VIVISECTION.

4174. Memorandum of Facts and Considerations relating to the Practice of Scientific Experiments on Living Animals, commonly called Vivisection . . . fol. (*Lond.*, 1882.)

Issued by the Assoc. for the Advancement of Med. by Research.

MEMORANDUM

OF

FACTS AND CONSIDERATIONS RELATING TO THE PRACTICE OF SCIENTIFIC EXPERIMENTS ON LIVING ANIMALS, COMMONLY CALLED VIVISECTION.*

Issued by the Association for the Advancement of Medicine by Research.

SUMMARY.—The extent, methods, and objects of Medicine—Its recent advances—Its dependence on Physiology and Pathology — The necessity of experiments for progress in natural science—The testimony of the medical profession, and especially of the late International Congress to this effect—The limits of our right to inflict pain or death on the lower animals—The amount of pain inflicted by scientific experiments—The practice of physiologists to limit this to the utmost—The effect of recent legislation—Possible abuse of experiments by incompetent persons—The true objects of scientific experiments on animals, physiological, pathological, remedial, and preventive—Examples of the attainment of these objects—Conclusion.

The art of Medicine depends upon Science.

§ 1. Medicine, as the art of preventing and curing disease, depends first, upon Anatomy and Physiology, or knowledge of the structure and working of the human body in health; secondly, upon Pathology, or knowledge of the origin, course, and results of disease; and thirdly, upon knowledge of the effects of various mechanical, physical, or chemical means which prevent or modify diseased processes, and are thus available for preventive or curative Treatment.

As in every other practical art, the application of scientific (that is to say, exact and general) knowledge to particular cases must be checked and controlled by practical experience. But the history of

* The term "Vivisection" is open to objection. As a question-begging epithet, it produces an unfounded prejudice against experiments, of which the majority are painless, and of which the object is to relieve the sufferings of both man and brutes. Moreover, the term is at once too narrow and too wide: too narrow, since it excludes painful experiments which do not involve cutting, such as exposure to disease; and too wide, since it includes painful procedures upon animals for other than scientific or humane objects, for food, as in preparation for the table, for convenience, as in horse and cattle breeding, or for amusement, as in certain sports. The same operation which, if performed for the acquirement of knowledge, is called a vivisection, is not called a vivisection when performed for a less worthy object.

medicine abundantly proves that experience is productive only in so far as it is guided by the habit of scientific inquiry and quickened by physiological knowledge. The foundation of efficient medicine was laid by the discoveries of the sixteenth century in anatomy, and of the seventeenth century in physiology, and its rapid progress in modern times has been chiefly the result of discoveries in physics, in chemistry, and in general biology.*

Medicine then, including Hygiene, or preventive medicine, and Therapeutics, or curative medicine, whether it acts by operative and mechanical measures,† by the administration of drugs, or by other means, does not depend upon arbitrary dogmas, or upon the theories of one or another school; it depends upon accurate knowledge of the structure and functions of the body in health and disease, and of the effects of various agents upon it, applied in each case by the aid of bedside experience—*καθ' ἕκαστον γὰρ ἰατρεύει.*

The relation of medicine to physiology and pathology is the same as that of navigation to astronomy and meteorology, or of engineering to applied mathematics, or of dyeing and other manufactures to chemistry. A seaman may safely direct a vessel who is ignorant of the construction of a quadrant, a bridge may be built without knowledge of theoretical mechanics, and a watch may be

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* Some otherwise well-informed persons have expressed doubt as to the reality of the great progress of medicine during the present century. This doubt arises partly from an arbitrary separation of what is called internal medicine from surgery (la médecine opératoire) and from preventive medicine. The world fully appreciates such triumphs of medicine as the cure of Aneurism and prevention of Small-pox, the discovery of Anæsthetics and the success of Ovariotomy, the results of antiseptic surgery, the vastly decreased mortality after operations, and the protection of cattle from pestilence by inoculation. But in the treatment of fevers, inflammations, and other internal diseases, conventionally called medical, progress is less striking, because, being more obscure, these maladies have not yet been brought under the complete influence of scientific investigation.

In proof, however, that the scientific spirit of modern medicine has not failed to advance the treatment of even the more obscure diseases, and that practical advance in medical treatment has not been limited to operative surgery, may be adduced as instances: the greatly lessened mortality in Fevers, owing to physiological observations and scientific treatment, the improved diagnosis and more successful results in cases of paralysis and other diseases of the Nervous System, the far shorter and less painful course of acute Rheumatism, the advance in treatment of Diabetes, Consumption, Dropsies, and affections of the Heart, and the successful cure of numerous forms of disease now proved to be due to animal or vegetable parasites.

"Looking back over the improvements of practical medicine and surgery during my own observation of them in nearly fifty years (writes Sir James Paget) I see great numbers of means effectual for the saving of lives and for the detection, prevention, or quicker remedy of diseases and physical disabilities, all obtained by means of knowledge, to the acquirement or safe use of which experiments on animals have contributed. There is scarcely an operation in surgery of which the mortality is now more than half as great as it was forty years ago; scarcely a serious injury of which the consequences are more than half as serious; several diseases are remediable which used to be nearly always fatal; potent medicines have been introduced and safely used; altogether, such a quantity of life and working power has been saved by lately acquired knowledge as is truly past counting."

† "Forasmuch as the Science of Physick doth comprehend, include and contain the knowledge of Chirurgery as a special member and part of the same."—Statute 32 Hen. VIII. c. 40.

"cured" or a musical instrument "tuned" by a workman who is unacquainted with mathematics or acoustics. In the same way many men are useful practitioners of medicine who are imperfectly acquainted with the scientific basis of their practice. But it is only the most ignorant of sailors who sneer at natural science, and the most presumptuous of watchmakers who rail at mathematics.

Medical, like other Sciences, depend upon experiments.

§ 2. The knowledge of the functions of the body in health, or Physiology; the knowledge of the origin and course of diseases, or Pathology; and the knowledge of the action of remedies, or Pharmacology, like other branches of natural science, depend entirely upon observation and experiment. Mere observation at its best is but careful noting of such experiments as natural laws or accident may present; designed experiment, or observation of events under intentionally varied conditions, is absolutely necessary in addition.* Indeed, it would be as unreasonable to expect the "Institutes of Medicine" (as physiology and pathology are rightly called) to advance without laboratories and experiments on animals, as to hope for progress in chemistry or physics by allowing only observation upon metals and gases and forbidding the performance of experiments.

The scientific method not fruitless in the study of living functions.

It is true that there are special difficulties in the study of the natural laws of living bodies. The conditions are far more complicated than those of the inorganic world, and observations and experiments must be proportionately numerous, well-devised, and cautiously interpreted. Fallacies of observation and of deduction are difficult to avoid, and often results are seemingly contradictory until their true meaning is perceived by help of fresh experiments and more careful reasoning. But the great and assured results which have been already obtained prove that these difficulties are far from insurmountable. All our present knowledge has been achieved in spite of them, and thereby the path to future discoveries has been cleared. No reasonable person would disparage experimental inquiry into the functions of plants and the cultivation of crops, because the laws of vegetable life are more complicated and obscure than those of mineralogy: or would call the experiments of the botanist useless because they are difficult.

That experiments on living creatures, like all other experiments made by fallible persons, have sometimes misled, is an obvious truth. Many errors attended the first application of the stethoscope, of the microscope, and of chemical analysis to medicine, so that impatience and ignorance pronounced that each of these valuable methods of investigation was useless.

This conclusion supported not only by argument, but by the testimony of experience.

§ 3. The future progress of medicine, in the widest sense of the word, of the art which prevents disease, promotes health, relieves sickness and prolongs life, depends upon the same cause which

* "L'observateur écoute la nature, l'expérimentateur l'interroge."—Cuvier.

has led to its present position — upon more complete acquaintance with the laws of health and disease. These laws have been, and can only be, successfully investigated by observations and experiments.

This conclusion is not only the inevitable result of reasoning, but is also enforced by the unwavering testimony of those best qualified to judge—not only of scientific workers themselves, but of the medical profession in all civilized countries. There is not the smallest danger that the ninety-nine hundredths of the medical profession who are engaged in the daily effort to prevent or relieve disease will undervalue practical medicine in comparison with the more abstruse branches of experimental physiology and pathology: the danger is the other way. With few exceptions, physicians and surgeons are not themselves experimenters in physiology or in pathology; their business is to prevent disease and to relieve their patients' sufferings: but they know the benefits which their art has derived from the work of the laboratory, and understand the nature and value of experiments. They are thus at once the most disinterested and the most competent witnesses, and their constant and unanimous testimony ought to be conclusive.*

The International Medical Congress of 1881, where upwards of 3,000 physicians and surgeons assembled in London, among whom were the ablest and most respected leaders of the profession in the three kingdoms, in America, and in foreign countries, passed, without a dissentient voice, the following resolution:—

"That this Congress records its conviction that experiments on living animals have proved of the utmost service to medicine in the past, and are indispensable to its future progress. That, accordingly, while strongly deprecating the infliction of unnecessary pain, it is of opinion, alike in the interest of man and of animals, that it is not desirable to restrict competent persons in the performance of such experiments."

The justification of experiments which inflict pain or death on animals.

§ 4. A moral question, however, arises, from the fact referred

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* It would be invidious to dwell upon the very few exceptions to this almost universal testimony. One only deserves special mention. Sir William Fergusson was one of the most skilful and successful operators, but he had no authoritative claim to give an opinion upon the sources or the methods of surgical science, and even he in his evidence before the Royal Commission admitted the use of experiments on animals.

The testimony of the late Professor Claude Bernard has been often adduced against that of all other physiologists because he once wrote, "Nous venons les mains vides, mais la bouche pleine de promesses légitimes" This phrase occurs in the midst of an elaborate exposition of the necessity of experiments on living animals not only for knowledge but for use. Bernard well understood the bearing of experiments upon medicine, but he foresaw future developments of scientific treatment, in comparison with which his own eminent services would appear insignificant. The following quotation shows that his evidence on the whole question did not differ from that of other competent witnesses:—

On voit que la physiologie, ou médecine scientifique, comprend à la fois ce qu'on a artificiellement séparé sous les noms de physiologie normale, de physiologie pathologique et de thérapeutique. Au point de vue pratique, c'est certainement la thérapeutique qui interesse au plus haut degré le médecin; or, c'est précisément la thérapeutique qui doit le plus de progrès à la physiologie expérimentale."—*Leçons de Physiologie Opératoire*, p. 20.

to in the resolution just quoted, that some of the necessary experiments of physiology and pathology involve the infliction of pain or of death upon certain of the lower animals.

The better informed opponents of experimental medicine do not dispute its scientific and practical value, but assert that no probable benefit to man or animals justifies the infliction of pain.

No one would succeed in closing the laboratories of the chemist, or the observatories of the astronomer, however strong his disbelief in the experimental method of inquiry might be, however cordially he disliked or dreaded the advance of science, or however obstinately he persisted that the useful arts do not depend on scientific data.* It is obvious, however, that the fact of pain or death being inflicted in the course of experiments cannot alter their scientific importance and necessity; it only imposes on us the duty of making a comparison between the injury to a sentient creature and the probable benefit to mankind, or to others of its own species. This comparison we will attempt to make.

Amount and degree of pain thus caused.

Happily, the amount of pain inflicted in the course of scientific experiments need only be small, and the destruction of life insignificant. That, from carelessness or want of forethought, experiments have been performed which were "cruel," because the pain produced was excessive and unnecessary, may be admitted. In many countries consideration for the brute creation is still little developed, and the vice of cruelty lightly regarded; even in England, until comparatively lately, the torture of harmless animals was thought an innocent pastime. Men of science have not always risen above the average humanity and moral enlightenment of their age and country. But speaking of this country, and of modern times, it may safely be said that no charge of wanton, needless, or excessive sacrifice of animals can be, or indeed has been, seriously alleged against the small number of experimental physiologists and pathologists at work in the three kingdoms.† Science has

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* On the other hand, it is almost as clear that no serious obstacle would be put in the way of even painful experiments in the cause of science, if all their opponents were convinced of their utility, and were acquainted with the methods of science in general or the facts of medical science in particular. This seems to follow from the very moderate opposition to, or tacit acquiescence in, the infliction of pain for desirable objects which obviously cannot be otherwise attained, such as more delicate food, more docile horses, increased wealth and comfort, or the pleasurable excitement of chasing and killing animals.

† The following extract is taken from the Report of the Royal Commission, which was drawn up after a prolonged and patient examination of witnesses and documents and was signed by all the Commission—Lord Cardwell (Chairman), Lord Winmarleigh, the Rt. Hon. W. E. Forster, the late Sir John Karslake, Professor Huxley, Mr. Erichsen, and Mr. R. H. Hutton :—

"That the abuse of the practice by inhuman or unskilful persons, in short, the infliction upon animals of any unnecessary pain, is justly abhorrent to the moral sense of your Majesty's subjects generally, not least so of the most distinguished physiologists and the most eminent surgeons and physicians."

The imputation of cruelty which has always been indignantly repudiated, has not been substantiated by a single authentic instance. In their evidence, given before the Royal

herself provided the means by which pain is reduced to a minimum. The beneficent discovery of anæsthetics is one cause of the great difference between the sufferings inflicted by Harvey, Boyle, Hales, Haller, Hunter, Magendie, and Bell, and the generally painless experiments of a modern laboratory. These may be classified as follows with reference to the suffering inflicted :—

(1) Many physiological experiments are entirely unaccompanied by pain, and can therefore be performed, according to convenience, either upon animals or upon man himself. Such are many experiments upon vision, taste, smell and touch; experiments on the value of different kinds of food, experiments on the effect of exercise, temperature and other conditions on the excretions; many experiments on bodily heat, on the pulse and on respiration.

(2) In still more numerous cases, observations and experiments can be made on the tissues and organs after the death of an animal: *e.g.*, the relative tenacity of the different textures, the mechanical effects of violence upon the bones, the action of the heart (which in cold-blooded creatures continues long after their death) and the whole of a long and important series of experiments on the functions of muscles and nerves, which cause no pain, since they are performed on the tissues of a dead organism.

(3) Next, but far less in number, comes a third class of experiments which are performed on animals rendered insensible by various anæsthetic agents. These can be, and were, by the practice of physiologists long before legislative sanction was added, carried out without any pain or even discomfort to the animal, which being killed before awakening is deprived of life in probably the most painless manner possible.

(4) There are, however, certain observations, for which it is necessary to allow an animal to recover from insensibility, and to live for a longer or shorter time. In such cases the severest pain, that of the operation, is abolished, and the subsequent suffering is sometimes quite insignificant, usually that of a healing wound, and occasionally that of inflammation, colic, or fever. In many of these experiments the initial pain is so trifling that it would be

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Commission, the Royal Society for the Prevention of Cruelty to Animals state, through their Secretary, that they do not know a single case of wanton cruelty.

On the occasion of the present Act (39 & 40 Vict. cap. 77) being passed, all teachers of physiology, in a memorial addressed to the House of Commons, said :—

"We repeat the statement which most of us have made before the Commission, that within our personal knowledge, the abuses in connection with scientific investigation, against which in this Bill it is proposed to legislate, do not exist, and never have existed in this country." Signed by the late Professor Sharpey (University College, London); Dr. William Carpenter, C.B. (formerly Lecturer on Physiology at the London Hospital); Professor G. Humphry (Cambridge); Professor Rutherford (Edinburgh); Dr. Pavy (Guy's Hospital); Dr. M. Foster (Trinity College, Cambridge); Dr. Burdon Sanderson (Unive sity College, London); Dr. Robert McDonnell (Dublin); Professor Redfern (Belfast); Professor Cleland (Galway); Professor Charles (Cork); Professor McKendrick (now of Glasgow); Dr. Pye-Smith (Guy's Hospital); Professor Yeo (King's College, London); Mr. Charles Yule (Magdalen College, Oxford); Professor Gamgee (Owens College, Manchester).

absurd to give an anæsthetic; such are acupuncture and inoculation. It would be unreasonable to give a rabbit chloroform for such operations as bleeding, vaccination, or pricking with the needle of a subcutaneous syringe, for which no human being would take it.

(5) There remain a small number of experiments in which anæsthetics would be impracticable. These are chiefly the experimental production of various diseases, such as tubercle, glanders, cattle-plague, where the pain is that of the subsequent disease, and more justly described as discomfort than as torture; and the trial of certain modes of treatment, as inoculation, and of various drugs, where the suffering produced is less than the familiar effects of corresponding remedies in human beings. Probably the most painful scientific experiments ever performed have not been vivisections at all. Such are those of ascertaining the effect of starvation, carried out abroad many years ago; observations of great value and importance, but happily not needing repetition.

Vivisections in the popular sense of the word, experiments comparable to surgical operations, involving cutting and irritation of sensitive parts, can, with few exceptions, be performed without the slightest pain. Hence the results of acutely painful experiments, comparable with the pain endured by rabbits and weasels caught in ordinary traps, by young animals being gelded, by wounded birds, or by rats poisoned with strychnine or phosphorus, are not to be found in our physiological laboratories.

Practice of physiologists in this particular.

That the utmost possible limitation of the infliction of pain has always been the object and practice of scientific workers in England,* is sufficiently proved by a Report which was drawn up by a Committee of the Physiological Section of the British Association for the Advancement of Science, in 1871, several years before the appointment of the Royal Commission.

While the suffering caused to animals by scientific experiments has been enormously exaggerated, both absolutely and relatively, no one denies that both pain and death are and must be inflicted thereby. Otherwise there would be no more reason for licensing and inspecting the physiologist's laboratory than that of the chemist. The whole question is one of justification for causing the pain or death of brutes. Few who compare the extent of suffering and of slaughter thus caused with that generally recognized as right in other cases by enlightened Christian morality, or who compare the objects for which animals commonly suffer pain and death (for food, for dress, for profit, for convenience, or for amusement) with those of the scientific observer (for advance of knowledge and for relief of human suffering) will hesitate to conclude that so long as the

* The following quotation, from a Manual of Physiological Experiment by a well-known continental physiologist, will serve to show that humane consideration for animals is not confined to this country:—"An experiment involving vivisection should never be performed, especially for purposes of demonstration, without previous consideration whether its object may not be otherwise attained;" and, as a second rule, "insensibility by chloroform or other drugs should be produced whenever the nature of the experiment does not render this absolutely impossible."—Cyon, *Physiologische Methodik*, p. 9.

principles and practice of scientific men in this country continue what they now are, their investigations should rather be fostered than impeded.

Recent legislation.

But any possible danger of abuse is prevented by the Act passed in 1876, by which not only are all physiological laboratories placed under the inspection of the Home Office, and exist only by its license, but, in addition, no experiment involving pain can be performed without a special, elaborate, and carefully guarded certificate. Indeed, so stringently has the law been administered that more than one investigation of great practical value has been prevented, others have been injuriously hampered or delayed, and a serious check has been given to medical science in England. In two instances eminent members of the profession found it necessary to go abroad in order to carry out investigations of great importance. The object of one was to decide a question in relation to treatment of wounds; that of the other was to determine the action of certain new drugs.

This was certainly not the intention of the Royal Commission in recommending, or of Parliament in passing, an Act for the purpose of preventing possible abuses without hindering scientific and useful work. What is now needed is such an expression of opinion in Parliament as will permit the Act to be worked in the spirit in which it was framed and loyally accepted, and according to its strict provisions. It may be remarked that attempts have been made, by the same methods of agitation, to check physiological research by legislation in Germany, Denmark, Sweden, and the United States: but in each case the humane and enlightened judgment of the country has refused to impede researches of which the usefulness is beyond dispute.

Imaginary abuses of experiment by incompetent persons.

§ 5. It has been imagined that students of medicine perform operations upon living animals in order to gain manual dexterity: such a practice would be as useless as it would be reprehensible, and has never, we believe, been thought of. For our veterinary surgeons it would be quite unnecessary, and they have always reprobated the practice.

It has also been supposed that students might, for amusement, perform physiological experiments upon living animals. This would be practically impossible, since not only are knowledge and skill necessary, but a properly equipped laboratory and suitable appliances. If, however, any ill-disposed person without scientific object or training should be guilty of cruelty most alien from the practice and the training of the profession, there is no doubt that every member of it, teacher or student, would help to detect and punish such conduct.* The case has never arisen; if it did, it could be efficiently dealt with under the law known as "Martin's Act."

* For the real sentiments of medical students, see Dr. Pavy's evidence before the Royal Commission, *Blue Book*, p. 114.

§ 6. The real objects of scientific experiments on living animals are briefly as follows :—

Real objects of experiments on living animals.

i. *To extend, correct, and define our knowledge of the functions of the living body.*

i. For Physiology.

Even apart from ulterior advantage to medicine, physiology must be held to be a branch of science of at least equal importance with chemistry or geology ; and to be successfully cultivated, it must be cultivated for its own sake, without perpetual or premature inquiry as to the immediate and material results which increased knowledge of the laws of Nature will bring. In physiology, as in other natural sciences, the investigator must have primarily in view the discovery of truth ; for, in the words adopted by the Royal Commissioners, "if in the pursuit of science he seeks after immediate practical utility, he may generally rest assured that he will seek in vain." There must be, to quote the words of an older authority, "light-bearing," as well as "fruit-bearing experiments."

As examples of this first kind of experiment, and of their success in extending useful knowledge, we may refer to the following :—

(1) The great discovery of the circulation of the blood by Harvey, the first-fruits of the experimental method.* Upon this as the foundation depends all the subsequent progress in the surgical treatment of hæmorrhage and of aneurisms, and the recognition and treatment of diseases of the heart, the arteries, and the veins.

(2) The discovery of the effects of electricity on animals by Galvani and Volta, from which have resulted not only the development of one great branch of electrical science, but also important means of diagnosis and treatment in cases of paralysis.†

(3) Artificial respiration, invented and improved in the case of animals with purely scientific objects by Vesalius, Hooke, Lower, and others, and long afterwards applied with complete success to resuscitation from drowning.

(4) The experiments of the Rev. Dr. Hales on pressure of the blood in the arteries.

(5) Those of Boyle, Hooke, Mayow, and other natural philosophers on respiration.

(6) Transfusion of blood from one animal to another, ac-

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* Some persons have ventured to deny that Harvey's discoveries were due to vivisection, on the faith of a reported statement of his to the Hon. Robert Boyle (another eminent vivisector), and in contradiction to Harvey's express words. Others have denied that the circulation was proved by vivisection, because Harvey having proved all but one point by a series of experiments on living animals, Malpighi completed the demonstration by another experiment on another living animal. The full account of the matter is contained in Harvey's own treatise, "De Motu Cordis et Sanguinis." It is briefly referred to in the article *Harvey* of the "Encyclopædia Britannica," and in the evidence of Professor Turner, of Edinburgh, before the Royal Commission (Blue Book, pp. 157, 158) ; where also are given the account of the discovery by vivisection of the great system of Lymphatic vessels, by Aselli and Pecquet, and of the discovery of motor and sensory nerves by the same means by Bell and Magendie.

† See on this subject the interesting details in Dr. Dalton's "Lectures on the Experimental Method in Medical Science." (New York, 1882).

complished by Sir Christopher Wren and others of the early Fellows of the Royal Society in the seventeenth century, but only recently, owing to fresh physiological knowledge, applied with success to the saving of human life.

(7) Experiments by a Committee of Physicians at Dublin, in 1835; showing the way in which the sounds that attend the action of the heart are produced, and enabling physicians to judge of the condition of the organ by the alterations of the sounds.

(8) The discoveries of reflex action and of the separate endowments of motor and sensory nerves,* on which much of our present knowledge of the functions and disorders of the nervous system is founded.

(9) The discovery of vasomotor nerves.

ii. For Pathology.

ii. *To obtain direct and exact knowledge of the processes of disease.* The following examples may be cited :—

(1) Experiments relating to the nutrition of the body and the maintenance of its constant temperature constitute the basis of the existing knowledge of fever.

(2) Experiments relating to the mechanism of the circulation, and to the influence of the nervous system thereon, have served to explain the nature and mode of origin of the various forms of dropsy.

(3) Experiments as to the effect of plugging arteries (Embolism) have afforded explanations of diseased processes previously not understood, and in particular of many obscure cases of sudden death.

(4) Experimental investigations of the functions of the liver and other secreting glands have materially advanced our knowledge of diabetes and of the affections known as Bright's disease.

(5) Knowledge gained from experiments relating to the mode of action of the muscles, and of the nervous system which regulates them, constitutes the basis of the pathology and diagnosis of convulsive and paralytic diseases.

(6) Experiments on animal grafting and as to the nature of the processes by which wounds are healed and injured parts restored. Among the best known are those which relate to the mode of repair of fractured or otherwise injured bones, particularly the researches of Duhamel (1740), Sir Astley Cooper (1820), and Syme (1831). In recent times such inquiries have been pursued much more completely by Ollier and others, and with practical results of ever-increasing value.

(7) The dangerous form of blood poisoning after operations has been investigated by strictly physiological experiments, with the result of almost complete protection from it.

(8) Researches into the origin and nature of inflammation, by Redfern, Cohnheim, von Recklinghausen, and others, have been of

* On the subject of Sir Charles Bell's discoveries by means of vivisection see the account by Dr. Dalton in the Lectures above quoted, and the paper by Dr. Carpenter in the *Fortnightly Review* for February, 1882.

necessity conducted by means of experiments on animals and have proved of great practical value.

(9). Our recently extended knowledge of the locality of diseases of the brain, and of their accurate diagnosis and treatment, has been due, as in other cases, partly to clinical observations, partly to pathological investigations, but also, and not least, to direct experiments upon the lower animals.*

iii. *To test various remedial measures directly.*

iii. Therapeutics.

The utility of the greater number of the older remedies and methods was first learnt empirically: but many of them were not applied to the best purpose until they had been investigated by observations on the lower animals. As regards the remedies and appliances of modern times, they have, in almost every instance, been investigated first and brought into use afterwards.† For example:—

(1) Subcutaneous injection was used in the laboratory for years before it was applied in practice.

(2) The useful property of the well-known anodyne chloral hydrate was first investigated in the laboratory, and then introduced into practice.

(3) Pepsin and pancreatin were known for years as physiological agents before they were applied in practice.

(4) The action and mode of administration of such important new drugs, as nitrite of amyl, physostigma, and the anæsthetic, methylene, were discovered entirely by physiological experiments.

(5) The better appreciation and more useful application of some of the most valuable remedies were gained by experiments, such as those by Traube on digitalis, by Magendie on strychnia, and by Moreau and others on saline purgatives.†

(6) The application of various practically useful methods of checking hæmorrhage was tested upon animals before being tried on human beings, with the result of saving innumerable lives.

(7) Similar preliminary trials of subcutaneous and other operations, especially those of tenotomy, have helped in the relief of numerous deformities: while the trial of such formidable operations as excision of the kidney and tentative improvements in ovariotomy have led to some of the most brilliant results of modern surgery.‡

(8) Experiments undertaken by the Indian Government to test various remedies used for snake-bites have proved the useless or injurious nature of many drugs hitherto trusted in: and

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* See an article in *Nature*, Nov. 24, 1881, p. 73.

† For further details on the "Value of Experiments on Animals in Pharmacology," see the Address of Prof. Fraser, "Proc. Internat. Med. Congr.;" and an article, by Dr. Lauder Brunton, in the *Nineteenth Century* for December 1881, p. 926.

‡ See a paper by Mr. Spencer Wells, *Trans. Internat. Med. Congr.* vol. ii. p. 226,

many lives have thus been saved by more effectual methods of treatment.

In cases where new drugs are to be introduced, or new operative methods tried, the first experiments must be made either upon living animals or upon living men. Where circumstances excluded the former alternative, members of our profession have not hesitated to make themselves the subject of often hazardous experiments: but happily, in most instances, the sacrifice of a few guinea-pigs or frogs will suffice to help in saving human life.

iv. For Prevention of disease.

iv. *To ascertain the means of checking contagion, and preventing epidemic disease both in man and in brutes.*

In Man.*

An experiment of this kind, inoculating the udder of a cow so as to produce a vaccine pustule, was one of the links in the great discovery of Jenner. Among more recent examples may be mentioned:—

(1) The experimental investigations of the last fifteen years, as to the origin and nature of the infective diseases which spring from wounds and injuries (pyæmia and septicæmia), the results of which constitute the basis of antiseptic surgery.

(2) The discovery by experiments of the infective nature of tuberculosis (1868), of its relation to chronic inflammation and of its probable connection with a living parasitic organism (1881).†

(3) Discovery of the mode of origin, and consequently of the prevention of various parasitic entozoa (as hydatids and trichina), which infect the human body, by inference from investigation of their development in the bodies of animals.

Among diseases of animals may be mentioned:—

In the lower animals.‡

(1) Silkworm disease, which has been brought completely under control by the experimental discoveries of Pasteur.

(2) Small-pox of sheep, against which preventive inoculation has been long used.

(3) Cattle plague, the prevention of which is entirely founded on the knowledge of its mode of spreading gained by experiment.

(4) Pleuro-pneumonia of cattle, and foot and mouth disease, of which, although experiment has not as yet yielded a satisfactory mode of prevention, it has furnished exact knowledge as to the method of its propagation.

(5) Splenic fever of cattle, and the analogous diseases of horses, sheep, and other animals, against which experiment has recently

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* For details on this part of the subject, see the Address by Mr. Simon, C.B., F.R.S., entitled "Experiments on Life as fundamental to the Science of Preventive Medicine." (Transactions of the International Medical Congress. 1881.)

† The Association for the Advancement of Medicine by Research, which issues this Memorandum, is at the present time expending funds in order to contribute to the experimental decision of this most important question.

‡ For details, see a paper in the *Nineteenth Century* for March, 1882, by Mr. Geo. Fleming, President of the Royal College of Veterinary Surgeons: "Vivisection and Diseases of Animals."

(1881) indicated a mode of prevention now being extensively and thoroughly tested in France and other countries in which this disease has most fatally prevailed.

(6) Farcy and glanders, the early detection and prevention of which has been greatly promoted by experiments.

v. *For instruction.*

v. Demonstrations to students.

It is not necessary to insist on the well-known difference between book-learning and demonstration. Like chemistry, physiology must be taught practically if it is to be taught well, and it is necessary that all students of medicine to whom the care of the human body will be entrusted should have a practical and thorough familiarity with the most important functions of that body. For this purpose no painful experiments are necessary, and none are performed in our medical schools and colleges. Most of the demonstrations of what is called "practical physiology" are demonstrations of the microscopical structure of the tissues, or of their chemical properties and processes, or of their physical endowments, and the remainder apply to the organs of insensible or recently killed animals. Whether the occasional repetition of an experiment of great importance, and involving very little pain, would be morally justifiable may admit of question; but, as a matter of fact, it is not and cannot be done. Apart from the provisions of the Act, this question was decided long before by the practice of physiologists.*

vi. *For the detection of poisons.*

vi. Medico-legal tests.

The fact that certain of the most subtile and dangerous poisons cannot be certainly identified by ordinary testing (*i.e.*, by recognition of their physical and chemical properties), is well known. In such cases the physiological test, or the effect of the poison upon the lower animals, is the only means by which the guilt of murder can be brought home to a criminal, or the innocence of a wrongfully accused person established. This, like many other scientific facts has been disputed by ill-informed persons: but it is beyond serious question.†

It was found necessary to insert a clause in the Act allowing a judge to order any needful experiments by a medical jurist. But this may cause, and has already caused, injurious delays, and it would be desirable for each person engaged in this department of scientific work to take out the necessary license beforehand.

§ 7. The above is only a brief enumeration of some of the more striking and illustrative cases in which the objects proposed by experiments on animals have been attained. In some of these success has been brilliant and complete, in others comparative and

Conclusion.

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* In the resolutions of the Committee referred to on page 7.

† See on this subject a paper by Prof. Gamgee, of Owens College. "The Utility of Physiological Tests in Medico-Legal Enquiries."

needing fuller development. In some the results have been the direct and exclusive consequence of the experiments, in others they have been due to these either as confirming or correcting previous conjectures, or as guiding clinical research, or as suggesting fruitful investigations by other methods.

Without exaggerating its extent and cogency, the evidence is ample to show what no one conversant with the subject doubts, that the great strides made in the practice of medicine during the last fifty years have been chiefly due to the exact, scientific, experimental inquiries of this epoch. In fact, experience fully bears out what reason demonstrates and authority confirms, that medicine rests chiefly upon physiology, and that physiology cannot advance without experiments.

The prejudices excited by the account of long past or distant abuses of the right and duty of experiment will, it may be hoped, be dispelled (as in many cases they have been) by increased knowledge of the facts; while those which have been raised by reckless misstatement will subside on candid investigation. If any fear remain that evils which do not now exist, may possibly arise in future, it may be dispelled by a consideration of the stringent regulations of the existing law, even if carried out with the utmost desire not to obstruct demonstrably useful work.

But it is on the scientific investigator himself that the responsibility must ultimately rest of determining what is the best method of accomplishing a given scientific result, and by what means *the greatest possible result may be obtained at the least possible cost of suffering*. If restrictions are supposed to be necessary to control the conduct of careless individuals, let them be continued; but so long as scientific men exercise their responsibility in the humane spirit which has hitherto guided investigation in this country, they have a right to ask that no unnecessary obstacles should be placed in their way.

It is therefore hoped that, should a fresh occasion arise, such a decided and influential expression of opinion will be made in Parliament, as will not only rebuke any ill-advised attempts to totally abolish one of the most important methods of natural knowledge, and an indispensable method for the improvement of medicine, but will also strengthen the hands of the Government in administering the law, so as not to interfere with the just claims of science and with the paramount claims of human suffering.

LONDON, *June*, 1882.

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* MR. DARWIN accepted this Nomination, but his death occurred on the day on which the Council first met.