a gain of cooling by letting liquid air vaporise at a lower temperature than that at which it had condensed, taking up more latent heat at the lower temperature than it had given out at the higher; and he overlooked the fact that the difference would be balanced by the specific heat given out by the liquid while being cooled to the lower temperature! Under a fresh patent in England Pictet has now for some years been associated with powerful supporters in installing a large and costly plant at Manchester with the same object. None of the former fallacies appear in the new patent. Whether practical success will attend the effort remains to be seen.

The liquid oxygen, or air rich in oxygen, obtained by distillation from liquid air, if mixed with a good combustible, such as cotton wool, makes an explosive. The Austrian military authorities, and the engineers engaged in tunnelling under the Alps, both made long and careful trials of such explosives; but the inevitable arrangements were too cumbrous, and the results too uncertain.

The nearest attempt to make what is called a practical use of liquid air is that of Dr. Allan Macfadyen (see NATURE, June 18, 1903, p. 152, and October 22, 1903, p. 608). By freezing the bacilli of typhoid in liquid air he makes them brittle enough for trituration in a mortar. By centrifugalisation the intracellular poison can then be separated from more fibrous material, and then by the methods of Pasteur an anti-typhoid serum prepared which promises to be of real value.

The most pronounced successes of liquid air have been in connection with scientific research. It was with liquid air made by the self-intensive process with a Hampson machine that Sir William Ramsay discovered krypton, xenon, and neon, that Prof. Rutherford and Mr. Soddy proved the emanations of radium and thorium to be condensable and vaporisable, that Ramsay proved the evolution of helium from radium emanations, and many other important investigations were carried out. Finally, it was by an extension of the same process that hydrogen was liquefied.

THE MEETING OF THE BRITISH MEDICAL ASSOCIATION.

A NUMBER of valuable and instructive papers were contributed at the recent meeting of the British Medical Association at Leicester, but the majority were technical and of a medical nature. The following, in addition to those described last week (p. 330), are, however, of more general interest:—

In the section of medicine, Dr. Nathan Raw (Liverpool) read a paper on human and bovine tuberculosis, with special reference to bovine infection in children. He said that while agreeing with the German view that there were decided differences between the bovine and human tubercle bacilli, he believed that bovine tuberculosis was a danger to human beings.

Bovine tuberculosis affected young people, was traceable to infected milk, and infected the tonsils, the alimentary tract, the glands, and, through the blood, the meninges, the bones, the joints, and other parts, while human tuberculosis was air-borne, and infected adults by way of the lungs as pulmonary phthisis. In evidence of this Dr. Raw indicated the rarity of pulmonary phthisis in infants and children, and, on the other hand, the comparative rarity of other than pulmonary lesions in adults, and suggested, further, that early tuberculous disease, presumably bovine, appeared to be protective against phthisis, as the development of pulmonary tubercle was relatively rare in those of a strumous diathesis who had suffered in infancy from bone and gland lesions.

In conclusion, Dr. Raw alluded to the frequency of tuberculosis among cattle, and the importance of the inspection of cattle and dairies.

Dr. F. J. Poynton (London) gave the results of his experience of milk to which sodium citrate had been added in the feeding of infants. The addition of sodium citrate to milk results in the formation of calcium citrate, and milk so treated forms a much finer curd and is more digestible than untreated milk. The sodium citrate may be added to the amount of 1 to 2 grains to the fluid ounce of milk.

In the section of ophthalmology, Prof. Hess (Würzburg) demonstrated by a series of beautiful drawings the influence of light in causing a migration of pigment in the retina of cephalopods. He had found in these eyes visual purple which had hitherto not been detected in any invertebrate.

All cephalopods studied by him showed this pigmentary migration within the retina, but the rapidity of the migration differed in various species, and it was different in different parts of the same retina, especially in the small horizontal stripe which contained very long and small rods, and corresponded evidently to an area of maximum vision.

In the section of tropical medicine, Mr. R. Newstead, of the Liverpool School of Tropical Medicine, read a paper on ticks concerned in the dissemination of disease in man, and gave a description of the *Ornithodorus moubata* which conveys tick fever, a spirillar infection, in the Congo Free State.

Mr. Newstead had found that in many respects the habits of the *Ornithodorus moubata* were not unlike those of *Argas persicus*, but the inert character of the larva of *Ornithodorus moubata* was unique among the Ixodinæ, in that it passes the whole of its life within the egg. The female *Ornithodorus moubata* laid eggs which were hatched, not as larvæ, but as nymphæ, although on the ninth day the larva was fully formed and the egg shell split, but the young tick remained until the fifteenth day, when as a nymph it escaped simultaneously from its larva covering and egg shell.

Dr. Graham (Sierra Leone) contributed a paper on guinea worm and its hosts. He had found that the incidence of the disease corresponded with the incidence of a cyclops, the presumed intermediate host, both seasonally and as regards its maximum manifestation.

SOME ASPECTS OF MODERN WEATHER FORECASTING.[1]

AFTER referring to the circumstances in which he was called upon to deliver the evening discourse in the absence of the Dean of Westminster, the lecturer explained that he had chosen the subject, not because he regarded weather forecasting as the only, or, from the scientific point of view, the most important practical branch of meteorology, but because, in a general sense, the possibility of its application to forecasting—the deduction of effects from given causes—was the touchstone of scientific knowledge.

The process of modern forecasting was illustrated by the daily weather charts of the period from February 1, 1904, up to the evening of February 12, which exhibited the passage over the British Isles of a remarkable sequence of cyclonic depressions, reaching a climax in a very deep and stormy one on the evening of the lecture. It was thus pointed out that the barometric distribution and its changes were the key to the situation as regards the weather, and this was supported by exhibiting the sequence of weather accompanying recognised types of barometric changes, as shown in the self-recording instruments at the observatories in connection with the Meteorological Office.

Some cases of difficulty in the quantitative association of rainfall or temperature changes with barometric variations were then illustrated. The barometric distributions in the weather maps for April 8 and April 16, 1903, were shown to be almost identical, and yet the weather on the later date was 10° colder than on the earlier. The observatory records for June 22, 1900, showed that a barometric disturbance of about the fiftieth of an inch, too small to be noticed on the scale of the daily charts, passed across the country from Valencia to Kew, over Falmouth, in about twenty-four hours, and produced at each observatory characteristic changes of temperature and wind, and also in each case about a fifth of an inch of rainfall.

Some examples of the irregularity of motion of the centres of depressions were also given, including one which travelled up the western coasts of the British Isles on October 14 and 15, and down the eastern coasts on

[1] Abstract of a discourse delivered at the Royal Institution of Great Britain by Dr W. N. Shaw, F.R.S.

October 16 and 17, 1903, one which developed from scarcely visible indications into a gale on December 30, 1900, and one which disappeared, or "filled up," as it is technically called, on February 6, 1904. The conclusion was drawn that the suggested extension of the area of observation by means of wireless telegraphy from ships crossing the Atlantic would not immediately place forecasting in the position of an exact science, but would add greatly to the facilities for studying the life-history of depressions.

The irregularities and uncertainties illustrated by the examples given might be attributed in part to the complexities of pressure due to the irregular distribution of land and sea in the northern hemisphere. Charts of the mean isobars for the world for January and July showed greater simplicity of arrangement in the southern hemisphere, where the ocean was almost uninterrupted, than in the northern hemisphere, where there were alternately large areas of sea and land. The comparative simplicity of the south as compared with the north was also illustrated by a chart representing an attempt at a synoptic barometric chart for the world for September 21, 1901.

The simplification of the barometric distribution at successively higher layers of the atmosphere, as illustrated by Teisserenc de Bort's chart of mean isobars at the 4000-metre level, was pointed out, and illustrations were also given of the method of computing the barometric distribution at high levels from observations at the surface, using data obtained from observations at high-level observatories, or those made with balloons and kites.

Some indication of the connection between the complexity of the surface and the simplicity of the upper strata might be established by means of careful observations of the actual course of air upon the surface and the accompanying weather conditions.

The actual course of air along the surface was often misunderstood. The conventional S-shaped curves representing the stream lines from anticyclonic to cyclonic regions were shown to be quite incorrect as a representation of the actual paths of air along the surface. A diagram contributed to the *Quarterly Journal of the Royal Meteorological Society*[1] showed the computed paths for special case of a storm of circular isobars and uniform winds, travelling without change of tyoe at a speed equal to that of its winds. An instrument made by the Cambridge Scientific Instrument Company to draw the actual paths of air for a number of different assumptions as to relative speed of wind and centre, and of incurvature of wind from isobars, was also shown, and the general character of the differences of path exhibited under different conditions was discussed.

In illustration of the application of these considerations to practical meteorology, it was noted that rainfall is an indication of the existence of rising air, and conversely the disappearance of cloud may be an indication of descending air. It was further noted that if the ascent and descent of air extended from or to the surface, the actual paths of air along the surface, as traced from the direction and speed of the winds, ought to show convergence in the case of rising air and divergence in the case of descending air.

The chart for April 16, 1903, was referred to for an obvious case of dilatation or divergence of air from a centre corresponding with fine weather, the centre of the area of divergence being specially marked "no rain," and the actual trajectories or paths of air for two different travelling storms were contrasted, to show how the rainfall might be related to the convergence of the paths of air. The two occasions selected were (1) the rapid travelling storm of March 24–25, 1902, and (2) the slow travelling storm of November 11–13, 1901.[2] The trajectories or actual paths of air for these two storms had been constructed from two-hourly maps drawn for the purpose from a collection of records of self-recording barographs, &c. Those for March 24–25 showed the paths to be looped curves with very little convergence, whereas those for the storm of November 11–13 showed very great convergence; so much so that if four puffs of smoke could be imagined starting at the same time from Aberdeen, Blacksod Point, Brest, and Yarmouth respectively, and travelling for twenty-four hours, they would find themselves at the end of the time enclosing a very small area in the neighbourhood of London.

Corresponding to this difference of convergence as shown by the paths was the difference of rainfall as illustrated by two maps showing the distribution of the rain deposited from the two storms. The first, with little convergence, gave hardly anywhere more than half an inch; the second, with its great convergence, gave four inches of rain in some parts of its area.

1 The Meteroological Aspects of the Storm of February 26–27, 1903. *Q. J. R. Met. Soc.*, vol. xxix. p. 233; 1903.

2 See Pilot Charts for the North Atlantic and Mediterranean, issued by the Meteorological Office. February, 1904.

BREATHING, IN LIVING BEINGS.[1]

It has been said that the most striking facts connected with respiration are its universality and its continuity. In popular language "the breath is the life." Breathing is not only a sign of life, it is a condition of its existence. Permanent cessation of breathing is regarded as a sign of death. Link up with this the icy coldness of death and you have two significant facts.

Respiration and calorification are therefore intimately related; in fact, calorification is one form of expression of the results of respiratory activity.

The popular view of respiration is an inference from what is observed in man and animals. During life the rise and fall of the chest goes on rhythmically from the beginning to the end. The respiratory exchanges effected in the breathing organs—lungs or gills—constitute "external respiration." This, however, scarcely touches the main problem, viz. what is called "internal respiration," or tissue respiration—*i.e.* the actual breathing by the living cells and tissues which make up a complex organism.

We are told that man does not live by bread alone. We know he requires, in addition, solids, fluids and air. Taking these to represent the three graces, then air is of all the graces best.

The higher animals have practically no reserve stores of air—unlike what happens with the storage of fats and proteids—and hence the necessity for mechanisms by which air is continually supplied to the living tissues, and also by which the waste product of combustion, viz. carbon dioxide, is got rid of. Closure of the wind-pipe, even for a few minutes, brings death with it from suffocation. The entrance of oxygen is prevented and the escape of carbon dioxide is arrested.

The process of breathing is common to all living beings—to plants and animals alike. It consists essentially in the consumption of oxygen by the tissues and the giving out of carbon dioxide. It is immaterial whether the animals or plants live in water or air, the principle is the same in both cases. Living active protoplasm demands a supply of oxygen.

All the world's a stage. The human body is at once a stage, and a tabernacle—a vast theatre—and the myriads of diverse cells of which it is composed, the players.

The cells or players, as active living entities, not only require food, but they require energy. The respiratory exchanges in and by the living cells provide the energy for the organism. This breathing by the cells is called "internal respiration." In a complex organism, therefore, the respiratory exchanges represent the algebraic sum of the respiratory activity of the several tissues that make up the organism. The various tissues, however, breathe at very unequal rates.

In one of his charming "contes philosophiques," Voltaire describes the visit of a giant of Sirius to our planet. Before reaching his journey's end he would have to traverse an aërial medium, and on arriving would see before him a fluid medium in continual movement, and tracts of solid land. After investigation—or no doubt he would be told, even though he was not personally conducted—that the water surface of this our globe is two

1 Abstract of a discourse delivered at the Royal Institution of Great Britain by Dr. William Stirling.