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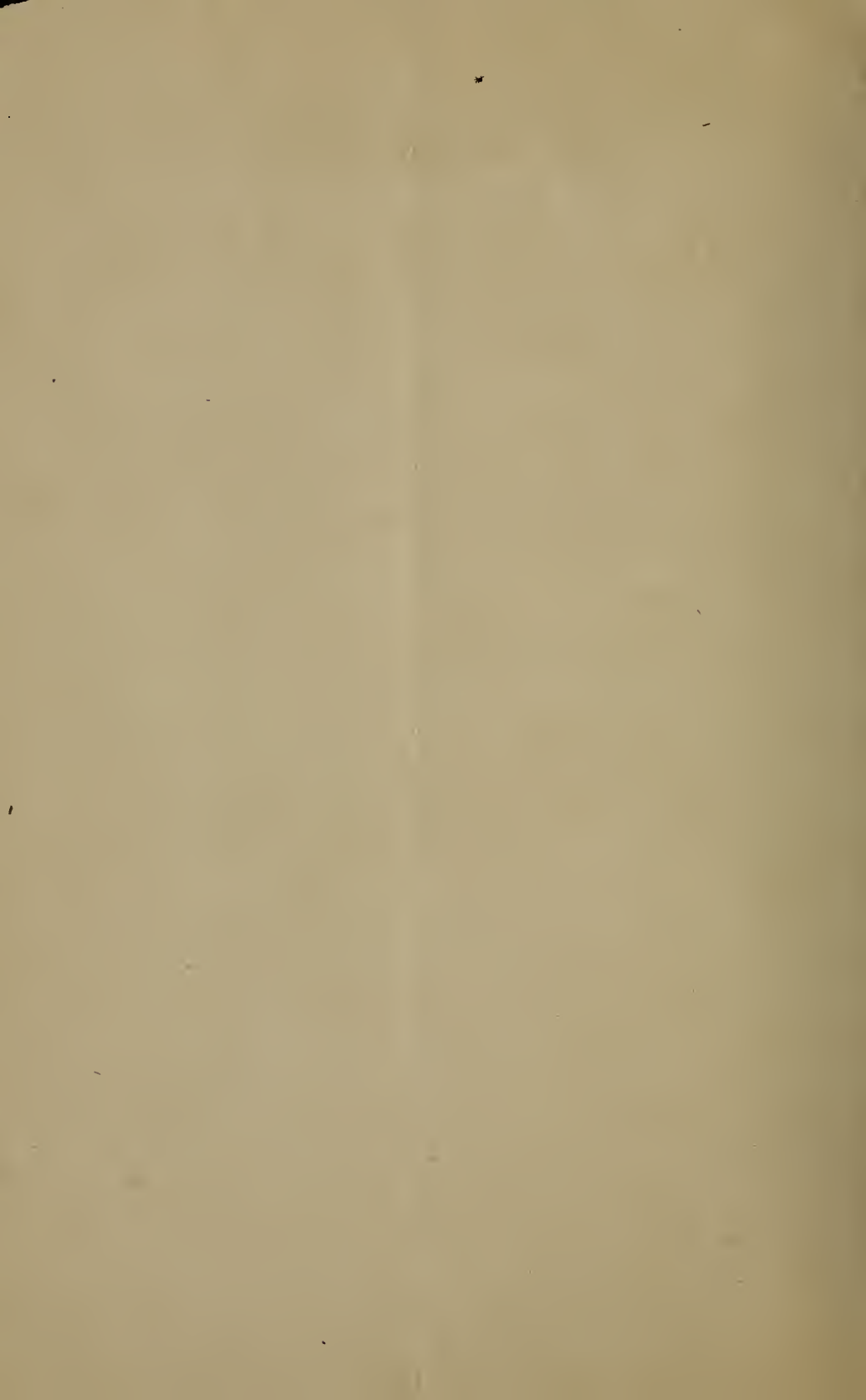
OUR RECENT DEBTS TO VIVISECTION

BY

WILLIAM W. KEEN, A. M., M. D.,
Professor of Surgery, Woman's Medical College of Pennsylvania.

[Reprinted from THE POPULAR SCIENCE MONTHLY, May, 1885.]

PHILADELPHIA:
PORTER AND COATES.
1885.



OUR RECENT
DEBTS TO VIVISECTION.

THE ADDRESS TO THE GRADUATES
AT THE
THIRTY-THIRD COMMENCEMENT
OF THE
WOMAN'S MEDICAL COLLEGE OF PENNSYLVANIA,
MARCH 11, 1885.

BY
WILLIAM W. KEEN, A. M., M. D.,
PROFESSOR OF SURGERY.

REPRINTED FROM "THE POPULAR SCIENCE MONTHLY," MAY, 1885,
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OUR RECENT DEBTS TO VIVISECTION.

LADIES : It is my happy privilege to congratulate you on the completion of your three years of preliminary study, and on your merited reward in receiving the degree of Doctor of Medicine from the oldest and largest medical college for women in the world.

By this degree you are permitted to enter the ranks of one of the most ancient, honorable, and laborious professions. With it you assume certain valued privileges, and have cast upon you certain weighty duties. Both the privileges and the duties will exact from you all the intelligence, skill, tact, and faithfulness which you possess.

You will observe that I said a moment since you had finished your "preliminary" studies ; for your first and most pressing duty after graduation, and one for which happily you will at first have ample time, is to continue your medical studies. I do not say complete them, for, be your lives even prolonged far past the allotted threescore and ten, instant, constant, intense study is the imperative condition of the right kind of success. You know very little now. Happy both you and your patients, if even with gray hairs comes ever-growing knowledge.

But you have other duties than those to self—you have great duties to the communities in which you will live. Women especially will not only look to you in times of peril, whether in childbirth or sickness or accident, but also for guidance in that greatest duty and privilege—the prevention rather than the cure of disease. This is the glory of our times and the magnificent duty of our profession, that by enlightened care and wise instruction we can prevent much of the sickness and sorrow of the race, and bid back the Angel of Death.

Hygiene—well named after Hygeia, the goddess of good health—must be one of your principal future studies, and its lessons ever on your lips ; line upon line, precept upon precept, here a little, and there a great deal. The greatest need of our College to-day is a Professorship of Hygiene. Would that in this vast audience some one could be found who would endow such a chair in the Woman's Medical College of Pennsylvania !

You must also direct public opinion, and especially the opinion of your own sex, in reference to medical questions; for your information and studies will fit you to be their instructors in all such technical questions.

It is to one of these medical issues of the day that I purpose to direct your attention at present—one as to which intense feeling, especially among women, has been aroused—viz., the question of experiments upon animals.

Epithets and invective have been freely used, but, as befits the audience and the occasion, I shall endeavor to approach it in a perfectly calm and fair spirit, seeking to lay before you only one aspect of a many-sided question, viz., the actual practical benefits it has conferred upon man and animals—a fact that is constantly denied, but which medical evidence proves to be incontestable.

I shall not consider the important older discoveries it has given us, but only those since 1850, almost all of which are within my own personal recollection. Even of these I must omit nearly all of its contributions to physiology and to pathology, though so much of our practice is based upon these, and confine myself to the advances it has enabled us to make in medical and surgical practice. I shall endeavor to state its claims with moderation, for an extravagant claim always produces a revulsion against the claimant, and is as unwise as it is unscientific.

Again, it must be borne in mind that, as in nearly every other advance in civilization and in society, so in medicine, causes are rarely single, but generally multiple and interwoven. While vivisection has been a most potent factor in medical progress, it is only one of several factors the disentanglement of which and the *exact* balancing of how much is due to this or to that are often difficult and sometimes impossible. Let me add one word more. All that I may say is purely upon my own responsibility. I commit the opinion of no one else to any view or any statement of fact.

Medicine in the future must either grow worse, stand still, or grow better.

To grow worse, we must forget our present knowledge—happily, an inconceivable idea.

To stand still, we must accept our present knowledge as a finality, complacently pursuing the well-worn paths; neither hoping nor trying for anything better—happily, again, an impossibility.

To grow better, we must try new methods, give new drugs, perform new operations, or perform old ones in new ways; that is to say, we must make experiments. To these experiments there must be a beginning: they must be tried first on some living body, for it is often forgotten that the dead body can only teach manual dexterity. They must then be tried either on an animal or on *you*. Which shall

it be? In many cases, of course, which involve little or no risk to life or health, it is perfectly legitimate to test probable improvements on man first, although one of the gravest and most frequent charges made against us doctors is that we are experimenting upon our patients.

But in many cases they involve great risk to life or health. Here they can not, nay, they must not, be tested first upon man. Must we, then, absolutely forego them, no matter how much of promise for life and health and happiness they possess? If not, the only alternative we have is to try them on the lower animals, and we would be most unwise, nay, more, we would be cruel, cruel both to man and to animals, if we refused to pain or even to slay a few animals, that thousands, both of men and of animals, might live.

Who would think it right to put a few drops of the hydrochlorate of cocaine (a year ago almost an unknown drug) into the eye of a man, not knowing what frightful inflammation or even loss of sight might follow? Had one dared to do it, and had the result been disastrous, would not the law have held him guilty and punished him severely, and all of us said Amen? But so did Christison with Calabar bean, and well-nigh lost his own life. So did Toynebee with prussic acid on himself, and was found dead in his laboratory.* Accordingly, Koller,

* I add the following striking extract from a speech in defense of vivisection, on April 4, 1883, by Sir Lyon Playfair, deputy Speaker of the House of Commons—no mean authority. The italics are my own:

“For myself, although formerly a professor of chemistry in the greatest medical school of this country, I am only responsible for the death of two rabbits by poison, and I ask the attention of the House to the ease as a strong justification for experiments on animals, *and yet I should have been treated as a criminal under the present act had it then existed.* Sir James Simpson, who introduced chloroform—that great alleviator of animal suffering—was then alive and in constant quest of new anesthetics. He came to my laboratory one day to see if I had any new substances likely to suit his purpose. I showed him a liquid which had just been discovered by one of my assistants, and Sir James Simpson, who was bold to rashness in experimenting on himself, desired immediately to inhale it in my private room. I refused to give him any of the liquid unless it was first tried upon rabbits. Two rabbits were accordingly made to inhale it; they quickly passed into anesthesia and apparently as quickly recovered, but from an after-action of the poison they both died a few hours afterward. *Now, was not this a justifiable experiment upon animals? Was not the sacrifice of two rabbits worth saving the life of the most distinguished physician of his time? . . .* Would that an experiment of a like kind on a rabbit or a Guinea-pig had been used by John Hunter, who probably shortened his own noble life by experimenting on himself! . . .

“Let me give one other instance. . . . A few years ago two young German chemists were assistants in a London laboratory. They were experimenting upon a poison which I will not even name, for its properties are so terrible. It is postponed in its action, and then produces idioey or death. A experiment on a mouse or a rabbit would have taught them the danger of this frightful poison; but, in ignorance of its subtle properties, they became its unhappy victims, for one died and the other suffered intellectual death. Yet the promoters of this bill would not suffer us to make any experiments on the lower animals *so as to protect man* from such catastrophes. It is by experiments on animals that

of Vienna, properly and wisely tried cocaine first on animals,* and then, finding its beneficial effects, tried it upon man with like results, and one of the most remarkable drugs of modern times was thus made available. We are only on the threshold of its usefulness. It has been used in the eye, the ear, the nose, the mouth, the larynx and all other mucous membranes, in the removal of tumors, and as an internal medicine. When its physiological action has been still more thoroughly and systematically investigated, its poisonous dose ascertained, when we know how it works, what its effects are upon the blood-pressure, the heart, the nerves, the blood-vessels—effects that can not be accurately studied upon man—its usefulness may be increased to an extent as yet but little dreamed of. Should it only soothe the last painful hours of our great hero, General Grant, a nation will bless it and the experiments which gave it effect. Moreover, had the experiments of Dr. Isaac Ott, of Easton, † on this very drug, borne their due fruit, America would have had the honor and the human race the benefits of cocaine ten years ago—ten years of needless suffering!

This is but one illustration of the value of experiments upon animals in the realm of new drugs. In fact, substitute for cocaine other drugs, or new operations, or new methods of medical treatment, and the argument repeats itself for each. Within the last thirty years a multitude of new drugs have thus been discovered, and their effects have been either first tested upon animals, or their properties studied exhaustively in a manner impracticable upon man. I will only enumerate some of them, since time will not allow me to enter upon each in detail. Thus have been introduced lily-of-the-valley in heart-disease, yellow jasmine, in diseases of the heart and nervous system, paraldehyde and chloral-hydrate, so valuable for sleep, caffeine for headache, eucalyptus as an antiseptic and in medicine, nitro-glycerine for nervous maladies, Calabar bean for diseases of the eye and nervous system, naphthaline and iodoform in surgery, quebracho as an antispasmodic, antipyrin and kairin in fever, jaborandi in dropsy, salicylic acid in rheumatism, nitrite of amyl in epilepsy and intermittent fever, jequirity in ophthalmic surgery, piscidia as a substitute for opium, the hypodermic method of using drugs, and so on through a long list. And, as to the old drugs, it may be truly said that we have little exact, that is scientific, knowledge of any one except through experiments upon animals. ‡

medicine has learned the benefits, but also has been taught to avoid the dangers of many potent drugs—as chloroform, chloral, and morphia.”

* “Archives of Ophthalmology,” September and December, 1884, p. 402, New York, Putnam’s.

† Ott, “Cocain, Veratrin, and Gelsemium,” Philadelphia, 1874.

‡ For three hundred years digitalis, for instance, has been given as a *depressant* of the heart, and, when a student, I was taught to avoid it carefully when the heart was weak. But the accurate experiments of Bernard and others have shown that it is, on the

Let us see now something of what America has done in advancing practical medicine by vivisection. In passing, I may say that the assertion that America has contributed but little, so far from being an argument for the restriction of vivisection, is a strong argument for its further cultivation, in order that greater good may result from remarkable discoveries here, equal to those that I shall show have been made in Europe.

Wounds of the abdomen, especially gunshot-wounds, are among the most fatal injuries known to surgery. A small, innocent-looking, external pistol-wound may cover multiple and almost inevitably fatal perforations of the abdominal contents. The recoveries from 3,717 such wounds during the late civil war only numbered 444, and of those with escape of the intestinal contents the recoveries, says Otis, may be counted on one's fingers. The prevailing treatment as laid down in our text-books has been purely conservative, treating symptoms as they arise. The brilliant results achieved in other abdominal operations have led a few bold spirits, such as our own Sims, Gross, Otis, McGuire, and others, to advocate the opening of the abdomen and the repair of the injuries found.

In May of last year, Parkes, of Chicago, reported to the American Medical Association * a series of systematic experiments on thirty-seven dogs, that were etherized, then shot, the abdomen opened, and the wounds of the intestines, arteries, mesentery, etc., treated by appropriate surgical methods. The results confirmed the belief awakened by earlier experiments and observations that surgery could grapple successfully with multiple and formidable wounds, by sewing them up in various ways, or even by removing a piece of the bowel and uniting the cut ends. Hard upon the heels of this important paper, and largely as its result, comes a striking improvement in practice. And remember, that this is only the first fruit of a rich harvest for future time, in all countries, in peace and in war.

November 2d, of last year, a man was brought to the Chambers Street Hospital, in New York, with a pistol-shot wound in the abdomen. Under careful antiseptic precautions, and following the indica-

contrary, actually a *heart tonic and stimulant*. So long as I live I shall never forget the intense joy of myself and the agonized parents, when one bright young life was brought back from the very grave, some five years ago, by the knowledge of this fact, and this is but one of many such cases. Thus have the action and dangers of our common anæsthetics been positively and accurately ascertained; thus the action of ergot on the blood-vessels, explaining alike its danger as an article of food and its wonderful use in certain tumors of the uterus and diseases of the nervous centers; thus, too, every one who gives opium in its various forms is a debtor to Bernard, and every one who gives strychnine a disciple of Magendie.

* "Medical News," May 17, 1884. I shall refer readers frequently to this journal, as it is often more accessible than foreign journals, and it will refer them to the original papers.

tions of Parkes, the abdomen was opened by Dr. Bull,* coil after coil of the intestines was drawn out, the bullet was found and removed, and seven wounds of the intestines were successively discovered and properly treated, and the patient made an uninterrupted recovery. A recovery, after so many wounds, any one of which would necessarily have been fatal under the old methods of treatment, shows that we have now entered upon a proper and successful method of treatment for such frightful accidents.

This is but one of the remarkable achievements of late years in abdominal surgery. The spleen has been removed, part of the stomach has been cut out for cancer, part of the bladder has been dissected away, the entire gall-bladder has been removed, and several inches of the intestine have been cut out, all with the most remarkable success. To all of these, experiments upon animals have either led the way, or have taught us better methods. To recite each in detail would occupy too much time, but one illustration I must not omit, for the improvement, produced by it and other experiments, affects every abdominal operation. When I was a student, the peritonæum was avoided by knife and needle wherever possible. After the death of his fourth case of ovariectomy, Mr. (now Sir Spencer) Wells, † in making the *post-mortem*, was led to believe that the then received treatment of the peritonæum was incorrect, and that he ought to bring its surfaces in contact in order to obtain secure union. Accordingly, instead of testing his ideas upon women, he experimented upon a few dogs, and found that his suspicions were correct. Since then it has been accepted as a cardinal point in all abdominal operations. Following this came improvements in the ligatures used, in the method of treating the pedicle, in the use of antiseptics, etc., all more or less the result of experiments upon animals, and what are the results? Taking successive hundreds of cases, Sir Spencer Wells's percentage of mortality has decreased steadily from thirty-four per cent to eleven per cent. In 1,000 operations he has saved 769 women from the grave and added a net gain of 17,880 years to human life, to say nothing of the happiness of the thousands related to them by ties of friendship and of blood—a proud boast indeed!

Since then, others have reduced the percentage of deaths after ovariectomy to three in the hundred; and Martin, of Berlin, has lost but one patient from blood-poisoning in his last 130 cases.

It can not be claimed, of course, as to *all* this wonderful history of abdominal surgery—and remember that in 1862, when I was a medical student, I heard ovariectomists denounced from a professor's chair as murderers!—that experiments upon animals have done the whole work. No one man, no one series of experiments has sufficed, and

* "Medical News," February 14, 1885.

† Wells, "Ovarian and Uterine Tumors," 1882, p. 197.

experiment *alone* would not have done it. But had such experiments not been made on animals, as to the peritonæum, the pedicle, the sutures, the ligatures, etc., we should be far behind where we now are, and still be ignorantly sacrificing human life and causing human suffering.

But to return to America. The first condition to successful treatment is an accurate knowledge of what any disease is—its cause and its course—then we may guide it, and in due time, it may be, cure it.

Before Dr. H. C. Wood's* accurate experiments on the effects of heat on animals, the nature and effects of sunstroke were almost matters of mere conjecture. Every one had his own theory, and the treatment was equally varied. Even the heat-effects of fever itself—the commonest of all symptoms of disease—were ill understood. Wood exposed animals to temperatures of 120° to 130° Fahr. and studied the effects. These experiments have often been alluded to as “baking animals alive.” You will note that the heat was no greater than that to which laborers are frequently exposed in our hot summer-days, when working in the sun or in many industrial works. His experiments showed that the effects of sunstroke—or, as he happily termed it, Thermic or heat fever, a scientific name now widely adopted—were solely due to the heat, death following from coagulation of the muscular structure of the heart, or by its effects on the brain. They explained also many of the phenomena of ordinary fever as the result of heat alone. They have established the rational and now generally-adopted treatment of sunstroke by reduction of the body-temperature; and the same method is now beginning to be appreciated and employed in ordinary fever. †

The same observer, with Dr. Formad, has made important experiments on the nature of diphtheria, and when we learn, as we probably soon shall, how to deal with the microscopic forms of life which seem to be its cause, it will not be too much to hope that we may be able to cope far more successfully with a disease now desolating so many homes.

In India alone twenty thousand human beings die annually from snake-bite, ‡ and as yet no antidote has been discovered. How can we *search intelligently* for an antidote until we know accurately the effects of the poison? This can not be studied on man; we must resort to animals, or else let the holocaust go on. Accordingly, Dr. T. Lauder Brunton began such a series of experiments in London, but was stopped by the stringent anti-vivisection laws there in force. But Drs.

* Wood, “Thermic Fever or Sunstroke,” Philadelphia, 1872.

† Eighteen out of Wood's experiments were on the general effects of heat, as above alluded to. In six others the local effects of heat (135° to 190° Fahr.) on the brain, and in four others the local effects (up to 140° Fahr.) on the nerves were studied and gave most valuable results, entirely and evidently unattainable on man.

‡ Fayrer, “Thanatophidia of India,” p. 32.

Weir Mitchell and Reichert,* in this city, have recently undertaken experiments on cobra and rattlesnake venom, the cobra-poison being furnished, be it observed, by the British Government, whose own laws have prevented investigations for the benefit of its own subjects! The results are as yet only partly made known, but they have been brilliantly successful in showing that there are two poisons in such venom, each of which has been isolated and its effects studied. The first step has been taken—the poison is known. Who will raise a finger to stop progress toward the second—the antidote? Can the sacrifice of a few score of animals each year in such research weigh for a moment against the continuous annual sacrifice of twenty thousand human beings? †

The modern history of anæsthetics is also of interest. To say nothing of ether and chloroform, whose safer use Bert has investigated in France, nor of cocaine, to which I have already alluded, let us see what experiments on animals have shown us as to bromide of ethyl—an anæsthetic lately revived in surgery. Its revival has quickly been followed by its abandonment on account of the frequent sacrifice of human life—that is to say, *experiments on human beings* have proved it to be deadly. Now, Dr. H. C. Wood, ‡ soon after its reintroduction, made a study of its effects on animals, and showed its physiological dangers. Had his warnings been heeded, not a few human lives would have been saved.

The ideal anæsthetic, that will abolish pain without abolishing consciousness, and do so without danger, is yet to be found. Cocaine is our nearest approach to it. Now, in all fairness and common sense, would it be real kindness or real cruelty to obstruct the search for such an anæsthetic—a search which will surely be rewarded by success, but which, if not carried on by experiments on animals, must be tried by deadly experiments upon man, or else be hopelessly given up?

In 1869 I was called to see a man suffering to the last degree from an abscess in the loin. I recognized the fact that it arose from the kidney, but I was powerless. All that I could do was to mitigate, and

* "Medical News," April 28, 1883.

† I am permitted by Rev. R. M. Luther, of this city, to state the following fact in illustration of the practical value of vivisection in snake-bite: When a missionary in Burmah, he and his brother-in-law, Rev. Mr. Vinton (two missionary vivisectionists!), made a number of experiments to discover an antidote to the poison of the "brown viper"—a snake but little less venomous than the cobra. They found a substance which is an antidote in about sixty per cent of the cases if applied at once. Thah Mway, one of their native preachers, when bitten by the brown viper, had some of this antidote with him, and by its use his life was saved when on the verge of death. This one life saved has been the means of leading, it is estimated, two thousand Karens to embrace Christianity. Was not this one life worth all the dogs used in the experiments—to make no mention of the many other lives that will be saved in all the future?

‡ "Philadelphia Medical Times," April 24, 1880.

that, alas ! but little, his pitiless sufferings till death came to his relief, after nearly a year of untold agony. I have never forgotten his sufferings, nor the sharp pain I felt when I learned, two years later, how I might possibly have saved his life. In the very same year (1869), Simon, of Heidelberg,* had a woman under his care suffering from urinary fistulæ from a healthy kidney—a surgical accident he in vain tried to heal. That she could live with one kidney had the other gradually been disabled by disease was probable, for one such diseased kidney had been already removed three times when mistaken for ovarian disease; and physiologists had often removed one or both kidneys in animals. But no one had removed a healthy kidney, and then studied the effects on the remaining kidney and upon the heart; no one had tested what was the best method of reaching the kidney, whether by the abdomen or the loin, or how to deal with its capsule, or the hæmorrhage, or the surgical after-effects. Of course, Simon could have tried the experiment on his patient, blindly trusting to Providence for the result. But he chose the wiser course. He studied the previous literature, experimented on a number of dogs and watched the points above noted, tried various methods of operating upon the dead body, and, after weighing all the *pros* and *cons*, deliberately cut down upon the kidney of his patient after a carefully formulated plan, not by the abdomen, but through the loin, and saved her life. She died in 1877, after eight years of healthy life, free from her loathsome disorder.

Now, what have been the results of these experiments upon a few dogs? One hundred and ninety-eight times the kidney has been removed, and 105 human lives have been saved; 83 times abscesses in the kidney have been opened, and 66 lives saved; 17 times stones have been removed from the kidney without a single death—or, in all, in the last fifteen years, 298 operations, and 188 human lives saved. Besides this, as an extension of the operation in 17 cases, in which the kidney, having no such attachments as ought to anchor it in place, was floating loosely in the abdomen and a source of severe pain, it has been cut down upon and sewed fast in its proper place; and all of these patients but one recovered.

Looking to the future, when not hundreds but thousands of human beings will enjoy the benefits of these operations, and in increasing percentages of recoveries, are not the sufferings inflicted on these few dogs amply justified as in the highest sense kind and humane? †

Not long since Dr. Ferrier, of London, was prosecuted for the alleged performance of certain experiments on the brains of the lower animals. With Fritsch, Hitzig, Goltz, Yeo, and others, he had destroyed or galvanized certain limited areas of the brain (and it must

* Simon, "Chirurgie der Nieren," 1871, preface.

† Very erroneous views prevail as to the sufferings of animals from experiments upon

not be forgotten that the brain is wholly without the sense of pain), and so determined the exact nervous centers for certain limited groups of muscles. As a result of their labors, the brain is now mapped out with reasonable accuracy, so that, given certain hitherto ill-understood or obscure localized symptoms, we can now say that there is certainly a tumor, an abscess, or other disease in precisely this or that locality. True, we can doubtfully infer somewhat of the same from the cruel experiments of disease on man. But Nature's experiments are rarely ever limited in area or uncomplicated; they are never systematic and exhaustive; it takes years to collect a fair number of her clumsy experiments, and the knowledge is diffused through many minds instead of being centered in one that will systematize the results.

Said Ferrier, a year ago, in the Marshall Hall oration, "There are already signs that we are within measurable distance of the successful treatment by surgery of some of the most distressing and otherwise hopeless forms of intra-cranial disease, which will vie with the splendid achievements of abdominal surgery."

Note the fulfillment! Last fall, within a year of the foregoing prophecy, a man, aged twenty-five, entered the London Hospital for Epilepsy and Paralysis.* From the symptoms, which I need not detail, Dr. Hughes Bennett, basing his conclusions on Ferrier's experiments, diagnosed a tumor of small size on the surface of the brain, involving the center of motion for the muscles of the hand. On November 15, 1884, at his instance, Mr. Godlee trephined the skull over the selected spot, and a quarter of an inch below the surface of the brain found a tumor as big as a walnut, and removed it. For three weeks the man did well, but died on the twenty-eighth day from blood-poisoning, such as might follow any operation, especially a new one. Macewen, of Glasgow, † has similarly trephined a woman, the victim of slow paralysis of body and mind, and opened an abscess a little distance below the surface, letting out two teaspoonfuls of pus, and followed by entire mental and physical recovery.

By these experiments and operations a wide door is open to surgery in the treatment of diseases within the skull—diseases heretofore so obscure and uncertain that we have hardly dared to attack them. The question is not whether death or recovery followed in these par-

them. Many persons suppose that "vivisection" means deliberate "cutting up" of an animal, little by little, till not enough is left to live. So far is this from the truth, that Professor Gerald Yeo, from the actual reports of vivisectionists in England ("Fortnightly Review," March, 1882), estimates that of one hundred such experiments, there are:

Absolutely painless.....	75
As painful as vaccination.....	20
As painful as the healing of a wound.....	4
As painful as a surgical operation.....	1
Total.....	100

* "Medical News," January 17, 1885.

† *Ibid.*, January 3, 1885.

ticular cases. The great, the startling, the encouraging fact is that, thanks to these experiments, we can now, with well-nigh absolute certainty, diagnosticate, and with the greatest accuracy locate such diseases, and therefore reach them by operation, and treat them successfully. Would that I had been born twenty-five years later, that I might enjoy with you the full luxury of such magnificent life-saving, health-giving discoveries!

It is, however, by the experimental study of the effects of minute organisms—microbes, as they are now called—that some of the latest and most remarkable results have been achieved. The labors of Koch, Pasteur, Klein, Cheyne, Tommasi-Crudeli, Wood, Formad, Sternberg, and others, are now known even to the daily press. Let us see what they have done.

It is but three years since Koch announced that consumption was caused by the “bacillus tuberculosis.” Later he has studied cholera and found the “comma-bacillus,” to which he ascribes that dreaded disease. In spite of the opposition of prominent scientists, his views have been in general accepted, and seem to be reasonable.

The method of experiment is simple, though difficult. The suspected expectoration or discharge is placed in a suitable soil, and after cultivation some of this growth is placed in another culture-soil, and so on till generation after generation is produced, the violence of the poison being modified by each culture. A small portion of any one of these cultures is then injected under the skin of a mouse or other animal, and in time it dies or is killed, and the results are verified by the *post-mortem*.

So exact is the knowledge in tuberculosis now that Koch can predict almost to an hour when the mouse will die of consumption, or that it will escape, according to the culture used.

It is far too early as yet to say that these studies have borne the immense practical fruit that the next few years will show; but they have already enabled us to recognize by the microscope doubtful cases of consumption in their earlier and more remediable stages, and have made certain what has hitherto been only a probability—that consumption is distinctly contagious.

By Gerlach’s experiments on animals with the milk from tubercular cows, also, it has been shown that consumption may be contracted from such milk. How important this conclusion is, in so universal an article of food to young and old, I need not do aught than state.

The experiments of Wood and Formad on diphtheria I have already alluded to. Those of Tommasi-Crudeli also have shown that probably the poison of malaria is due to like organisms, while a large number of other diseases are being similarly investigated.

As to cholera, the classic experiments of Thiersch, in 1853,* are well

* John Simon, “Proceedings International Medical Congress,” London, 1881.

known. He inoculated fifty-six mice with cholera-discharges. Of these, forty-four sickened and fourteen died from choleraic diseases. In the same year two water companies in London experimented on 500,000 human beings, one of them inoculating its patrons with cholera-discharges through its impure water-supply. This one sickened thousands and killed 3,476 human beings, most of whom might have escaped had the lessons of Thiersch's fourteen mice been heeded. To ask the question, which was the more cruel, is to answer it.*

At present our strenuous efforts are all in one direction—viz., to study these microbes by the microscope, by clinical observation, and by experiments on animals, in order to find out their origin, causes, growth, and effects, and to discover by what means their deadly results may be avoided, or by what remedies, without harm to the patient, they may themselves be destroyed. Evidently these studies can not be tried on our patients. They must either be tried on animals or be abandoned.

The inoculation experiments of modern times have recently borne rich fruit in still another pestilential disease—yellow fever—whose ravages in this country are fresh in our minds. November 10, 1884, M. Bouley reported to the Paris Academy of Sciences † that, since 1880, M. Freire, of Rio Janeiro, had experimented on Guinea-pigs with the virus of yellow fever, and believed that he had been able to produce such attenuation of the virus that by vaccination he could secure immunity from this dreadful scourge. Following the experiments, he and Rabourgeon tested the results on themselves, some students of medicine, and employés. Later the Emperor Dom Pedro authorized two hundred wharf-laborers to be inoculated. All these, after a three days' mild attack, remained free from the pestilence, while their fellow-laborers, similarly exposed to the fever, were dying on every hand. If, in an epidemic, this still prove true, as there seems every probability it will, from the five hundred lives already saved, we can hardly estimate either the medical or the commercial advantages to this country alone. Is this cruelty? Let Norfolk, and Memphis, and Pensacola, and New Orleans answer.

We are all familiar now with the numerous deaths from eating pork infested with trichina. While I was in Berlin, in 1865-'66, a ter-

* The population supplied by the Southwark and Vauxhall Company, in the epidemic of 1848-'49, died at the rate of 118 in each 10,000, and, in that of 1853-'54, at the rate of 130 per 10,000. Those supplied by the Lambeth Company died in 1848-'49 at the rate of 125 per 10,000, but having improved its water supply meantime, the death-rate, in 1853-'54, fell to 37 per 10,000.

† If Thiersch lived in England to-day, he would have to take out a license to kill his fourteen mice in the interests of humanity—a license possibly refused, or only to be obtained after the most vexatious delays. But any house-maid might torture and kill them with arsenic or phosphorus, or Thiersch might give them to a favorite terrier without the slightest interference, provided only it be not for a scientific or a humane object!

‡ "Medical News," November 29, 1884.

rible epidemic of the then new disease broke out at Hedersleben, a small town in Prussian Saxony. I well remember with what zeal Virchow and his assistants immediately investigated the disease, inoculated animals with the parasitic worm, studied its natural history, found out that heat killed it, and to-day, as a result of these and other experiments, we all know how to avert its dangers by proper cooking, or to avoid it altogether by the microscope. The value of these experiments, both to human life and to commerce, you know even from the daily papers.

You will find it difficult to make the non-medical public understand—nay, you yourselves as yet hardly understand—the enormous advance in medicine and surgery brought about by recent researches on inflammation, and by the use of antiseptics. My own professional life only covers twenty-three years, yet in that time I have seen our knowledge of inflammation wholly changed, and the practice of surgery so revolutionized that what would have been impossible audacity in 1862 has become ordinary practice in 1885.

It would seem that so old a process as inflammation would long ago have been known through and through, and that nothing new could be adduced. In 1851, however, Claude-Bernard, by a slight operation, divided the sympathetic nerve in a rabbit's neck and showed its influence on the caliber of the blood-vessels. In 1858 Virchow published his "Cellular Pathology." In 1867 Cohnheim (Virchow's "Archiv") published his studies on the part that the blood-cells played in inflammation as shown in the frog, followed by further papers by Dr. Norris, of this city, Stricker, Von Recklinghausen, Waldeyer, and many others. Already in my lectures I have pointed out to you in detail the advances made by these studies, both in theory and practice. They have brought about an entire reinvestigation of disease, and given us wholly new knowledge as to abscesses, ulceration, gangrene, the organization of clots in wounds, and after operations and ligature of blood-vessels for aneurism, as to thrombosis, and embolism, and paralysis, and apoplexy, and a score of other diseases through the diagnosis and treatment of which now runs the silver thread of knowledge instead of ignorance.

With this the brilliant results of the antiseptic system have joined to give us a new surgery. Sir Joseph Lister, to whom we chiefly owe this knowledge, has done more to save human life and diminish human suffering than any other man of the last fifty years. Had he only made practicable the use of animal ligatures, it would have been an untold boon, the value of which can only be appreciated by doctors; but he has done far more, he has founded a new system of surgery. We may reject the spray and carbolic acid, but the surgical world, regardless of details, with few exceptions follows the principles upon which his method is founded and humanity is the gainer, by the nearly total abolition of inflammation, suppuration, secondary hæmorrhage,

blood-poisoning, gangrene, and erysipelas, as sequels of accidents and operations ; by the practicable relief from suffering and death, by operations formerly impossible ; by rendering amputations and compound fractures safe and simple instead of deadly. Reflect on what each one of these brief but momentous statements means !

But we have by no means reached perfection. Lister himself, no tyro, but the great master, is still searching for further improvements. But when lately he desired to make some experiments on animals, still further to perfect our practice, so many obstructions were thrown in his way in England that he was driven to Toulouse to pursue his humane researches.

I had intended also to speak of many other practical benefits to man directly, but can only mention such important matters as the surgery of the thyroid gland, the seat of goitre ; the surgery of the lungs, part of which have been removed ; the surgery of the nerves, removal of the entire larynx, the remarkable researches of late years as to the periosteum in the reproduction of new bone after removal of dead or diseased bone ; Bernard's important observations as to diabetes ; Brown-Séguard's experiments on epilepsy, the modern extraordinary advance in nearly all the diseases of the nervous system, and a number of other discoveries, as to all of which experiments upon animals have added largely to our knowledge, and therefore to our means of diminishing suffering and saving human life. For many of these, as well as for the most judicious discussion of the vivisection question I have yet seen, I must refer you to that remarkable book, "Physiological Cruelty," written, not by a man, *but a woman*.*

I had also intended to refer in detail to the splendid results of vivisection in relieving the sufferings of animals, and in preventing enormous pecuniary loss to man. We are only beginning to see that vivisection is as humane to animal life and suffering as it is to human, and that for financial reasons as well as humane motives it is of the utmost importance to the State that such diseases as cattle-plague, splenic fever, chicken-cholera, swine-plague, and others, should be eradicated. Vivisection has shown us how this may be done, and has so conferred upon animals too the boon of life and health. For all this, however, I must refer you to the recent admirable lecture by Professor Robert Meade Smith, of the University of Pennsylvania.†

One subject, however, is so recent and of such interest, both to man and animals, that I must not pass it over—I mean that justly-dreaded disease hydrophobia. Thanks to vivisection, its abolition in the near future seems no longer to be a matter of doubt.

Within the last three years Pasteur has announced that, by passing the virus through the monkey, he has been able to protect dogs from

* See also the just issued "Life and Labors of Pasteur."

† Reprinted from the "Therapeutic Gazette," November, 1884.

hydrophobia by vaccination with this weakened virus. The French Government recently appointed an eminent scientific commission to report on the alleged discovery.* Pasteur furnished them with 23 vaccinated dogs. These 23, and 19 others unprotected, were all inoculated from rabid animals. Of the 19 unprotected, 14 died. Of the 23 protected dogs, one died of diarrhœa, and all the others escaped. It has yet to be tried on a man suffering from hydrophobia, but, should our reasonable hopes be realized, what a boon it will be !

With this brief summary of a few of the recent practical benefits from vivisection, I must close. I have given you only ascertained facts for your future use in the communities in which you may settle. They may assist you in forming public sentiment on a basis of fact, of reason, and of common sense. The sentiments of our own profession, so constantly and so conspicuously humane, are always against inflicting pain ; but if in yielding to sentiment we actually increase disease, and pain, and death, both among animals and men, our aversion to present pain is both unwise and actually cruel.

In conclusion, let me wish you the greatest success in your professional life, and the richest blessings of our kind heavenly Father. Farewell.

* "Medical News," August 30, 1884.

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