

he prepared and published no fewer than four large biographical works, one on botany, one on anatomy, one on surgery, one on practical medicine—the first of these in three quarto volumes, and the last occupying as many as four. These “Bibliothecæ” contain not only lists of scientific works, but also short analyses and criticisms of their contents, along with biographical notices of the authors—a titanic labour of vast utility to subsequent workers. Nor were his writings confined to the natural sciences. As we have already seen, he early attained considerable fame as a poet; later we find him publishing historical novels—“Usong, an Oriental Story,” 1771; “Alfred, King of the Anglo-Saxons,” 1773; “Fabricius and Cato, a Fragment of Roman History,” 1774. His “Journal,” which was published ten years after his death, contains his opinions on other literary men and on things in general, and especially philosophy and religion. Both this and his correspondence manifest strong conservative and anti-democratic views, with a tendency to intolerance towards those who held different opinions.

Haller was loaded with honours during his lifetime. He was an honorary member of almost all the learned societies of Europe. Frederick the Great in vain attempted to induce him to settle in Berlin, and the endeavours of Oxford and Utrecht to obtain his services were equally futile. The King of England appointed him his physician, and the Emperor of Germany granted him a title of nobility. But he was himself content to live and die a simple citizen of Berne, a prophet not without honour in his own country.

Haller's bicentenary was celebrated at Berne with great ceremony in October by the inauguration of a statue erected in front of the university on a height overlooking the town. On the day preceding the inauguration a joint session of the Historical, Medicochirurgical, and Scientific Societies of Berne was held in the hall of the university, which was occupied by a large audience, including many ladies. Interesting accounts of Haller's life and work were given by Prof. Steck (history), Prof. Fischer (botany), and Prof. Kronecker (physiology). Addresses were also received from various societies with which Haller had been connected, as well as from universities and other learned bodies. The societies were represented by Prof. Leo, who appeared for the Royal Society of Sciences in Göttingen; Prof. Waldeyer, for that of Berlin; Prof. Heger, Brussels; Prof. Bohr, Copenhagen; Prof. Rückert, Munich; Prof. Wangerin, Halle; Prof. Gamgee, London (presenting a Latin address from the Royal Society); Prof. Schäfer, Edinburgh: whilst the universities were represented by Prof. von Grütznér, of Tübingen; Prof. Merkel, of Göttingen; Prof. Kollmann, of Bâle; Prof. Ewald, of Strassburg, and others. In the evening a reception was held in honour of the foreign delegates by the president of the memorial committee, Prof. Tschirch.

The actual day of the inauguration (October 16) was kept as a public holiday. A procession of all those who were to take part in the ceremonial, including the Swiss and foreign delegates, the university authorities, and the students—the latter with the banners and in the uniforms of their respective corps—was marshalled in front of the Parliament buildings, and marched through the principal streets of the old city to the site of the memorial. There, orations were pronounced by the rector of the university, Prof. Tschirch, and by State Councillor Dr. Gobat, representing the Education Department of the Canton. A fine choir of men's voices rendered a selection of appropriate music, and in glorious sunshine, to the accompaniment of the booming of cannon and the

sound of the Swiss national anthem, the covering which had concealed the monument was removed, and the representation of Haller, by Siegwart, of Lucerne, was displayed to the view of the assembled multitude.

The statue represents Haller as he might have appeared to his contemporaries in about his fiftieth year. No contemporary picture or bust of this period of his life is extant, although his appearance in earlier and in later life is not unfamiliar. The sculptor had, therefore, to imagine him at the period chosen—which was that of his greatest scientific activity—a circumstance which has certainly not detracted from the artistic merit of the statue.

The unveiling ceremony was followed by a banquet to the delegates and others who had been invited to the celebration. Not the least interesting of the guests were some of the direct descendants of Haller. Indeed, the reply of M. Albert de Haller, of Lausanne, to the toast of the Haller family showed that some at least of the literary ability of his ancestor has descended to his generation.

The festivities were wound up by a torchlight procession of students, followed by a “Kommers” in the Kornhaus-keller.

A bronze plaque, exhibiting the bust of Haller in profile, designed by the sculptor of the memorial, was struck to commemorate the bicentenary, and a copy was presented to each of the foreign delegates—an artistic memento of a memorable ceremony.

E. A. S.

#### CAISSON DISEASE.<sup>1</sup>

MEN who have been working in compressed air, either under water in diving dresses or diving bells, in caissons used in preparing foundations for bridges, &c., or in making shafts or tunnels through watery ground, are liable to a variety of symptoms known generally as “caisson disease.” These symptoms, which come on only at or shortly after the return to atmospheric pressure, vary in severity from pains in the muscles and joints, known as “bends” or “screws,” to paralysis and even death. Paul Bert showed experimentally thirty years ago that these attacks are due to the fact that air (chiefly nitrogen) which has been dissolved in the fluids and tissues of the body while under pressure may, on decompression, be liberated in the form of bubbles, which produce local or general blocking of the circulation or other injuries. He also showed that if decompression were effected sufficiently slowly, the excess of air which had been taken up could escape by diffusion through the lungs, and thus bubbling and symptoms could be avoided. The phenomenon is, in fact, that of decompressing soda-water by pushing in the stopper; the problem of the prevention of caisson disease is how to push it in so slowly that the gas can escape without forming bubbles, and without the loss of so much time that the primary object of the manœuvre is frustrated.

Practical experience has shown clearly that the incidence of caisson disease varies with the height of the pressure and the duration of exposure to that pressure. Cases of illness are much more frequent in caissons where the pressure required to keep out the water approximates to 45 lb., or 3 atmospheres in excess of atmospheric pressure, than in those which are worked at about 20 lb. or 25 lb. Yet far higher pressures may be experienced with impunity

<sup>1</sup> “The Prevention of Compressed-air Illness.” By A. E. Boycott, G. C. C. Damant, and J. S. Haldane (*Journal of Hygiene*, vol. viii., 1908, p. 342).

if appropriate precautions be taken. Dr. Greenwood has exposed himself to as high a pressure as 92 lb. in an experimental pressure chamber, and Lieut. Damant and Gunner Catto have descended in diving dresses to a depth of 210 ft., or 94 lb. In these cases the time of exposure to compressed air was very short, and human experience in caisson work definitely shows that it is more dangerous to work for six hours than three, and that exposures of half an hour or so are usually quite free from risk. Practical experience is, however, by no means so clear with regard to the salutary effect of prolonging the period of decompression. The cause of this is that the really slow decompressions which are necessary have hardly ever been tried in actual practice, with the result that many practical men are still somewhat sceptical as to the truth of Paul Bert's discovery.

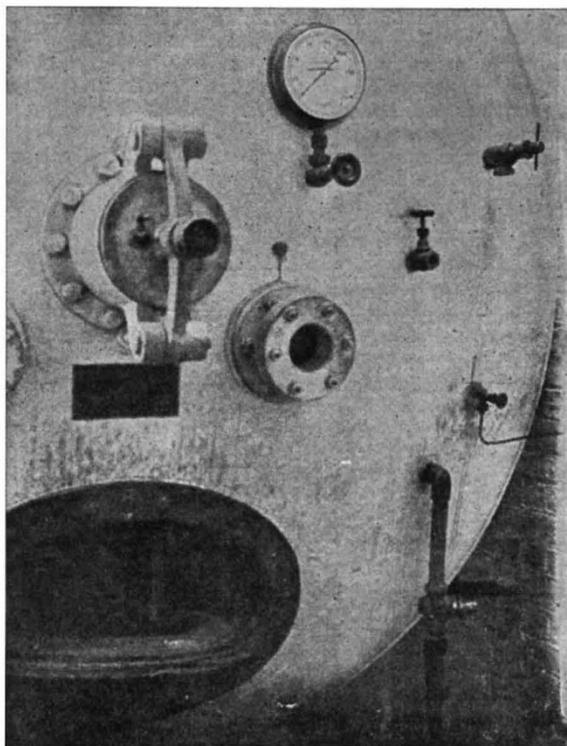
The formation of gas bubbles in the living body obviously depends on the pressure of the gas dissolved in the body being greater than the external pressure. It is, however, well known that liquids, and especially sticky liquids such as blood, can hold gas in a state of supersaturation at pressures much in excess of the external pressure without the formation of bubbles, especially if they are not agitated or brought into contact with foreign substances. These phenomena are well illustrated by soda-water after decompression, noting the effects of shaking the bottle or adding sugar to the lemon-squash. If the limit of "safe" supersaturation is exceeded, bubbles are formed. Whether this occurs or not in the body will depend, then, on the extent to which the body has become saturated while under pressure, and the point to which the saturation has been reduced during decompression. How much gas is taken up while under pressure and given off during decompression depends in the main on the height of the pressure, the duration of exposure, the duration of decompression, and the activity of the circulation of the blood, which is the means whereby the air is brought from the lungs to the tissues, and subsequently evacuated from the tissues *via* the lungs.

The different parts of the body vary very widely in respect of the quantity of blood passing through them in unit time. Those that are freely supplied with blood, such as the kidneys, take up excess gas very quickly, and in such parts the nitrogen pressure soon comes into approximate equilibrium with the nitrogen pressure in the air in the lungs. By some ingenious experiments Drs. Hill and Greenwood have shown that this point is reached in as little as ten minutes in the case of the active human kidney. Practical experience shows, however, that other parts of the body take much longer—four or five hours or more—to become saturated with nitrogen at the given excess air pressure, and, further, that the importance of these slowly saturating parts as regards caisson disease is much greater than that of organs which saturate quickly, and which, therefore, desaturate correspondingly fast on returning to atmospheric pressure.

The duration of the exposure to high pressure is, then, of the utmost importance; it should in all cases be reduced to the shortest practicable time. The duration of decompression must, on the other hand, be much extended if accidents are to be avoided. It is also clear that the rate of decompression should be adjusted to the height of the pressure and the duration of exposure; what is safe after one hour at 60 lb. pressure would be waste of time if the pressure had been 30 lb. or the time of exposure only ten minutes.

Human experience shows that symptoms practic-

ally never occur after decompression from a pressure of 15 lb. in excess of atmospheric pressure, however long the exposure or however short the period of decompression. In other words, it is safe to reduce the pressure quickly from 30 lb. absolute to 15 lb. absolute. Experiments made at the Lister Institute with the aid of the pressure-chamber presented by Dr. Ludwig Mond showed that the principle that the *absolute* pressure may always be safely halved held good up to at least 6 atmospheres. A goat, for example, may be quickly decompressed from 75 lb. (90 lb. absolute) to 30 lb. (45 lb. absolute) without ill effects, while a similar rapid drop of 45 lb. from 60 lb. absolute to 15 lb. absolute is frequently followed by severe symptoms. Under a pressure difference of 45 lb., nitrogen rapidly leaves the tissues, is carried away by the blood, and diffuses through the lungs without forming bubbles. After a time,



The steel chamber at the Lister Institute. Front end, showing the manhole for entering, the small air-lock for passing food, &c., into the chamber, an inspection window, a pressure gauge, and several valves, &c. (From the *Journal of Hygiene*.)

which may be approximately ascertained by calculation, the pressure in the body will have fallen from 75 lb. to, e.g., 61 lb.; the absolute pressure may again be halved, making the air pressure 23 lb. The difference of pressure inside and outside the body is now only 38 lb., so that nitrogen leaves the body more slowly than before. Ultimately the pressure difference, which must never be much more than the absolute air pressure, becomes so small that the excess gas escapes very slowly. Consequently, the rate of decompression must be made slower and slower as the pressure falls, the final decompression from 15 lb. to atmospheric pressure occupying perhaps as much as 60 minutes.

It has hitherto been customary to recommend that decompression should be effected at a uniform rate throughout, such as 20 minutes for each atmosphere of excess pressure. Such a procedure is altogether unsound; the rate suggested is needlessly slow for

the early part of decompression, and much too fast towards the end. To decompress safely a man after a long exposure at, e.g., 75 lb. pressure would probably require eight or ten hours if the pressure were reduced at a uniform rate throughout; by the new method here described not much more than three or four hours would be required. At such pressures it is clear that in practice the time of exposure must be reduced.

#### THE DIET OF THE HINDU.<sup>1</sup>

CHITTENDEN'S well-known work on diet advocates a reduction of the nitrogen intake to an amount far below that in the standard Voit dietary. By experiments on others and himself, he endeavoured to show that a low protein diet is compatible with bodily equilibrium and health. He directs attention to the well-known fact that the muscular energy of the body makes little or no call on the nitrogenous constituents of the muscles, and urges that the excretory channels, such as the kidneys, are overworked and so liable to damage when dealing with the large amount of waste nitrogen which it is the habit of the white races to ingest.

The conditions which Chittenden artificially constructed for the subjects of his experiments are found ready made on a large scale in the teeming millions of Bengal. It is quite obvious that much more correct conclusions as to the ultimate outcome of a reduction of the protein intake to less than half the European standard can be drawn from such a huge experiment, extending over the lives of a population, than it is possible to deduce from a limited series of observations on a few men lasting only for a few months. Scientific investigators therefore owe a debt of gratitude to Prof. McCay for the brilliant piece of work in which he has systematically and statistically grappled with the problem.

He admits it is perfectly true that the Bengali of varying castes maintains nitrogenous equilibrium on his poor vegetarian diet, and he naturally does not dispute the dictum that nitrogen is not the source of muscular energy. But his conclusion is that the low nitrogen intake acts deleteriously; the amount of protein in the blood is permanently decreased in amount, and the poor pabulum provided for the muscles leads to work in disadvantageous circumstances, and tends to produce degenerative changes in the body cells, notably in the kidneys. Not only is the output of work by the Hindu miserably small in comparison with the European labourer, but he is more easily fatigued, his blood-pressure is below the normal, and his lack of reserve force renders him an easy prey to bacterial infection and other forms of disease. His body weight and measurements show the native to be a puny person, exhibiting all those signs usually associated with an under-fed condition.

<sup>1</sup> Scientific Memoirs by the Officers of the Medical and Sanitary Departments of the Government of India (No. 34). Standards of the Constituents of the Urine and Blood and the Bearing of the Metabolism of Bengalis on the Problems of Nutrition. By Capt. D. McCay. Pp iv+67. (Calcutta: Superintendent Government Printing, India, 1908.) Price 2s. 2d.

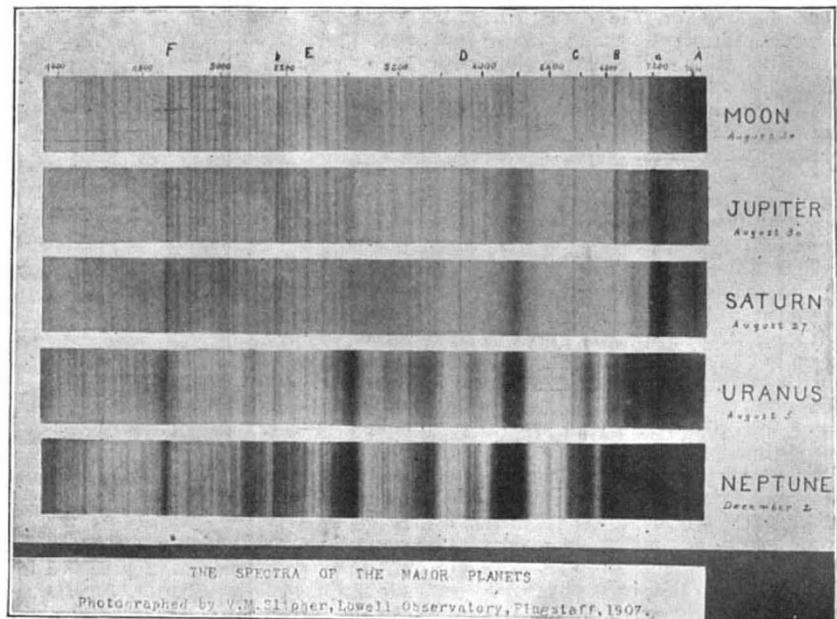
Even if one grants that in the normal decomposition of proteins, toxic substances are formed which may act injuriously upon the body, it must be remembered that in health the body is provided with an efficient machinery for eliminating them. It is by no means certain that decomposition products, also toxic in nature, are not formed from the fat and carbohydrate of the diet. The large carbohydrate intake rendered necessary by a diet poor in nitrogen seems to be full of danger, and the extreme prevalence of diabetes in its most aggravated forms among the Bengalis proves conclusively that the evils due to excess of carbohydrate are even more real than those supposed to be due to excess of protein.

The favourite argument of the vegetarian is to point to the races of the east as examples of the good results accomplished on a low diet. Such an argument has been refuted more than once, and its fallacies have been finally demonstrated by Prof. McCay's observations and statistics.

W. D. H.

#### THE SPECTRA OF THE MAJOR PLANETS.

AS the result of his experiments, Mr. V. M. Slipher succeeded in 1907 in rendering some plates (Seed, 23) sensitive far into the red. This was done by bathing them before exposure in a solution of pinacyanol, pinaverdol, dicyanin, alcohol, and water. With them he photographed the spectra of all the major planets and, for comparison purposes, that of our moon.



The results are shown in the accompanying print, made by enlarging, combining, and re-photographing on one plate all the spectra. Three things are to be observed in the spectra:—

(1) The great number of new lines and bands disclosed. Some of these are evident in the spectra of Jupiter and Saturn, but chiefly in those of Uranus and Neptune.

(2) A steady progression in the intensities of the non-solar lines and bands as one goes outward from the sun.

(3) The intensification of the hydrogen lines F and C, notably in Uranus and Neptune.

PERCIVAL LOWELL.