

that matter during one second is equal to its radiation during the same time, and this holds for all kinds of heat. On the other hand, if we take a single molecule and a billionth of a second, we cannot affirm the same equality. This is no doubt correct; in fact, if the equality between radiation and absorption were to hold for the smallest conceivable mass and the smallest conceivable increment of time, our equilibrium would in reality be a tensional one instead of being movable or dynamical. I shall con-

clude by repeating the words of Tait ("Heat," p. 253):—"It is vain, at least in the present state of science, to look for a truly *rigorous* investigation of the relation between radiating, absorbing, and reflecting powers. In all the professedly rigorous investigations which have been given the careful reader will detect one or more steps which are to be justified only by the statistical process of averages."

BALFOUR STEWART

(To be continued.)

### THE LIFE OF AQUATIC ANIMALS AT HIGH PRESSURE<sup>1</sup>

THE magnificent expeditions of the *Talisman* and the *Travailleur* have called the attention of naturalists and physicists to the conditions of life at the bottom of the sea. A learned physiologist, Dr. Regnard, has conceived the happy idea of studying experimentally these

condition of life at high pressure. With apparatus designed by M. Cailliet, he has subjected aquatic animals to enormous pressure, such as prevails in the depths of the ocean, and has examined the results when those inhabiting the surface are suddenly placed at great depths. Since his first experiments Dr. Regnard has invented an ingenious method by which he can see, notwithstanding the great pressure, what goes on inside the apparatus.

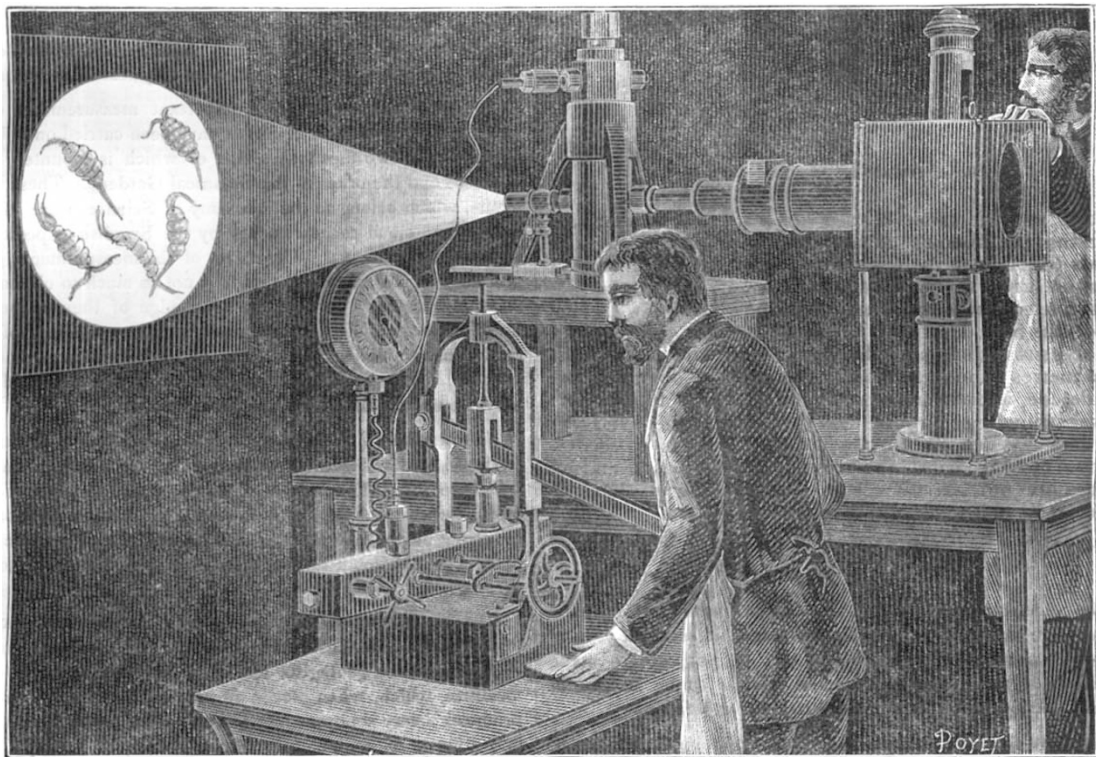


FIG. 1.—General View of Dr. Regnard's Apparatus.

Hitherto the operator simply placed the animals on which he experimented in the iron block of the Cailliet pump, and subjected them to the pressure corresponding to a given depth; he then released them, sometimes very slowly (after several days), sometimes rapidly and even instantly. He examined then, physiologically and microscopically, the lesions produced. But all the intermediate stages between the entrance of the animals and the time they were taken out escaped the observer. But now the apparatus in Fig. 1 allows him to follow each minute the effects. The following is Dr. Regnard's description of his apparatus to the Academy of Sciences:—

Two holes are pierced through and through across the lower part of the Cailliet block, M (Fig. 2). In these two holes, placed in a straight line, are inserted two tubes in *r* and *r'*. These are hollow, and in each of them is

solidly fixed a cone of quartz, B, the extremity of which joins the edges of the hole which is pierced in the screw nut E. A ray of light thrown by the orifice *r* will thus traverse the apparatus and emerge at *r'*. Experiments have shown that a similar apparatus will resist easily a pressure of 650 atmospheres, which represents that of the greatest depths that have been dredged—about 6500 metres. Across one of the quartz cones are sent the concentrated rays of an electric lamp. These rays cross the block full of water, and emerge on the opposite side, where they are received by an achromatic object-glass which projects them on to a screen. The observer therefore works at a distance from the apparatus, where he is sheltered from all danger (Fig. 1). This arrangement has another advantage. The orifice pierced at *r* is hardly half a centimetre in diameter, and one can experiment with animalculæ so small as to be scarcely perceptible

<sup>1</sup> From *La Nature*

with the naked eye in the vessel immersed in the block M. By projecting them with a lens they are increased about 200 times, and it is even possible to see by transparence the state of their organs." In the experiment represented in Fig. 1, one of the operators is occupied in regulating the electric lamp and in setting the microscope of projection, while the other commences to apply the pressure. The animalculæ projected on the screen are the *Cyclops*, small crustaceans which are met with at this time of the year in brooks, and which are scarcely a millimetre in length. These are so enlarged, and appear with such transparency, that we can follow on the screen the movements of their branchia, and even of their heart, during the experiment. Dr. Regnard is pursuing at present his

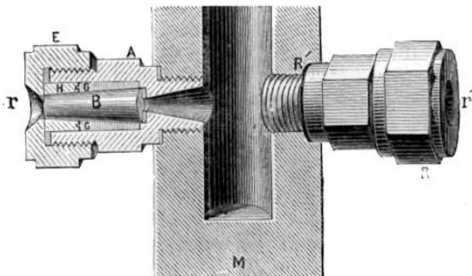


FIG. 1.—Details of apparatus in Fig. 1.

studies into life under high pressures. He showed last year that the unequal compressibility of the liquids and solids which form the organism caused the latter after a long pressure, to be soaked with water, become turgid, and consequently lose their functions. But, with the apparatus here described, he has been able to follow the phenomena which precede this. From the pressure at 1000 metres (about 200 atmospheres) the object shows inquietude, at 2000 metres it falls to the bottom of the vessel struggling; towards 4000 it remains inert and benumbed. When its normal pressure returns it recommences moving, unless the pressure has been long and its tissues are not soaked. This seems to show that the effect is a compression of the nervous system.

#### NOTES

WE understand that Mr. Francis Galton has already obtained valuable results from the Family Records sent him last year in response to his offer of prizes, and that he purposes to make much use of them in his Presidential address to the Anthropological Section of the British Association at Aberdeen.

WE have already intimated that Prof. Bonney has decided to retire from the Secretaryship of the Association after the Aberdeen meeting. We understand that Mr. A. T. Atchison will be proposed as his successor.

MANY interesting excursions have been arranged by the Local Committee of the Aberdeen meeting of the Association. One of them will, of course, be to the great granite quarries in the neighbourhood of Aberdeen. Her Majesty has invited 150 of the members to Balmoral, where they will be shown over the grounds and have lunch. It is not to be expected that the Queen will personally receive all the members, though it is possible that a few representative men of science may be presented to Her Majesty. Other excursions will be to Haddo House, Dunecht, Dunnottar, Drum and Crathes, Loch Kinerd, on the Saturday; while on the Wednesday and Thursday of the second week parties will be taken to Braemar, Invercauld, Haddo House, Huntly Castle, Elgin, Banff, Portsoy, and other places. The efforts which the Local Committee are making to render the meeting a success are all that could be

desired. It is only to be hoped that they may succeed in persuading the Aberdeen hotel and lodging-house keepers to reduce their exorbitant charges. The arrangements for important discussions in Sections A and B we have already referred to.

IN connection with the meeting we venture to recommend to our readers the new edition of Baddeley's "Guide to Scotland," Part I, a copy of which has been sent us. It includes all the country from the Borders to as far north as Aberdeen, Inverness, Gairloch, and Stornoway. No more useful, practical, and trustworthy guide to the region exists, while the thirty-seven admirably executed maps and plans will be found a great comfort and convenience. Dulau and Co. are the publishers.

M. JANSSEN will shortly begin a new series of experiments on the influence of gases in spectrum analysis, in continuation of those which he made about fifteen years ago at La Villette gasworks. The tubes in which the gas will be contained and compressed will have a length of more than 100 metres, and be able to bear an unusual amount of pressure. Thus a new degree of accuracy may be expected from these researches, which are progressing favourably at the Meudon Physical Observatory.

FOR more than a year some important measurements of the altitude and movements of clouds have been carried on at Upsala by the aid of two theodolites, one of which is mounted in the Linnæus and the other in the Botanical Gardens. These instruments, which belong to the Academy of Science, were used for auroral and cloud measurements by the Swedish expedition to Spitzbergen, 1882-83. The object of the measurements of the altitude and movements of clouds is not so much to obtain their mean altitude as to derive some knowledge of their movements in the upper part of the atmosphere, a matter which is of great importance to meteorology. The researches have advanced so far that it has been found possible to fix astronomically the movements and altitude of the cirrus clouds.

ACCORDING to the *Tägliche Rundschau* the population of Ratisbon has been greatly frightened by the sudden disappearance recently of thousands of jackdaws, which dwelt in the spire of the cathedral of the town, on account of a similar phenomenon occurring before the outbreak of the last cholera epidemic in the place. In Munich a similar phenomenon is also stated to have taken place.

REFERRING to "sonorous sand," the report of the secretary of the Smithsonian Institution says that an interesting problem to physicists and geologists has been the sand found in certain localities, which, when placed in motion by sliding, sometimes produces a very sonorous or resonant sound, peculiar in character and difficult of explanation. Prof. Bolton, of Trinity College, Hartford, desirous of making researches on the subject, and especially of studying the microscopical, chemical, and physical peculiarities of the grains, requested the aid of the Institution in obtaining materials for the purpose. A considerable variety of specimens was collected in the Sandwich Islands, the coast of Oregon, Germany, and many other places. These are now in Prof. Bolton's hands, and he will prepare a report on the subject.

THE Chesapeake Zoological Laboratory, as the marine station maintained by the Johns Hopkins University is designated, is *Science* states, established for the present summer session at Beaufort, on the coast of North Carolina. Dr. W. K. Brooks, the director, who was prevented last year by ill-health from giving as much time as usual to the laboratory, is fortunately quite restored to his usual strength, and is in full activity at his post. Twelve collaborators are with him. Several of these are already teachers in various branches of zoological science, and all of them are well prepared to make use of the opportunities