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A PAPER

Read before the Cheltenham Natural Science Society,

BY

SURGEON-MAJOR FRANCIS DAY.

THE British Medical Association, at a General Meeting held in Edinburgh in 1871, had this question under consideration. They came to the conclusion that a new class of teachers were springing up in this country, who were confining their investigations to Physiology and Biology, but were not engaged in the practice of Medicine. Vivisections, it was observed, were being carried out for two purposes, (1) Original research; or (2) Demonstrations of the functions before classes of students. They *resolved* that, although vivisections could not be prohibited, having due regard to the interests of the human race, still the giving of pain to any of the lower animals is an evil to be avoided where possible, and minimized where practicable. That all experiments ought to be performed under the influence of an anæsthetic: while no painful ones are justifiable for the purpose of illustrating a known fact; and ended by suggesting that no unskilled persons, possessing inefficient instruments, or incompetent assistants, ought to be permitted to make any experiments on living animals. These opinions were generally approved of by the Medical Profession. A Bill was drafted having these ends in view, but was not passed by the House of Commons.

In 1875, a Royal Commission was issued to enquire into the practice of subjecting live animals to experiments for scientific purposes, and a Bill was passed in accordance with the original Medical suggestions: it has been generally accepted on the principle that these experiments are unfortunate necessities, which *were it possible* had better be avoided, but that if any are necessary,

it is better they should be made on the lower animals, in Physiological laboratories, than on human beings in Hospitals, or in the sick room.

Still it cannot be ignored that some persons with very humane (perhaps hyper-sensitive) feelings, at least as regards brutes, desire that experiments of every sort on live animals should cease, *provided such are done for scientific purposes;* and led away by sentiment, but ignoring facts, they assert that nothing has been learnt from vivisections, and prophecy nothing will be.

Another class have no personal experience in the matter, but consider vivisections hellish, horrid, and monstrous, going hand in hand with atheism.

Lastly, I will advert to a section of the public who object to any experiments having for their object researches into what may be termed the mysteries of life; and they perhaps are not far removed from such as would repress intellectual progress altogether.

What do we understand by Vivisection?

The term *Vivisection* to most minds is associated with wounding a living creature. I am not sure whether some persons are not inclined to regard it as almost, if not quite, identical with dissecting animals alive; errors, as it has been asserted, purposely spread by some unscrupulous individuals. The term is now employed for all investigation upon living animals, from severe operations down to pricking the skin with a needle; or even the administration of drugs in order to investigate their properties; and experiments with poisons, or with the products of disease.

Medicine cannot accept such testimony as would be conclusive in a Court of Law, where *direct* or *circumstantial* evidence leaves no doubt on the legal mind. In a Medical question both direct and circumstantial evidence may be utterly worthless. The declarations of the most able and conscientious men may be quite insufficient, for few are able to accurately distinguish between *opinion* and *fact*. One asserts he was cured of a *certain disease* by a *peculiar drug*, and believes such to be true, but this *assertion* includes *two opinions* both of which may be erroneous:—*First* as to his having had the disease, and *secondly* as to the drug having cured it.

We see nostrums for both curable and incurable diseases freely sold, with the dose apportioned simply to the person's age, taking no consideration as to anything else. Would not the most credulous laugh at a shoemaker selling a shoe to fit all feet?

The practice of Medicine and Surgery is still in a state of progress, and is not based solely upon observations made on patients and post mortem investigations. A good practitioner must know something of Physiological research, or the results of enquiries *into the laws governing the functions of life.*

How are these functions of life to be investigated? Are we to believe that all that can ever be known is known? Are we to

accept as unchangeable what it is believed has been ascertained up to 1879? Are there no doubtful questions still in dispute? Can we boldly affirm that we have attained to the summit of knowledge, consequently experiments may cease?

Has any profession, has any trade or occupation learnt so much that nothing more remains to be discovered? Can any be pointed out in which some experiments are not going on? Are experimental laws a thing of the past? Has law making attained perfection? Has the architect, the engineer, the carpenter, or bricklayer nothing new to discover?

Which of us shall answer these questions? Shall the bricklayer decide upon the wants of the carpenter? Or the schoolmaster review the works of the lawyer? Who knows best where the shoe pinches but he who wears it? Who is so capable of judging what is still desired by Medical Science as those who practice that profession, and are daily engaged in endeavouring to alleviate sickness and pain in the sick room and in the wards of our Hospitals?

If we accept for the sake of argument that Physiologists have arrived at that summit of intelligence, that they know everything appertaining to the functions of life, and that nothing new can be discovered,—how about the laws governing disease in their widest sense? Is there nothing to be learnt respecting the germs which propagate infection? Is it known how to check the spread of every variety of epidemic?

Then as to *drugs*, are all existing forms as well as their therapeutic uses known? Can the chemist in his laboratory point out an infallible test for every vegetable poison? May it not be necessary to perform experiments on a living creature to be certain of our tests before the guilty poisoner can be convicted, or an innocent prisoner be saved who is falsely accused of crime?

The *minority* reply that in no case is it justifiable to try experiments on living animals. The *majority*, that if, at a small expense of suffering to one of the lower animals, we may obtain knowledge enabling us to prevent, or mitigate, severe and lasting pain, or even to ward off peril to life in a human being, such is justifiable under certain restrictions.

Vivisections are carried out for five purposes:—(1) *Physiological*, or respecting the functions of life: (2) *Etiological*, or the causes of disease: (3) *Pathological*, or processes of disease: (4) *Therapeutical*, or the action of drugs: and (5) *Toxicological*, or the nature of poisons.

First, then, Physiological or the *functions of life*—but what is life? In its simplest and perhaps most correct acceptation, it is vital action, and therefore involves change. But this is a subject I do not propose discussing. Some of our earliest works took *blood* to be synonymous with life. If we examine the writings of Erasistratus, Pliny, &c., at the commencement of the Christian era, we find

that what we now know as blood-vessels, were then divided into two kinds :—those which we term *veins* were supposed to be the *blood carriers*, because after death they were found to be full of blood ; whereas the *arteries* were believed to hold the *vital air* or *spirit of the individual*, because after death they were seen to be empty.

Galen who flourished at the middle or end of the second century of the Christian era appears to have been one of the first who doubted the truth of this belief, and he ascertained by experiments on living animals, (in other words by vivisections,) that arteries during life carry blood and not air. He likened the arterial and venous circulation to two trees having their roots implanted in the lungs, their branches distributed through the body, and united by a common trunk, the heart. He became so successful in the treatment of some diseases that "he was driven out of Rome by the persecution of the Physicians who attributed his success to magic." But subsequently he returned to that city where he appears to have enjoyed a great reputation.

A long interval succeeded, and the knowledge of the circulation appears to have remained much as Galen left it. At last one arose in this country who spent his time in endeavouring to unravel the mystery. I allude, of course, to Harvey, who early in the seventeenth century (1615) discovered the secret of the circulation of the blood. "When," he writes, "I first gave my mind to vivisections, as a means of discovering the motions and uses of the heart, and sought to discover these from actual inspection, and not from the writings of others, I found the task so truly arduous, so full of difficulty, that I was almost tempted to think with Fracastorius that the motion of the heart was only to be comprehended by the Deity. For I could neither rightly perceive, at first, when the contraction, and when the dilatation took place. . . . At length, and by using greater and daily diligence, having frequent recourse to vivisections, employing a variety of animals for the purpose, and collecting numerous observations, I thought that I had attained to the truth." And we know, or might if we cared to read, that it was due to Harvey's researches that the mode of the circulation of the blood was first ascertained, such having been entirely discovered by means of experiments made on the lower animals while living. He never found out, however, by what channel the blood got from one set of vessels to the other. This was shown by Malpighi who ascertained the existence of the intermediate capillaries by means of the microscope, and first in living frogs.

Time went on, two centuries had elapsed since Harvey's time, but still another mystery required solving. In some diseases, more especially in acute Rheumatism, (unhappily not rare among us), the heart becomes affected, sometimes to end in death occurring rapidly, in others more slowly, perhaps by dropsy, but leaving

the unfortunate victim a martyr to suffering. Physicians listened to the sounds of the heart when in health, to the abnormal sounds it made during disease : they examined the organ after death in those that died, but the mystery could not be solved, the sounds and murmurs of the heart were not understood. They were in the position many of us would be in, if we heard some abnormal sound in the ticking of our clock which had ceased to properly perform its duties, but were unaware what they denoted. Dr. Hope in conjunction with Sir Benjamin Brodie and some others determined to ascertain by actual experiment on some living animals to what the varied sounds were due. Donkeys were procured, and these having been brought under the influence of the Wooraree poison, were operated upon, the sounds of the heart were ascertained, and the mystery was solved. I have stood upon the side of the well where the remains of those animals now lie, and I remember a fellow student at St. George's, now one of London's foremost Physicians, observing, "some people in those bones see only the remains of asses, but the information obtained from the sounds of their hearts saves more lives yearly that can almost be estimated.'

But these benefits, great as they are, are but an infinitesimal portion of what we derive from the labours of those vivisectionists who worked on the circulation alone. Up to the time of Celsus amputations of limbs were not thought of, as no means were known to stop the bleeding, they were allowed to mortify, and the mortified parts removed, bit by bit. In those days the actual cautery, boiling oils, and astringent preparations were mostly relied upon to stop bleeding; they even cut the flesh with red-hot knives to prevent hæmorrhage, and this was the mode of operating for fourteen centuries: and when amputations commenced, there was no knowledge of how the blood circulated, bandages were placed anyhow, compresses anywhere, and mortification commonly resulted. Ambrose Paré, a celebrated French surgeon, suggested in 1582 laying aside the actual cautery, and instead, trusting to ligatures. But prejudices could not be overcome, and many adhered to the old treatment of cautery, until Harvey's immortal discovery of the mode of the circulation of the blood obtained universal credence. At first he was met with the assertion he might expect in these days, *it is not true;* but as proof upon proof were brought forward, the cry became, *it is not new;* and finally opposition merged into that last retort, *well, everybody knew it before.* Then he was accused of having arrived at his discoveries by vivisections, and as the *truth* of his deduction could not be upset, cavillers attacked the *means* by which he had worked.

One of the first outcomes of Harvey's discovery was the tourniquet (1674), or an instrument for compressing arteries and so arresting bleeding. This instrument, simple as it now appears, has saved more human lives than probably all the lower animals have lost consequent upon vivisection in all its branches.

The next great discovery or rather innovation in treatment which I shall refer to, was in that of *aneurisms*. The old method was to sacrifice the limb, but *Hunter*, who made many experiments on the vessels of the lower animals, came to the conclusion that cures might be effected by tying the vessel between the heart and the seat of the disease. But thick and broad threads were employed, tapes, reserve ligatures, cylinders of cork and wood, linen compresses, and all sorts of contrivances against bleeding, which believed securities, merely increased the chances of hæmorrhage.

Jones did not point out any new fact, but scientifically investigated the whole subject. By means of *experiments* he ascertained the causes of this secondary hæmorrhage, and he found out the best means for procuring obliteration of the artery. If science had to wait solely for observation on men, such could only be made after the patient had fallen a sacrifice to the want of assistance, or imperfect knowledge of the surgeon.

Sir Astley Cooper, by experiments on the lower animals, ascertained the possibility of tying some of the largest arteries in the body, in fact, he operated and with success upon the aorta of a dog. This gave a fresh impetus to those operations, conclusively showing that it was possible to ligature a vessel some distance from the affected spot.

The torsion of arteries was discovered in a similar way, when instead of ligatures being used, the vessel is twisted, by means of a pair of forceps, in a peculiar manner, and this twisting completely secures the end of the vessel and prevents bleeding.

Transfusion of blood was ascertained entirely from vivisections on the lower animals. The first experiments were tried by transfusion from one animal into another, and then into man: and a long course of experiments were performed which have shown us this,—that transfusion of blood may certainly save the lives of a considerable number of persons who would otherwise die. It is therefore now resorted to in every necessary case: but of course the experiments on animals led to a great many precautions being found necessary, the overlooking of which would be fatal in the case of man. Thus, if air is injected, immediate death ensues, and clots may occasion the same result.

It was by experiments that it became proved (1670) that atmospheric air is a necessity for the maintenance of life, that animals become stupified on its being withdrawn, reviving on its being readmitted. That respiration only acts upon the oxygen contained in the air (1775-80). That the 8th pair of nerves is concerned in the functions of deglutition, respiration and cardiac action.

In 1662 *Aselius* (Italian) first discovered the *lacteals*. They are very minute, with thin walls, and cannot be seen unless distended either with chyle or injection: the former only being present during digestion. He found them in a dog but could not comprehend their direction nor their course. He supposed they ended in *the liver*.

Pequet (French) ascertained that they terminated in the great veins at the root of the neck, where the chyle is poured into the venous system to mix with the blood, and employed for nutritive purposes. In short, he proved it by tying the thoracic duct.

I will now pass on from the circulation to the nervous system—and here again very much has been learnt from the experiments of vivisectionists. Perhaps I had better mention how *Galvani* the Italian (1786) ascertained by applying a plate of silver and a plate of copper to the nerves and muscles of a frog how contractions were set up. That simple experiment has, (through the investigations of Volta, Davy, Faraday, Ærsted, Thompson, and others) led to all we know about current electricity, electro magnetism, magnetic electricity with all their applications to therapeutics, electric telegraphy, electro plating, electric lighting, *and all taking their origin from an experiment on a frog.* This should teach us not to despise small results.

The nervous system as we are all aware is a very complicated structure, still it has been due to experiments that the two classes of nerves, or those for motion, and those for sensation, have been made out. That the portio dura portion of the seventh pair is for motion and not sensation; of the functions of the *cerebellum* or little brain in co-ordinating muscular movement; that the gray matter on the surface of the cerebral hemispheres is connected with sensation and volition; of the motor functions of that which covers certain convolutions in the anterior part of the cerebral hemispheres; of the functions of the sympathetic.

At the commencement of this century Dr. Walker, due to anatomical researches, as well as observations in a hospital, began to speculate upon the double functions of the spinal cord: he considered one root of the spinal nerves was for sensation, the other for volition, but he transposed their functions, and while he was speculating, Mr. Charles Bell began to act. In a letter dated Dec. 4th, 1809, he wrote, "I must make experiments, and that is what I hate to do." He ascertained that the anterior root was for motion, but failed in discovering the use of the posterior root. He and Majendie made many more experiments before this point was cleared up.

"It was known that on the side of the face of men and animals there exists a large distribution of nerves, some of these Bell showed directed motion, others sensation, while a third set were employed in nutrition." Patients came in those days (as they come now to almost every practitioner) having paralysis on one side of the face, and the severity of the disease can be judged by ascertaining which set of nerves are affected. Paralysis of the (facial) nerve which emerges behind the ear is a trifling complaint due probably to some local pressure, and not occasioning loss of sensation. But in a somewhat similar case in appearance we find loss of sensation as well as loss of motion, this is a more serious

matter, the mischief is deeper in the brain. It was by experiments on living animals that it became proved what function appertained to each nerve. Before Bell's time it was the common practice to divide the portio dura portion of the seventh pair, or the facial nerve, for neuralgia. However, experiments showed that this nerve exercises no influence over sensation, it is entirely employed for motion. Here was a useless operation as investigations proved.

Marshall Hall established very important principles as to the functions of different parts of the spinal cord, independent of the brain itself, showing that there are certain functions residing in the spinal cord, which were not known to exist before, commonly called the reflex action of the spinal cord. These functions continue even if the spinal cord is divided, and which before his time were believed to depend on the action of the brain. It may be asked *but what is the good of this discovery?* A man may fall from a scaffold or some high place, a soldier or sailor may be shot through the spine and the spinal cord be injured. Here the patient lies in bed without the power of moving his lower extremities by his own will, and a casual observer would be surprised to see his legs moving, giving the uninitiated the belief that the paralysis is assumed. Touch the sole of that paralysed man's foot with a feather, the leg is drawn up, but the patient is unconscious of it. This motion is due to the independent function of the spinal cord, and may be observed in a frog that has had its head cut off.

I remember when all these cases were deemed hopeless or nearly so, that Brown Sequard demonstrated the possibility of recovery, and that to the relief of many an unfortunate patient whom the nurses previously considered, it was almost trouble thrown away to look after He divided the spinal cord in one of the canine species, and the animal not only recovered but subsequently reared a numerous offspring. A division of the *spinal cord may be restored, and the lost powers* be entirely regained.

From Marshall Hall's experiments on the nervous system, the action of spasmodic affections first became understood, how the exciting cause had to be removed, as a tooth, a spicula of bone, or the irritation set up by the cicatrix of a wound. Experiments have shown how some diseases which were formerly considered due to affections of the brain really have their seat in the spinal cord.

By experiments on the liver it was ascertained that its functions are not merely to secrete bile, but likewise to elaborate substances which become the sugar principle in the circulation.

But (it has been asked) why do you not discover the cause, the progress, and the cure of disease by working in the dead-house and examining all fatal cases? This is done, and medical investigation in ascertaining appearances after death, has arrived at almost as far as it can go. But it is requisite to know how and in what order those processes occur in the living body. This can only be made out by performing experiments on the lower

animals and destroying them at different periods of the disease, and thus its course or natural history (from its commencement to its fatal termination) may be ascertained. By means of experiments on lower animals, it was discovered that in inflammation the globules of the blood could pass through the blood vessels into the surrounding tissues, become diseased, and find their way back again into the circulation. It is a most important fact lying at the root probably of a vast amount of disease: by experiments on living animals and by diseases instituted in them, we are beginning to get an idea of the nature of tubercle, and it is within the bounds of hope that some day we may learn the nature and possibly the means of preventing that most awful of all maladies, namely *cancer*.

If, as I say, *consumption* can be induced in a lower animal, it is possible that some day it may be discovered how to hinder its production in man, as the first necessity for the prevention of disease is a knowledge of the cause which produced it, the more exact the better. Thus *Diabetes* can be artificially produced by an injury to a portion of the brain; this gives an insight into its cause and nature, showing its seat is not in the kidneys.

Mr. Simon considered that owing to an experiment occasioning a disease in an animal, information had been obtained respecting cholera which would be of great service in sanitary legislation.

A most remarkable result was ascertained in epilepsy, that it could be artifically produced in a lower animal and the disease become hereditary.

I know of no disease causing more exquisite torture to the patient than *rabies* or hydrophobia as it is sometimes termed. A disease terminating in death and in the most terrible agonies. One day in India a mad dog rushed up the garden of a house biting two natives and the European resident, then turning off to one side it attacked the fowls, two goats and a pony. Both natives died of rabies, the European was saved by his clothes. But now came the question what was to be done? Could fowls, goats and ponies take and spread rabies? Before experiments were tried on the lower animals it was believed that rabies could only be spread by the Carnivora or Omnivora, but not by the Herbivora. But the doubt has been cleared up by those who have experimented on the subject, and they have ascertained that although this disease is communicable by inoculation of the saliva it is not communicable by inoculation of the blood and tissues. Rey demonstrated that the bite of a rabid dog could occasion rabies in sheep, while the saliva of rabid sheep produced a like disease in rabbits. The foam of horses and asses thus affected has been known to propagate the complaint, while rabies has been communicated from the ox to fowls.

Small-pox is another disease the ravages of which have been much checked by remedies, or rather a prophylactic based upon experiments on the lower animals. I find that in 1806 small-pox

was directly fatal in 1 case in 6; in inoculated cases, 1 case in 250. We all know how inoculation came into vogue, and how it was observed that the propagated disease in the human beings was less severe than that received through ordinary contagion. One objection raised by ignorance and spread by folly, was to refuse to submit to inoculation because after the patient recovered, symptoms of scrofula or other affections occurred, which, of course, were all laid down to the treatment adopted, ignoring the fact that such results were more frequent after ordinary small-pox.

I will quote a passage from a sermon published by a very learned and probably well-meaning Divine (the Rev. E. Massey), who appears to have followers even in these days. He observed that "Job's distemper was confluent variola, inoculated by the devil," and that "diseases are sent for the punishment of sins, and the attempt to prevent them is a diabolical operation." I conclude he enjoyed rude health, and if subsequently ill, altered his opinions.

About 1798, Dr. Jenner of Berkeley in this county, and who practised in St. George's Place in Cheltenham, discovered (or perhaps, I should say, brought prominently to notice) the effects of vaccination in protecting the individual against attacks of small-pox. I have often seen the hide of the very cow which furnished his first virus, it is still kept as a relic in the Museum of St. George's Hospital, for the hospital of Hunter was that of Jenner, and later on of Brodie and of Hope.

When Jenner brought his discovery to notice, I find that the average number of deaths occurring yearly within the bills of mortality in London from small-pox alone were 2,000 a year, and I need hardly observe that this did not include anything like the whole of London, while the population was not half at that period what it is now.

Vaccination was discovered about the time of Napeoleon's wars, and it has been estimated to have saved more lives than were lost during the Peninsular campaigns.

Vaccination as we all know is a disease taken from a lower animal through which small-pox has passed, become modified in its transit, and capable of being reintroduced into the human subject as a prophylactic against small-pox. Tanner proved the correctness of Jenner's published idea that cow-pox in the bovine races may be induced by inoculation with the grease from the heels of a horse. It is only those who have been in countries where small-pox runs an almost unchecked career, that can realise its horrible effects. In many parts of India the Hindoos consider that an evil spirit sows the germs of the disease as a punishment for crime, and the patient is left to die as an accursed being, while the corpse is precluded from receiving the usual funeral rites. Many and many are the people blinded for life by this terrible scourge, or their constitutions are shattered from the effects of this disease.

We hear the efficacy of vaccination questioned, but we must not

lose sight of the fact that it may occasionally have been badly performed. I remember once a native vaccinator was suspected of making false returns, so some coloured water was sent him with directions to report as soon as possible whether the fluid sent was as good as the lymph which he was employing? In due time he wrote to say that it was far better.

In another instance the magistrate of a district sent for the native vaccinator, and asked, "What are your duties?"

"My duties, your Excellency," replied the native, "are to vaccinate the people."

"What is the purpose of vaccination?"

"Vaccination, your Excellency, is by introducing a modified disease by means of *lymph* into a human being, to render him secure from an attack of small-pox."

"What is lymph?"

"Lymph, your Excellency, is the juice of a tree which grows in the neighbouring jungle."

There exist a class of venomous animals almost unknown to the dwellers of these islands, I allude to *poisonous snakes*, which are computed to kill upwards of 20,000 persons yearly in British India. It has been believed by many that some remedy might be discovered by means of experiments on living animals, and, as I presume no one would suggest for this purpose the employment of our convict population, we have to choose between two courses, let the thousands die and wait for chance to supply a remedy, or, try experiments on the lower animals.

Some years since Dr. Shortt of Madras had charge of an enquiry into how a remedy for snake-bites could be found out, and a large reward was offered, and still exists for this purpose. Dr. Shortt left for England, and I took charge of his duties. A native came one day claiming the reward, as he announced that he had discovered an infallible remedy for snake-bites, so positive was he that he proposed trying it on himself. Here was a dilemma, the man wished to prove the efficacy of his drug and claimed the money; to prove the usefulness a case must be tried. Shall such be tried upon a man or on a dog? I let it wait until Dr. Shortt's return, and he considered it best to try on one of the lower animals. The dog was bitten, and in spite of the remedies the dog died. The discoverer of the remedy was astonished and left, expressing his satisfaction that the experiment had not been made on himself.

In 1869 I was at Balasore and went to the marine watering place, where the sands are as soft and fine as those we have in Tenby Bay. I wished to examine the stake-net fishery that extended some distance out to sea, and a party of us were called down to the beach at the time for taking up the nets. Some of us, myself amongst the number, took off our shoes and socks and waded out, as the water was very low, the tide being on the ebb. I felt something round and smooth which wriggled under my feet, and a

native said, "Oh, it is only a snake." I went further, and the same thing occurred more than once, so I determined to return to the shore for my shoes. As I turned, I felt a prick at the heel of my right foot, lifting it up there was a sea-snake *(Hydrophis)* hanging on. Having shaken him off and examined the place, there were seen two drops of blood, conclusively proving that the fangs had penetrated. We had no remedies but brandy and sherry, while the station was nine miles off. The natives crowded round, said it was a very bad business, and considered it a judgment on my having killed two snakes the previous day. They detailed how two of their number had been bitten the previous week, how both had died within a few hours, and how nobody ever recovers.

Here was a recovery without remedies, showing how if any remedy had been tried it would have been considered proven that by it I had been cured. How do I account for this? A snake having discharged his venom, perhaps at a fish, in order to obtain food, a considerable period elapses prior to his poison sac being replenished, at these periods his bites may be almost inocuous. This shows us that we must not consider the result of one recovery conclusive—several experiments have to be successfully made before the cautious practitioner can admit the efficacy of a new drug.

Experiments on animals have afforded information respecting the union of broken bones: the reproduction of periosteum for the covering of bones: and the repair of tendons. Also in cases of *starvation* they have demonstrated the effect of want of food upon the function of the production of heat: upon the order in which the tissues are consumed and on the immediate cause of death. Before Majendie's time it was believed that animals could live and thrive on a single substance as *gelatine,* he tried it and found they were starved.

We will now pass on to the *action of drugs* which have been ascertained by means of experiments on the lower animals. Here I do not mean to contend that the effects of medicines on the lower animals is always identical with what we find in man, *but,* if certain results are produced on these creatures, such would lead us to expect that the same effects might occur in man.

Rhubarb Colchicum and *Podopholine* have all been ascertained to powerfully stimulate the *liver:* while on the other other hand the direct effects of *mercury* on that organ have been disproved.

Chloral as an *hypnotic* was discovered by experiments, and in the same way it was ascertained in large doses to be an antidote to *strychnia:* and *Atropia* was discovered to be a remedy for *salivation.*

Many in this room must have witnessed the intense agony of a person suffering from *angina pectoris.* The paroxysms are due to excessive tension of some of the blood vessels, which may be relieved for a time by blood letting, but such treatment is known to be weakening. So it was proposed to try and discover some remedy which would relieve this tension, and in this way a prepara-

tion of *Petroleum Ether* (nitrite of amyl) was found to possess this property. These experiments could not have been tried upon human beings, but being performed on lower animals, while under the influence of chloral, no pain was occasioned.

Chloroform was discovered by Dumas when distilling Formic acid from red ants: its present use for the relief of pain was discovered by what are now termed vivisection experiments, as was also the similar use of *Æther*. Simpson searched long for an anæsthetic and tried many and various drugs on lower animals, on his pupils, as well as on himself, before the now, well known, chloroform was brought to light. Previously it had been considered a curious chemical compound but nothing more. Anæsthetics were introduced 1846-47, and we know, as in cases of neuralgia, that they deaden sensation prior to the production of unconsciousness.

Since the discovery of chloroform (1846-47) and its general use in operations, other great benefits to the patients have been brought about by experiments upon the lower animals. Some in this room must remember the painful scenes witnessed in operating theatres prior to the time of anæsthetics. Silently to the general public, but surely to the patients have other and most beneficial treatments been devised. I allude more particularly to the antiseptic treatment of wounds: *Lister* developed this by means of experiments upon the lower animals. He it was, who desiring to find a ligature which did not cause irritation and consequently set up but little inflammation in the wound, thought of using cat-gut. He tried on brutes and he succeeded. Ask patients how they would like to revert to a period before chloroform? How they would wish the antiseptic treatment abolished?

Claude Bernard discovered by means of experiments on dogs the method by which *carbonic oxide* occasions blood poisoning. When a charcoal brazier is lighted two sorts of gases are produced (1) carbonic acid and (2) carbonic oxide. When a person is suffocated simply by *carbonic acid* as in the case of a man falling into a brewer's vat, he can often be resuscitated by keeping up artificial respiration for a certain time. Not so with *carbonic oxide*, which latter gas he discovered forms a compound with the blood, and then the blood becomes incapable of taking up the oxygen of the air at the lungs, and the patient dies of asphyxia. In these cases some blood *must be withdrawn*, as well as artificial respiration being kept up.

Claude Bernard was led to this investigation when making some experiments on poisoning by carbonic acid. He found that in some cases the blood was of dark colour but in others that it was of a cherry red. Being struck by this curious difference he was induced to investigate the amount of gases present in the blood, and in this way his interesting and useful discovery was made.

The nature of asphyxia and what gases are respirable or irrespir-

able along with the uses of artificial respiration have been worked out in a series of experiments on animals. Look at a simple case of drowning; why the week before last some policemen in order to resuscitate a person apparently drowned held him up by the heels to drain him as if he were a beer barrel, and then laid him on his face. They were surprised on finding him dead. But this used to be a common method before experiments were instituted.

But we have another class of drugs, namely, poisons, which deserve attention. I mean those administered for criminal purposes. A chemist may believe, in fact be morally convinced, that *A* has poisoned *B* by a certain drug, but he requires to demonstrate such, whereas he does not possess infallible tests for every vegetable poison, although such may and probably do exist. Experiments have to be tried, a man's life hangs on the result. In *Palmer's* case it was found necessary to perform some experiments on living animals, due to the many conflicting results reported to have been obtained by experiments performed by witnesses for the defence. Taylor found that the power of discovering the poison depended on the amount given to the animal, and the length of time it subsequently lived, demonstrating that such need not be invariably present in the body. A very small amount of strychnine destroyed a rabbit, into which it had been introduced by absorption, and after death no trace of it could be detected (6 rabbits were used).

Then, on the other hand, we may have persons falsely accused, not from malice or spite, but on what seems to be sufficient grounds. About 14 or 16 years since a woman in Suffolk was charged with poisoning her step child, a little girl. She had applied to its skin an ointment containing arsenic for medicinal purposes. The child died, and arsenic was discovered inside it. Dr. Taylor and Dr. Pavy performed experiments, in order to ascertain whether poison introduced into the circulation through an abrasion of the skin, or absorbed, any portion could be found internally after death? Rabbits and dogs were used for the purpose, and the coroner's jury were satisfied that it was not inconsistent with the prisoner's statement that death had been occasioned by the admitted application of the ointment to the skin. Prior to this it had not been clearly proved by science that a poison could find its way from the skin to the internal organ and be discovered there after death.

These cases, Taylor observes, he could multiply indefinitely. And would any of us refuse to permit experiments on any animal in order to save a person charged with a heinous crime in establishing their innocence? If humanity would forbid any one to experiment on animals to convict the guilty, I hardly believe they would go so far, as to rather allow an innocent person to be hanged, than some of the lower animals to be operated upon.

Taylor observed that if chemistry failed in detecting poison in a dead body, he should apply to an animal some part of the substance said to have caused death, in order to determine its nature. The

Calabar bean is a poisonous drug, paralyzing the heart and destroying life, but chemistry has not yet discovered any re-agent by which it may be detected. These poisons act as much on dogs as on human beings, and by such means antidotes may be discovered.

The best thing to rouse a lower animal which had taken prussic acid has been found to put it under a tap of cold water, and a similar result occurs in man.

Dr. J. Browne ascertained from experiments on animals that *choral* is a drug antagonistic in its action to the essential constituent of *cocculus indicus*, and prevents death.

There is no test for *digitalis* which acts on the heart, and we must learn effects by experimenting on the lower animals.

I have, although but briefly, sketched out how it has occurred that discussions upon vivisection have arisen during the last few years by those who do not believe anything has been discovered by their means. I have traced some of the advantages which humanity has reaped from these investigations, more especially as regards the circulation, the nervous system, and the therapeutic action of drugs. How by its lessons some prophylactics have been discovered, and the mode of treating asphyxiated persons has become more clear; how the changes in structures induced by disease have been followed out step by step, and some organs formerly unsuspected are found to be the seat of certain complaints. How by means of anæsthetics operations have become painless, and owing to the discovery of the antiseptic treatment the pain of after treatment (as well as the mortality) has been greatly reduced. And, lastly, how by these means some prisoners have been convicted, and some persons unjustly accused have been saved from the gallows. But there are still many strong places to be attacked, remedies are required for many epidemics, as, for instance, cholera, or fevers; or for poisons as those of serpents, and curative agents for the removal of disease; while a great boon would be an equally efficacious but safer anæsthetic than chloroform.

The question is now narrowed into these grounds, first that some experiments on living creatures are a necessity; but shall such be carried out in the wards of our hospitals and amongst patients? or on the convict population? or on the lower animals? Most of us in this room have been asked to sign petitions to except the lower animals from all experiments, thus throwing such upon human beings. The medical profession object to this plan, preferring the ancient adage "*fiat experimentum in corpore vili.*"

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