In reference to these assertions, one experiment is rarely or ever sufficient to test a theory in science; many elaborate researches are usually necessary; many, for instance, have been made to test the contact and chemical theories of voltaic electricity. The “crucial experiment,” if there is one, is usually only arrived at after years of experimental research. Random experiments are rarely made by experienced investigators, and never, except as a last resort; and no sane experimentalist would make “a hundred thousand” of them, or devote a life to them, in the hope of discovering anything which may turn up. Having made and published many experimental researches, I can testify that the way described in the above quotation, as that in which discoverers usually work, is grossly incorrect.

The substance of much that has been said against physiological, as against all other abstract original experiments, is, that they either yield no useful results, or those they yield are so small that they are not worth the cost. The following are some remarks of this kind made by “anti-vivisectionists”:—“At the best, vivisection is *prospecting in such barren regions* that, if pain could be measured by money, no mining company in the world would sanction the outlay;” “while hundreds of thousands of medical men have practised vivisection, not half a score of them *have contributed an idea* to physiology;” “the old promises of physiology—that Joanna Southcote of the sciences—puffed up with her vain-glorious self-delusion, and for ever prophesying the immediate appearance of a Messiah of Medicine—who never arrives;” “it raises a yell of triumph when it has succeeded in inflicting upon some poor dog or rabbit the doubtful semblance of some human

disease ; but when it is called upon to mitigate some real disease of humanity its hands are empty if its mouth be full." In reference to these remarks : That such experiments do yield useful knowledge is a conviction of all persons who have properly made them ; but whether they yield much or little, or whether the knowledge is cheap or dear, are circumstances over which we have but little control ; we have no alternative but to pay the price or remain without the knowledge. It is not reasonable to suppose that new knowledge, obtainable only by means of tedious, difficult, and costly experiments, should be as low in price as that obtainable from books ; but whatever its cost, we are compensated by the endless value of the knowledge. Anti-scientific persons willingly take the benefits arising from physiological research whilst they make these objections to it.

All the objections to such experiments appear to be made upon the assumption that man is the sole arbiter in the case ; but this is a great mistake—it is not man, but the laws of Nature that decide the question. It is probable that for ages to come the necessity for experiments in all the complex sciences will increase. Possibly in some much more advanced state of knowledge, men may be able to entirely dispense with experiments in some of the sciences, and logically and mathematically predict all the results ; but at present they can only predict with certainty a very small proportion, and least in the biological sciences.

If these statements are true, we have very little choice in the matter ; and if we (and all other animals) are so constituted and circumstanced that we must all of us either be decimated by all kinds of disease, or sacrifice some animals, and expend an immense amount of mental toil, in order to discover preventives, no one can be justly blamed. The attainment of new knowledge is an object of very great importance, and justifies great sacrifices ; this is proved by the fearful penalties we incessantly pay for our ignorance. Great calamities, such as epidemics, &c., are warnings to us to obtain new knowledge, and if we neglect them, we are all of us punished without distinction. The complete disregard of human and animal life by the operations of Nature, as in the recent earthquakes of Ischia and Java, ought to teach us that in cases where objects of greater importance and magnitude are involved, pain and death, even of countless numbers of men and animals, is a secondary matter. The necessity of new knowledge, and of pain and toil to obtain it, are unavoidable conditions of life, and to find fault with this, or object to take the means necessary for gaining such knowledge, is disobedience of Divine commands. As pain is an unavoidable condition of life, it is our duty to bear it with the least complaint.

"Turn, turn, my wheel! This earthen jar
 A touch can make, a touch can mar;
 And shall it to the potter say,
 What makest thou? Thou hast no hand?
 As men who think to understand
 A world by their Creator planned,
 Who wiser is than they."

With regard to the question, "Has vivisection" (*i.e.*, including not only the use of the knife with chloroform, but also the influence of temperature, pressure, drugs, poisons, &c., upon animals) "contributed so much to the relief of suffering, or the advancement of human knowledge, as to justify its continuance, in spite of the manifest objections to it?" It has been stated that "this is a question which can be discussed by an educated layman just as well, perhaps better, than by a physician, or a surgeon, or a professional physiologist," and that, "above all, the answer must not assume the protection of a privileged mystery."

In reference to this statement: Of all subjects, there is scarcely one with which educated laymen are less acquainted than that of abstract experimental research and its relations to human welfare. Many "educated" laymen consider all such experiments to be a mere hobby, if not a waste of time. The great bulk of such persons only consider as useful the technical applications of scientific knowledge in the arts and manufactures, and are unaware of the great utility of the truths discovered by such research as an important means of discovering further knowledge, and of research itself as a valuable source of mental discipline. As also laymen do not usually possess physiological information, they cannot know "how much" such information "has contributed to the relief of suffering or the advancement of human knowledge."

On the other hand, a professional physiologist is a man who knows what is new and what is old in the subject, and whose entire time is occupied in studying and teaching it, and in devising and making new experiments in it. As his object is to be a competent teacher, and as the final purpose of his experiments is to discover new knowledge, and therefore to avoid wasting his time in re-discovering what other persons have already found, he is compelled to make himself acquainted with the whole of the literature of his subject up to the most recent date. In order also to be able to illustrate his lectures, he is obliged to possess a knowledge of the chief practical applications of physiology in relation to disease, surgical accidents, and their treatment. He is therefore qualified in a far greater degree than an ordinary educated layman to answer those questions.

In reference also to those assertions: does any surgeon who has made experiments in ovariectomy on women, at great risk of

their lives, seriously believe that the utility or justifiability of those experiments could be discussed by an educated layman "just as well, perhaps better," than by himself? or that they were "useless"?

It is very acceptable to some "anti-vivisectionist" laymen to be informed that they can discuss a difficult and complicated question in one of the most complex of the sciences, of which they know but little, "just as well, perhaps better," than those who have made a life study of the subject. The implication also, that scientific investigators "assume the protection of a privileged mystery," and that the relations of new scientific knowledge are so easily comprehended by laymen, debases scientific research, because it incorrectly represents it and its relations to human welfare as subjects commonly understood, but purposely rendered mysterious.

Why should unscientific persons be thus flattered; why should they know, "just as well, perhaps better," than Dr. Priestley or Sir Humphry Davy, respecting the justifiability of their physiological experiments with oxygen and nitrous oxide, or perhaps better than Faraday respecting the utility of his physiological experiments on electric fish?

In reference to physiological experiments on animals, the question has also been asked: "Why should a venerable osteologist, a world-famed naturalist, or a couple of illustrious physicians, be any better judges than a man of average intellect, average education, and average fairness, when the question is, what is the limit between lawful and unlawful knowledge, and lawful and unlawful means of gaining it, and what is the moral effect necessarily or probably, according to the facts of human nature, of a certain course of practice?" The answer to this, in the case to which it refers, is simple, if the former gentlemen were actual workers in physiological research,* and the latter were not; they alone possessed the additional knowledge indispensable to form a correct judgment. Persons who know but little of physiology, or of the means necessary to obtain new physiological knowledge, cannot judge respecting the lawfulness of such knowledge, or of the means of getting it, as correctly as those who are fully acquainted with both those subjects.

It is not to the zeal and sentiment of "anti-vivisectionists," but to experimental investigators, that mankind are chiefly indebted for the discovery of the principles of physiology, a knowledge of comparative physiology and pathology of men and animals, and

* The "venerable osteologist" has 368 researches set down to his name in the Royal Society's "Catalogue of Scientific Papers," whilst his critic has none.

inventions of the methods and appliances for preventing and alleviating animal suffering and prolonging human life ; to them we also owe the application and use of many of the numerous remedies contained in Pharmacopœias. Whilst also the former class have been talking and opposing, the latter have been discovering and applying new knowledge, and giving the results to their suffering fellow-creatures. It is also worthy of remark, that whilst the chief of the opposition of the "anti-vivisectionists" has been directed against medical men, more original experiment-alists have come from the ranks of the medical profession than from any other calling.

It is a noteworthy fact that there has been established in London an "Anti-vivisection Society" (or rather several), with a considerable income and a large separate fund, with affiliated societies in various provincial towns, with a monthly periodical entirely devoted to its objects ; also that many public meetings have been held, numerous lectures delivered, tens of thousands of pamphlets circulated, petitions addressed to Parliament, &c. &c., under its auspices, for the "total suppression" of painful experiments on animals. And whilst all this organization exists expressly for this purpose, comparatively little has been done by this Society to suppress the infliction of a thousand times greater amount of pain on animals for vastly less beneficent purposes. A "Society for Suppressing Cruelty by United Prayer" also exists, consisting of "about 10,000 members," and one of its "rules" is, that each member will "disseminate facts relating to vivisection and all other cruelty."

That the opposition of these Societies is not only directed against physiology and physiologists, but also against science and scientific men in general, is shown by the very frequent and unnecessary use of the words science, scientific, scientists, scientific discovery, men of science, &c., in the hostile language employed ; and also by the following quotations :—"The dilettantism in pursuit of physical science ;" "the dilettante and empirical school of professors and physiologists ;" "scientists are finding out that they are not to have their own way without opposition ;" "the man of science never seems more ridiculous than when wearing the mask of philanthropy, with his keen, remorseless eyes peering out of it ;" "the man of science without religion and without heart ;" "ossification of the heart as a result of the dilettantism of discovery ;" "the physical sciences will perhaps have to be called *scientiæ inhumaniores* ;" "accuracy is the last thing we now look for in the statement of a man of science," "accurate enough for scientific purposes ;" "the convenient darkness which always has been, and always will be, longed for by

every man, be he scientist or be he assassin, whose desires and whose deeds are evil."

Disparagement of scientific knowledge is a favourite occupation with many "anti-vivisectionists." The important discovery, in cases of consumption, "of the constant presence in the tubercles of exceedingly minute organisms," termed bacilli, is thus depreciated by them:—"Analogy would seem to point out that as the knowledge that our cheese is eaten by 'specific organisms,' called rats and mice and mites, has not been of any great advantage to us, so neither will such knowledge avail more with regard to the infinitely smaller creatures which we are told are the cause of disease." They also speak of scientific knowledge in the following terms:—"The greed of knowledge;" "thirst for knowledge at its best and purest is but an inferior part of our being, a part which we may share with demons in the Pit;" "the vilest devil may possess a million times more knowledge than is shared by the British Association;" "you may buy knowledge at the cost of sin, and often do so in scientific investigations," &c. &c.

It is also worthy of notice that all this opposition comes, with but little exception, from unscientific persons, Church dignitaries, noblemen, aristocratic ladies, officials of "anti-vivisection" societies, and persons professing religion. The question therefore arises, why do unscientific, non-medical, and religious persons so greatly oppose the infliction of pain on animals when it is done for the purpose of discovering new truth, and so little oppose it when it is done for vastly less justifiable purposes? There must be a cause for this very significant fact, and the cause must be something connected with the discovery of truth.

As the opposition comes so largely from the same class of persons who in all ages have opposed scientific research—viz., sentimental persons and others professing religion; and as it is chiefly confined to the cases in which the object sought is new truth, it is reasonable to infer that it is largely directed against the discovery of new knowledge, and the question of infliction of pain is far from being the only consideration.

Why have such persons in all ages opposed the discovery of new knowledge? The cause lies in that circumstance which has always been present—viz., the dread that the power which new knowledge imparts may be used to overthrow their beliefs and sentiments, and thus diminish their happiness. Science has already changed human belief and conduct, and may do so again. This is a perfectly natural fear; it must be a painful experience to have to change one's long-cherished sentiments, and those who have to do so deserve sympathy; but the irresistible laws of Nature are not influenced by this circumstance; civilization

marches on, and those who are ignorant of science are left behind. If we wish to avoid these painful experiences, we must avoid unstable doctrines, and place our faith in the great scientific principles which regulate the universe and man. Perceiving the necessity of a retarding as well as of an advancing section of mankind, and having great faith in the inevitable development and progress of knowledge, I venture to say to all anti-experimentalists, although you have the laws of God opposed to you, you have a large portion of mankind with you, and you are performing the important function of regulating the speed of progress: win if you can.

That the feelings of hostility of "anti-vivisectionists" towards animal physiologists are very intense, is proved by the violence of their language. All the quotations I have made were taken from publications ("The Zoophilist," &c.) officially sanctioned or approved of by the leading "anti-vivisection" societies, and are chiefly taken from the speeches and writings of Church dignitaries, and officials of those societies. The following additional ones from the same sources also support the same conclusion:—"No vivisector has ever yet acquired an *enviable* celebrity—no good man or woman would knowingly be his friend;" "not a single physiologist takes out a licence for vivisection, or writes an article or gives a lecture in defence of the practice, but he thereby becomes a marked man;" "every man and woman in England has it at will to hasten that day by calm and righteous display of his natural feelings of repugnance and indignation—when no master or mistress of a house dare any more invite a vivisector amongst a mixed company of guests, lest he throw a chill of disgust over all the rest." This hostility has further been shown "by posting up (300) large pictures, exhibiting the horrors of vivisection, at the corners of the streets, on the walls, in railway stations, hotels, and restaurants" in London.

Here we have, on the one hand, scientific persons making experiments, often costly and requiring unusual skill, usually also at their own expense, and publishing all the knowledge obtained; and on the other, the painful spectacle of unscientific and "religious" ones taking and using this knowledge for their own benefit free of cost, whilst calumniating the authors. That physiological experiments on animals have the *appearance* of being cruel and immoral is quite true; but although that would be an urgent reason for a searching inquiry to ascertain if they were really so, it does not justify the infamous charges and suggestions contained in the various statements I have quoted.

The ultimate and permanent effect of all this opposition will probably be similar to what it always has been in analogous cases.

Attack excites defence, inquiry, and explanation ; and the more truthful explanation which science has usually to offer will become better understood and be accepted, and science will advance. In the absence of such attacks and excitement, men take less trouble to understand the explanations which science has to offer. Either to stop all experiments on animals, or to prevent all opposition to science, is quite out of the question. We must submit to the changes of belief and practice which result from the discovery of new knowledge, and also to the opposition which ignorance offers to advancement. It is as unphilosophical to expect civilization to advance faster than its necessary rate, as to hope that it will not advance at all. Men are compelled by the activity of the forces within them, and by the influence of external circumstances, to move in one way or another, to hinder or promote civilization ; and the rate of human progress is too great a phenomenon to be much affected by the exertions of any small body of men. It may therefore be reasonably anticipated that any human-made law enacted to "utterly suppress" physiological experiments on animals will largely fail. Advance of knowledge is an influence which no class of anti-experimentalists, even with unlimited money at their command, can permanently resist ; and the operation of great natural laws is not much affected by the distribution of a few thousand pamphlets. Scientific men also will not avoid "the investigation of the action of drugs by experiments on animals" because "it is a very difficult one," or "because after we have found out what they do in one individual, we find that in another the results are different, and the process of investigation has to be repeated in man," or because "in human individuals the action of drugs in very many cases varies so much that each patient may form a really new research."

In these few pages I have adduced evidence to show that physiological experiments upon animals are not "useless," because they lead to the discovery of new knowledge useful to man, and to better practice in preventing and curing disease ; that they are necessary, because much of the knowledge they yield cannot be obtained in any other way ; and that they are moral because men are compelled to make them in order to avoid greater evils. From the evidence adduced also, it is charitable to conclude that the assertions that they are "useless," and "that if they were utterly stopped the result would be the search for and the finding of far better and more certain means of discovery in hundreds of other directions," have either been made in ignorance of some of the fundamental truths of science, or carelessly, not observing that they were incorrect.

Having replied to these charges against such experiments, I now respectfully ask "anti-vivisectionists" to seriously consider

whether they ought not to acquire a knowledge of the Divine laws by which the universe and themselves are governed, and thus avoid the appearance of atheism; to consider how they can reasonably expect to be able to obey those laws if they do not understand them; to justify their keeping mankind in ignorance and suffering by opposing physiological experiments; also to prove, if they can, the assertion that an ordinary "educated layman" can discuss the question of the utility of physiological experiments on animals, "as well, perhaps better, than a physiologist;" and above all, to explicitly state what new "means of discovery" they have to propose, "far better and more certain" than that of experiment, for obtaining new physiological knowledge.

Not only has the discovery of new physiological knowledge been hindered by ignorance, but also by the absorbing pursuit of wealth in this country. In all directions, manufacturers and others have taken the knowledge gained by the labours of experimentalists, and given very little to aid original research in return. This has not only been one of the causes of our loss of commercial supremacy in various cases, but has largely prevented research in all the sciences. It may be regarded as a national calamity, that nearly the whole of the wealth derived from the useful applications of research has been withheld from the promotion of research, and that little or no provision has been made for investigating the causes and conditions of famines, pestilences, fevers, &c., and for discovering the laws which regulate physiological phenomena. When famine, pestilence, contagious disease, &c., overtake us, what do we do? Instead of previously gaining new knowledge and preparing to meet them, we vainly attempt to use our utterly insufficient stock of knowledge for the purpose. What can be more painful to behold than a mother and father, deprived of an entire family of five or six children in rapid succession by scarlatina or other contagious disease, and both the medical man and the parents utterly unable to save them? And this is a common occurrence. Thousands die annually in this country alone of preventible diseases, such as scarlatina, tubercle, scrofula, typhoid fever, &c.,* whose lives might probably be saved by means of new knowledge. Meanwhile, there are numerous manufacturers whose processes would never have existed had it not been for the gratuitous labours of scientific discoverers, and it is reasonable to suppose that they would be anxious to render relief to their suffering fellow-creatures by the intelligent method of applying some of their wealth to the promotion of original scientific research in all its branches.

* See Reports of the Registrar-General.

