

hitherto connected, and be taught as a separate science on its own merits and usefulness, and extent of practical application. It is therefore proposed that meteorology might constitute a separate course of lectures, theoretical and practical, at our colleges, where might be expounded its bearings on navigation, agriculture, human health, and engineering. To it might also be attached the sciences of ventilation of buildings, as barracks, factories, and mines, and hydrology, or a knowledge of ocean and sea currents, and ice drifts.

The foundations for such a professorship in scientific materials have, it is suggested, now reached a sufficient weight and bulk as to furnish ample occupation, and to be of universal interest and general application.

Weather observatories, now numerous established, will require superintendents and assistants, captains of ships would be benefited by some scientific knowledge of the winds and waves, and farmers would find meteorology useful for the successful tillage of the soil.

Again, overseers of mines would derive some good from a knowledge of the mechanism of the currents of the air they have to regulate in ventilation, and engineers of waterworks would require to know the variability and extent of rainfall for the sites and construction of their reservoirs.

Finally, the science of the weather is of most importance of all to those who have to fulfil the duties of health officers in our great towns, and climatology is more than ever studied by the physician having to give advice to the numerous invalids who now travel abroad for the sake of restoration of health by change of air and scene.

In order to facilitate the accomplishment of this object, it is suggested that some means should be taken to originate a fund to defray the expenses of such a course of lectures, either in London or Edinburgh, both of which cities have meteorological societies which might lend their influence to promote such schemes of scientific development.

The class of men to whom resort might be suggested for patronage of this proposition would most likely be shipowners, landowners, and boards of health, either for the study of their self-interest or for the benefit of the public. SPES

Edinburgh, June

THE BRITISH ASSOCIATION—GLASGOW MEETING

THE arrangements for the reception of the British Association are fast progressing towards completion. The Executive Committee met on Tuesday, and the following is a brief sketch of the work which has been done:—

Finance Committee.—The total sum subscribed to the Guarantee Fund amounts to £6,559 10s.

Museum Committee.—This Committee has arranged as follows:—The Geological Exhibition will be accommodated in the Corporation Galleries, Zoology and Botany in the lower Queen's Rooms, and Archæology, &c., at the University. These exhibitions will be large and complete, and arrangements have been made for keeping them open, if desired, for some time after the meeting of the Association.

Local Industries Committee.—This Committee has three sub-committees—one for Machinery, one for Chemicals, and one for Textile Fabrics—and the materials for a highly instructive exhibition are being collected, which will be held in Kelvingrove Museum, where there is already a general museum of considerable size and variety.

Reception Committee.—Already a number of distinguished persons have been invited and have accepted invitations. Among these are the President-designate, Prof. Andrews, of Belfast, who will be the guest of Sir William Thomson, the present President, Sir John Hawkshaw, who, with Lieut. Cameron, the African explorer, will be the guest of the Lord Provost. The Duke of Argyll, one of the Vice-Presidents, will be the guest of Prof. Blackburn.

Arrangements have been made with all the leading railway companies in England and Scotland to facilitate the visits of strangers and their stay in Glasgow. A

guide and handbook for Glasgow and the West of Scotland is being prepared under the general editorship of Dr. Blackie.

The following places have been secured for the use of the Association:—The University, where, as at present arranged, all the Sections except the Geographical and Ethnological Section (Section E) will meet, Section E meeting in the large upper hall of the Queen's Rooms. At the University, also will be the Reception and Refreshment Rooms. Kelvingrove Museum.—This will be the receptacle for the exhibitions of machinery, of chemicals, and textile fabrics. Queen's Rooms.—Here will be held an exhibition of the zoological and botanical collections of the district, and here also the meetings of Section E will take place. The upper Corporation Galleries will be filled with a geological exhibition, there being no room at the museum at the University to accommodate more than the Archæological Section, in addition to the permanent and temporary exhibits already arranged there. The City Hall and the Botanic Garden Palace have also been secured for the use of the Association. The Chambers of the Association, where all inquiries may be made, will be found at 135, Buchanan Street.

A great many of the citizens have indicated their wish to receive guests, and a list is being drawn up of expected visitors, from which guests may be selected. Notice of its completion will be given by advertisement in the newspapers.

Excursion Committee.—It has been arranged that excursions will take place on Saturday, the 9th, and Thursday, the 14th of September, to the following among other places:—Arran, Lochlomond, Loch Fyne, and the Holy Loch, Coatbridge, and Paisley. Mr. A. B. Stewart has placed his yacht at the disposal of the Association, as has also Mr. Duncan of Benmore, for dredging expeditions. It is intended that there will be at least one dredging excursion to the Firth of Clyde, or other suitable place. Mr. Duncan will also receive at Benmore a party of 100, who go the round by Loch Fyne, for whom he has arranged a delightful excursion. Mr. Martin of Auchendennan will receive a party at dinner there, and Mr. Campbell of Tulliechewan and Mr. Matheson of Cordale have also intimated their desire to show hospitality to members of the Association visiting Dumbartonshire. Mr. Ellis will entertain a party at luncheon at Coatbridge after inspection of the North British Wireworks, and Sir Peter and Mr. Thomas Coates are expected to do the same at Paisley.

ABSTRACT REPORT TO "NATURE" ON EXPERIMENTATION ON ANIMALS FOR THE ADVANCE OF PRACTICAL MEDICINE¹

II.

*Experimentation with the forms of *Lycoperdon giganteum*, or common Puff-Ball.*

IN 1853, while the study of the art of producing safe anæsthesia was fresh upon me, my attention was directed by my friend, Mr. H. Hudson, to the fact that in the country the owners of bees rob the bee-hive of its contents of honey and wax after they have stupefied the bees by driving into the hive the smoke of the common puff-ball—*lycoperdon giganteum*. It struck me at once that I ought to ascertain whether the stupefying agent which is given off in the smoke would act as an anæsthetic on the higher animals and on man, and whether a new and safer anæsthetic than chloroform was contained in it. The results of this research, some of which I published in the *Association Medical Journal* in 1853, showed that the narcotic agent present is indeed a true anæsthetic, and that all animals may be narcotised by it, but that owing to the mode in which it has to be administered, it cannot conveniently be applied to man. All the lower animals about to be subjected to operations of any kind, surgical

¹ Continued from p. 152.

or physiological, could, I found, be rendered insensible by this agent safely and inexpensively. I invented a room or chamber in which animals could be placed so as to be exposed to the anæsthetic, and I introduced the use of this method of anæsthesia. From time to time during the past twenty-five years, many necessary surgical operations have been painlessly performed on domestic animals under this anæsthesia, and almost all my own physiological experiments which would have been painful have been conducted under it without pain. Some other physiologists have followed me in this procedure, and have introduced the puff-ball narcotising box into their laboratories in order to save pain from experiment. In these ways the simple experimental research derived from the observation on the bees has proved doubly useful.

While these researches were first being pursued a friend of mine came to me in great distress because his splendid and favourite retriever dog had been bitten by a rabid dog and was now stricken with rabies. He asked me to destroy his dog in the kennel, as nobody dared to remove the animal. I carried out the request at once by simply closing the door of the kennel, covering it with a horse-cloth, and letting the clarified and condensed fumes from the burning lycoperdon pass into the kennel. The animal lapsed quickly into sleep and died without a struggle. I believe this was the first time in the history of science in which anæsthesia had been employed intentionally and systematically for the painless extinction of the life of the inferior animals. I shall show in a future note the singular importance of this application.

Research with Carbonic Oxide.

The observation that the smoke of the burning lycoperdon would produce anæsthesia in the higher animals led naturally to an inquiry after the agent that was at work in creating the insensibility. I commenced to make an analysis of the smoke in order to determine the question, but was forestalled in discovery by two other experimenters, the late Dr. John Snow,—so well known for his researches in anæsthetics, and as the author of the water theory of cholera,—and by the late Thornton Herepath, one of our most promising young chemists. These two gentlemen almost simultaneously discovered that the gas called carbonic oxide is present in the smoke of the lycoperdon. This was a new light, and led me to study the action of carbonic oxide on animal life. I found that this agent, a colourless and inodorous gas, produced insensibility in precisely the same way as the purified smoke of the puff-ball. I found that when the combustion of the puff-ball was made so perfect that no carbonic oxide was formed, there was no anæsthesia induced by the purified fumes, and so the fact was rendered clear that the special anæsthetic in the smoke is the gas in question. I estimated also the proportions of carbonic oxide that could be breathed in the atmosphere, and the effects of the gas in larger and smaller proportions on the lower animals and on myself.

Experimentation in Relation to Diabetes from Breathing Carbonic Oxide.

In conducting the observations on the action of carbonic oxide on living bodies, I was led to examine the animal secretions, and to my surprise I found that the renal secretion of an animal subjected to the gas yielded evidence of glucose or grape sugar. The fact was of such importance I was compelled to follow it up until I had quite established it, and had proved that by the inhaling of this active gas, a temporary attack of the disease known commonly as diabetes, which in the human subject is often fatal, could always be artificially induced in the dog. In a further experiment I found that the inhalation of common coal-gas diluted with air would produce the same condition, an effect caused by the carbonic oxide which is always present in coal-gas. The same has subsequently been observed in a human subject accidentally

exposed to the gas. The ultimate value of these observations has yet to be proved. When I first published, in the *Medical Times and Gazette*, on March 22, 1862, the fact of the artificial production of diabetes by carbonic oxide, nine years after I had first observed it, it was looked upon rather as a curious than a practical demonstration. I have always felt that though it did not seem to offer any immediate practical result, it must some day be useful in throwing light on the origin, or at least on one origin of a fatal malady. Quite recently Dr. Pavy has published some valuable details on the production of diabetes by the same means, that is to say, by making animals inhale carbonic oxide, and he has been able to arrive at some clear ideas on the question of the chemical changes that are involved in the process. We may fully expect to receive from him further valuable information.

I wait a moment at this point to observe that the history of experimental research given in the last note illustrates forcibly the value of what may be called the accidental observations that are picked up in the course of experiment. Who ever would have dreamed that from a practice of stupefying bees in order to rob them of their honey, a practice which has been carried on by the vulgar for many centuries, would come the discovery that the higher animals, and even man himself, can be made to produce glucose, and that they may become afflicted with the symptoms which characterise a destructive disease from a simple perversion in the animal chemistry induced by the smoke of the burning puff-ball?

Experimentation with Oxygen Gas.

The experiments with carbonic oxide led me to a series of experiments with oxygen gas. The late Sir Benjamin Brodie and Mr. Broughton, in their experiments on this same subject, had observed that when animals are placed in pure oxygen they die, with symptoms of sleep, as if they were narcotized, although the products of respiration are removed. Hence for many years oxygen gas, on which we depend for life, was believed to be a narcotic or sedative poison. In my experiments many new facts came out which modified this view. In the first place I found that some animals, such as frogs, will live in oxygen as readily as in common air; that herbivorous animals will live in it if it be kept supplied to them in fresh current, but the carnivorous animals will not live in the pure gas for a long time without becoming drowsy and insensible and without undergoing changes of their blood, which are fatal to life owing to separation of the fibrine within the vessels. The most important observation, however, which I made on the subject of the effects of oxygen, is the following:—I found that a narcotic action of the oxygen is produced, however pure from the products of respiration the oxygen is maintained, whenever it is breathed over and over again by being passed backwards and forwards through the chamber in which the animals breathe it. Subjected three times to this passage through the chamber, though it be purified so fully from carbonic acid that it contains less of this gas than the common air, it fails to support the active life of all common animals excepting frogs. In a word, the oxygen assumes a negative condition in which it will not support living function. In a report on these researches, made to the British Association for the Advancement of Science, at the Oxford meeting in 1860, I defined this state as one in which no new poison was produced, but in which the oxygen lost some principle or property by which in its fresh state it sustained the animal life.

The lessons taught by these observations extend to the human family. They show that if the oxygen of the great atmospheric sea in which we all breathe should from any cause assume this negative condition, it will fail to sustain the active life. They explain the depressing effect of breathing over again the same air in close and badly ventilated rooms. They throw a distinct light on that "epidemic condition" of the atmosphere, which, since

the time of Sydenham has been noticed, but never explained, in which diseases of spreading type extend uncontrolled when once they are started on their course. In the artificial negative atmosphere which I produced in the manner described above, I observed that dead animal and vegetable substances underwent rapid decomposition, and that slight wounds on living bodies became foetid.

There followed upon these observations other series, in which the effect of the forces of heat and electricity were tried in order to determine whether they would modify the condition of the negative oxygen in respect to its life-sustaining power. The result of these inquiries was to prove that cold added to the negative effect and quickened the narcotism, while a raised temperature, a temperature of 75° F., delayed the narcotism. I also discovered that the passage of electrical sparks through the negative gas restored it to its full activity.

In yet another series of inquiries oxygen, under the influence of the forces of heat and electricity, was rendered active until its sustaining power was destroyed by an opposite process, viz., by the activity with which it entered into combination with the blood. In this manner the action of ozone was observed on animal bodies, and the quickened state of the circulation and over-action which the oxygen in this active state produces were defined. The local action of ozonized air on the air-passages and nostrils in the human subject was tested on Dr. Wood and myself, and the peculiar catarrh and headache which follow the inhalation of ozonized air were described from our own personal experiences.

The whole of these inquiries on the effects of differing physical conditions of oxygen were full of the most useful practical information in reference, if not actually to disease, to the mode in which surrounding atmospheric conditions modify the course of disease. They indicated how men and animals living in the large atmospheric sea are influenced by the action of the great forces of nature on the vital oxygen. They have taught me so much that I could, if I had the means, build a hospital with such appliances for modifying the air, that the course of some diseases might be governed towards recovery by the simple management of the physical conditions of the atmospheric oxygen. In a future and more advanced day of science, this method, the basic principles of which are here sketched out, will be an approved and positive method of treatment. Even now, under the greatest disadvantages, from want of organised plans, I have been able to render useful service to the sick from the experience gained by the experimentation.

BENJAMIN W. RICHARDSON
(To be continued.)

THE CRUELTY TO ANIMALS BILL

IN the House of Lords the Government "Vivisection Bill" was discussed in a full Committee on Tuesday.

The Marquis of Lansdowne began by a very temperate remonstrance against the Government going so far beyond the recommendations of the Royal Commission on the subject. His speech (which is fairly reported in the *Times*) is by far the best for knowledge and for sense that has yet been made on the Bill, but the provision against which he especially protested—the licensing of places as well as of persons—though warmly supported by Lord Kimberley, still remains part of the Bill. This provision scarcely affects physiologists as such, but may be a means of serious annoyance and hindrance to strictly medical experiments, on, for instance, the contagion of disease or the action of drugs, and would have made the experiments by which Jenner freed the world from the plague of small-pox impossible.

On the first clause Lord Carnarvon stated that the title will be altered from "An Act to Prevent Cruel Experiments upon Animals" to "An Act to Amend the Law relating to Cruelty to Animals," *i.e.*, the Bill no longer

pretends to prevent alleged cruelty by scientific men in this country, inasmuch as the charge has not been in a single instance maintained, and only provides that infliction of pain on an animal shall not be screened by the excuse of a scientific object, if the delinquent does not hold a certificate from the Secretary of State that he is a competent person to conduct experiments on animals with all possible humanity and with ability to make them useful.

After some desultory conversation on the definition of the word "animal" (in which one Minister of the Crown committed himself to the opinion that some creatures can feel when their heads are off), the first important amendment was moved by Lord Rayleigh, supported by Lord Cardwell, and accepted, after discussion, by the Ministry. The Bill now, therefore, actually recognises the pursuit of knowledge as equally worthy of respect with that of medicine, and both as entitled to some small share of the immunity accorded to the pursuit of wealth or of amusement. In other words, while the members of the House of Lords have all their lives been vivisectioning their animals without anaesthetics *for fun*, they are now pleased to allow physiologists to do the same under many limitations for the advancement of science. This admission was actually opposed by Lord Coleridge in a speech which was forensic and sentimental in the worst sense of the words.

In the fifth clause, exempting cats and dogs from all experiments (even when painless) if undertaken for physiological or medical purposes, the Government accepted the amendment of the Earl of Harrowby, to include horses, asses, and mules under the same provision; but admitted a proviso for these animals being available on special certificate from the Secretary of State when absolutely necessary for some special investigation. On this clause the Earl of Airlie made a sensible speech, but he was not supported by the peers on the Royal Commission, whose report was implicitly condemned. The other clauses were rapidly run through, the Earl of Portsmouth making a successful attempt to obtain some recognition of the necessity of studying the diseases of animals as well as of man. The absurd regulation which, apparently by an oversight, subjected registered and inspected laboratories to the police visitation intended to prevent experiments in unregistered places, was amended without discussion, and the Bill is now probably in the form in which it will be laid on the table of the House of Commons.

Some of its most glaring contradictions and absurdities have been remedied; and, if worked by a reasonable Home Secretary, competent inspectors, and physiologists as humane as the ten or twelve gentlemen who now possess laboratories in the three kingdoms, it will probably do good. But the whole discussion shows the folly of legislating to satisfy unreasoning clamour, and the hopelessness of Parliament dealing in detail with a subject of which almost all its members are profoundly ignorant.

The reasonable plan would have been to register laboratories, and give certificates to persons duly recommended; to inspect them carefully; to withdraw the licence on any abuse being proved; and then to extend "Martin's Act" so as to apply to all cruelty to animals, whether domestic or wild, whether performed with a bad object or a good one, so long as the delinquent did not hold a certificate. This would have been in accordance with the recommendations of the Royal Commission, would have given far less trouble to Home Secretaries and to physiologists, and would have been a more effectual provision against cruelty. But Parliament has nothing important to do, the Government are in want of popular applause, and very few have the patience or the candour to learn the true state of the case; so that we must be content to hope that the Bill will do less harm than was at first inevitable.