LETTERS TO THE EDITOR.

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The Temperature of the Upper Part of Clouds.

AT the recent meeting of the British Association, a report of which appeared in NATURE of October 14 (p. 473), Prof. A. L. Rotch gave an account of the highest balloon ascent in America. It is stated he found the remarkable result that on at least two ascents the temperature increased in a cumulus cloud in passing upwards. It is stated that during the discussion of the paper doubt was expressed as to the reality of the phenomenon. The first thing that strikes one on reading Prof. Rotch's result is that it seems rather curious that this phenomenon had not been recorded in previous ascents. When one considers the conditions, it is only what might be expected. The upper part of the cloud is receiving and dealing with the whole solar radiation falling on its surface, as none of it passes through it. Some of this heat penetrates some distance into the cloud, where it undergoes repeated reflections from the cloud particles. One would thus expect that the cloud particles and the saturated air would absorb some of the heat and have their temperature raised, though probably the greater part of the heat is reflected into space.

There is, however, a point to which I wish to direct attention, and that is to the extreme difficulty of getting anything like correct records of temperature and humidity in the conditions existing at the top of cumulus clouds. On one occasion, while making observations on Pilatus Kulm, the top of the mountain being at the time in dense cloud, but evidently near its upper limit, part of the observations consisted in taking readings of wet- and dry-bulb thermometers, but under the conditions it was found to be very difficult to get trustworthy results. All sorts of abnormal and contradictory readings were at first obtained, even to the wet-bulb reading higher than the dry. A few observations of the surroundings cleared up the difficulties. To begin with, one felt as if in an oven. Radiant heat streamed in from every direction, though no sun was visible, not even the direction of it. An examination of the surfaces of surrounding objects showed them to be in a very abnormal condition, though in the midst of dense cloud many of them were perfectly dry, not the usual dripping condition. The heat reflected from the cloud particles was absorbed by the surrounding objects, and their temperature raised far above the dew point. For instance, a thermometer placed on a large piece of wood showed a temperature of 60° F., while if hung up near it only rose to 48°.

Under the conditions the diffused radiation acted on all surfaces and raised their temperature, but, of course, did not raise them all to the same amount, large bodies, as is well known under these conditions, being much more highly heated than small ones. For instance, ordinary pins driven into a wooden post for hanging the thermometers on got wet, while the post was quite dry. All other freely exposed small objects were wet, and all large ones dry. It was while the thermometers were hung on the post that the wet bulb read higher than the dry, the reason being that the dry was not really dry, but had a film of water over it; and it was colder than the wet bulb, because it was a little smaller, and the wet had also the advantage of a better heat-absorbing surface in its muslin covering. The wet- and dry-bulb temperatures could only be obtained after they had been properly protected from all radiation. In ordinary cloud observations no such protection is required.

As bearing on the question of the heat absorbed by clouds, it may be mentioned that while the observations were being made on Pilatus Kulm the atmosphere was in a constant state of boil, so to speak. Vertical currents were constantly surging up on one side or the other, though there was no wind. These vertical currents were probably due to the disturbing effects of the absorbed heat, and they seem to suggest that this heated upper part of the cloud may explain the formation of those pillar-like clouds sometimes seen rising from sunlit cumulus by the hot part breaking away from the body of the cloud and rising high above it. JOHN AITKEN.

Ardenlea, Falkirk.

Lines of Force and Chemical Action of Light.

THE fact that carbon dioxide is dissociated at the low temperature of the surrounding medium, when green organs of plants are exposed to sunlight, has been often considered as somewhat paradoxical. Count Rumford was the first who tried to account for it by suggesting that this process takes place in spaces so small that the temperature produced by the absorption of light may approach the highest temperatures obtainable in our laboratories. More recently I tried to adduce in support of this ingenious interpretation some considerations, derived from the experimental study of the actual conditions of this photo-chemical process.[1] Still more wonderful is the possibility of its going on, though very slowly, in diffused sunlight. But perhaps in the whole range of photo-chemical phenomena there is no fact more wonderful than the possibility of obtaining photographs of the remotest star or nebula.

All these photo-chemical riddles seem to me to find their full explanation in Sir Joseph Thomson's theory,[2] so eloquently expressed in his recent presidential address to the British Association at Winnipeg.[3]

If "a wave of light may be regarded as made of groups of lines of electric force," if "in the wave front there cannot be uniformity," and "it must be more analogous to bright specks on a dark ground than to a uniformly illuminated surface," then it becomes evident that the chemical effect of light on a single molecule cannot fall off in the same ratio as the dispersion of light in space. A single molecule lying in the path of a line of force may be, with regard to the distant sun or star, in the same condition as another molecule in the nearest proximity of these centres of energy. It will be only the number of molecules attacked that will be reduced with the increasing divergence of the lines of force, and this result can be compensated by prolonging the exposition. It seems to me that Sir Joseph Thomson's theory furnishes for the first time a real explanation for the fact that a ray of light is not deprived of its photo-chemical efficiency, no matter how great the distance between the source of energy and the molecule acted upon.[4] These considerations may give us perhaps a deeper insight into the part played by radiant energy in the chemistry of the universe than we possess until now.

A full discussion of the problem would require, of course, something more than the very modest scientific equipment of a botanist, and I should be very grateful if a more competent reader of NATURE would find it worth while to decide the question whether the conclusions here deduced are really consistent with Sir Joseph Thomson's theory.

University, Moscow. C. TIMIRIAZEFF.

The Position of the Radio-active Elements in the Periodic Table.

MANY arrangements have been suggested, which include the radio-active elements in the periodic table. So far as I am aware, these have all attempted to confine each space in the table to a single element. This restriction has led to unlikely assumptions, on account of the large number of these elements, and the limited number of spaces vacant preceding uranium.

From analogy with organic compounds it seems possible that different internal structures of the atoms of the heavier elements may exist, resulting in elements of the same weight with perhaps very different properties. Similarly,

[1] In my Croonian lecture on "The Cosmical Function of the Green Plant" (Proc. Roy. Soc., vol. lxxii., p. 454).

[2] "Electricity and Matter." (1903.)

[3] NATURE, August 26, p. 253.

[4] For instance, it seems to me that the following lines, though referring to photo-electric, may be as well applied to photo-chemical phenomena: ". . . thus any effect which can be produced by a unit by itself will, when the source of light is removed to a greater distance, take place, less frequently it is true; but when it takes place it will be of the same character as when the intensity of light was stronger." Sir Joseph Thomson, "On the Ionisation of Gases by Ultra-violet Light, &c." (Proceedings of the Cambridge Philosophical Society, vol. xiv., part iv., p. 421).