ent: the liquid is capable of dissolving solids which are insoluble in the vapor. The latter fact is proved by the experiments of Hannay and Hogarth (*Proc. roy. soc.*, Oct., 1879), and also by similar experiments of Dr. Ramsay. A small piece of potassium iodide was placed in the lower part of the experimental tube, which was partly filled with anhydrous alcohol. The upper part of the tube was free from alcohol, but its sides were covered with a film of crystalline potassium iodide. When the tube was heated and the meniscus disappeared, the salt in the lower part of the tube was dissolved, while that in the upper part remained unchanged. Similar observations were made on eosine.

Dr. Ramsay's second paper contains the isothermal lines for benzine, ether, and a mixture of benzine and ether, below and above the critical temperatures. The apparatus used resembled that of Andrews. The most remarkable feature of these lines is, that, below the critical temperature for benzine, there appears to be a diminution of pressure corresponding to a diminution of volume, immediately before complete condensation takes place. This phenomenon appears very slightly in a mixture of benzine and ether, but is not apparent in ether alone. It has been suggested by James Thomson (*Proc. roy. soc.*, 1871) that the isothermals for all gases might have somewhat this form below the critical temperature. Dr. Ramsay explains the fact by supposing that the molecules, when the gas has been compressed to a certain extent, begin to exert mutual attraction and relieve the pressure. The fact may be connected with the observed phenomenon that the meniscus of benzine remains easily distinguishable until it vanishes, whereas the meniscus of ether soon becomes hazy. At the part of the isothermal under consideration the substance is evidently in a condition of unstable equilibrium, and it is difficult to see how this part of the curve could have been detected experimentally.

The critical temperature and pressure of a mixture of benzine and ether were found to be not far removed from the mean of the critical temperatures and pressures of the components.

No direct experiments have yet been made to ascertain whether heat is evolved when a gas is converted into liquid by pressure at temperatures above its critical temperature. Mr. Jamin concludes that at and beyond the critical point there is no latent heat. This conclusion, however, does not seem probable; since the molecular constitution of a liquid and its vapor are probably different, even above the critical temperature.

The conclusions which Ramsay draws from his experiments are summed up as follows: —

"1°. A gas may be defined as a body whose molecules are composed of a small number of atoms.

"2°. A liquid may be regarded as formed of aggregates of gaseous molecules, forming a more complex molecule.

"3°. Above the critical point, the matter may consist wholly of gas if a sufficient volume be allowed, wholly of liquid if the volume be sufficiently diminished, or of a mixture of both at intermediate volumes. That mixture is, physically speaking, homogeneous in the same sense as a mixture of oxygen and hydrogen gases may be termed homogeneous."

C. B. PENROSE.

COLORED SKIES AFTER AN ERUPTION OF COTOPAXI.[1]

THE remarkable sunsets which have been recently witnessed upon several occasions have brought to my recollection the still more remarkable effects which I witnessed in 1880 in South America, during an eruption of Cotopaxi; and a perusal of your highly interesting letter in the *Times* of the 8th inst. has caused me to turn to my notes, with the result of finding that in several points they appear to have some bearing upon the matter which you have brought before the public.

On July 3, 1880, I was engaged in an ascent of Chimborazo, and was encamped on its western side at 15,800 feet above the sea. The morning was fine, and all the surrounding country was free from mist. Before sunrise we saw to our north the great peak of Illiniza, and twenty miles to its east, the greater cone of Cotopaxi; both without a cloud around them, and the latter without any smoke issuing from its crater, — a most unusual circumstance: indeed, this was the only occasion on which we noticed the crater free from smoke during the whole of our stay in Ecuador. Cotopaxi, it should be said, lies about forty-five miles south of the equator, and was distant from us sixty-five miles.

We had left our camp, and had proceeded several hundred feet upwards, being then more than 16,000 feet above the sea, when we observed the commencement of an eruption of Cotopaxi. At 5.45 A.M. a column of smoke of inky blackness began to rise from the crater. It went up straight in the air, rapidly curling, with prodigious velocity, and in less than a minute had risen 20,000 feet above the rim of the crater. I had ascended Cotopaxi some months earlier, and had found that its height was 19,600 feet. We knew that we saw from our station the upper 10,000 feet of the volcano, and I estimated the height of the column of smoke at double the height of the portion seen of the mountain. The top of the column was therefore nearly 40,000 feet above the sea. At that elevation it encountered a powerful wind blowing from the east, and was rapidly borne for twenty miles towards the Pacific, seeming to spread very slightly, and remaining of inky blackness, presenting the appearance of a gigantic inverted ⌊__ drawn upon an otherwise perfectly clear sky. It was then caught by a wind blowing from the north, and was borne towards us, and appeared to spread rapidly in all directions. As this cloud came nearer and nearer, so, of course, it seemed to rise higher and higher in the sky, although it was actually descending. Several hours passed before the ash commenced to intervene between the sun and ourselves; and, when it did so, we witnessed effects which simply amazed us. We saw a green sun, and

[1] From *Nature*, Dec. 27. A letter sent to Mr. Norman Lockyer.

such a green as we have never, either before or since, seen in the heavens. We saw patches or smears of something like verdigris-green in the sky; and they changed to equally extreme blood-reds, or to coarse brick-dust reds, and they in an instant passed to the color of tarnished copper or shining brass. Had we not known that these effects were due to the passage of the ash, we might well have been filled with dread instead of amazement; for no words can convey the faintest idea of the impressive appearance of these strange colors in the sky, seen one minute and gone the next, resembling nothing to which they can be properly compared, and surpassing in vivid intensity the wildest effects of the most gorgeous sunsets.

The ash commenced to pass overhead at about midday. It had travelled (including its détour to the west) eighty-five miles in a little more than six hours. At 1.30 it commenced to fall on the summit of Chimborazo, and, before we began to descend, it caused the snowy summit to look like a ploughed field. The ash was extraordinarily fine, as you will perceive by the sample I send you. It filled our eyes and nostrils, rendered eating and drinking impossible, and reduced us to breathing through handkerchiefs. It penetrated everywhere, got into the working-parts of instruments and into locked boxes. The barometer employed on the summit was coated with it, and so remains until this day. That which ssed beyond us must have been finer still. It travelled far to our south, and also fell heavily upon ships on the Pacific. I find that the finer particles do not weigh the twenty-five thousandth part of a grain, and the finest atoms are lighter still. By the time we returned to our encampment, the grosser particles had fallen below our level, and were settling down into the valley of the Chimbo, the bottom of which was 7,000 feet beneath us, causing it to appear as if filled with thick smoke. The finer ones were still floating in the air, like a light fog, and so continued until night closed in.

In conclusion, I would say that the terms which I have employed to designate the colors which were seen are both inadequate and inexact. The most striking features of the colors which were displayed were their extraordinary strength, their extreme coarseness, and their dissimilarity from any tints or tones ever seen in the sky, even during sunrises and sunsets of exceptional brilliancy. They were unlike colors for which there are recognized terms. They commenced to be seen when the ash began to pass between the sun and ourselves, and were not seen previously. The changes from one hue to another, to which I have alluded, had obvious connection with the varying densities of the clouds of ash that passed; which, when they approached us, spread irregularly, and were sometimes thick and sometimes light. No colors were seen after the clouds of ash passed overhead and surrounded us on all sides.

I photographed my party on the summit of Chimborazo whilst the ash was commencing to fall, blackening the snow-furrows; and, although the negative is as bad as might be expected, it forms an interesting souvenir of a remarkable occasion.

Edward Whymper.

MODERN PHYSIOLOGICAL LABORATORIES: WHAT THEY ARE AND WHY THEY ARE.[1] — II.

We have seen that Haller laid the foundation of the knowledge that the body of one of the higher animals was essentially an aggregation of many organs, each having a sort of life of its own, and in health cooperating harmoniously with others for the common good. In the early part of this century, before scientific thought had freed itself from mediaeval guidance, this doctrine sometimes took fantastic forms. For example: a school arose which taught that each organ represented some one of the lower animals. DuBois-Reymond relates that in 1838 he took down these notes at the lectures of the professor of anthropology: —

> "Each organ of the human body answers to a definite animal, is an animal. For example, the freely movable, moist, and slippery tongue is a cuttlefish. The bone of the tongue is attached to no other bone in the skeleton; but the cuttlefish has only one bone, and consequently this bone is attached to no other. It follows that the tongue is a cuttlefish."

However, while Professor Steffens and his fellow-transcendentalists were theorizing about organs, others were at work studying their structure; and a great step forward was made in the first year of our century by the publication of Bichat's 'Anatomie générale.' Bichat showed that the organs of the body were not the ultimate living units, but were made up of a number of different interwoven textures, or *tissues*, each having vital properties of its own. This discovery paved the way for Schwann and Schleiden, who laid the foundation of the cell-theory, and showed, that, in fundamental structure, animals and plants are alike, the tissues of each being essentially made up of aggregates of more or less modified microscopic living units called cells. Our own generation has seen the completion of this doctrine by the demonstration that the essential constituent of the cell is a peculiar form of matter named protoplasm, and that all the essential phenomena of life can be manifested by microscopic lumps of this material; that they can move, feed, assimilate, grow, and multiply; and still further, that, wherever we find any characteristic vital activity, we find some variety of protoplasm. Physiology thus became reduced, in its most general terms, to a study of the faculties of protoplasm; and morphology, to a study of the forms which units or aggregates of units of protoplasm, or their products, might assume. The isolation of botany, zoölogy, and physiology, which was threatened through the increased division of labor, brought about by increase of knowledge, necessitating a limitation of special study to some one field of biology, was averted; and the reason was given for that principle which we have always insisted upon here, — that beginners shall be taught the broad general laws of living matter before they are permitted to engage in the special study of one department of biology.

If I be asked, what have biological science in general, and physiology in particular, done for mankind

[1] Concluded from No. 50. Address by Dr. H. Newell Martin.