

Letters to the Editor.

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Distribution of Temperature in the First 25 Kilometres over the Earth.

It is with much pleasure that I notice in NATURE of June 1, p. 834, Dr. Ramanathan's amplification and correction of the tropical portion of my diagram of distribution of temperature in a vertical section of the atmosphere of the globe from the summer pole to the winter pole. I hope the time is not far distant when some other enterprising meteorologist will render a like service for the polar regions of that diagram. It is badly needed.

While, however, we are waiting for that amplification, it would be very helpful if Dr. Ramanathan would supplement his contribution by additions and corrections within his knowledge to another diagram, namely, that of lines of equal entropy in a similar section which will be found on p. 116 of the volume to which he refers.

My reason for asking for this particular service is that, in order to deal with the physics of the upper air, the distribution of temperature alone is not sufficient; the corresponding values of pressure come into consideration too; and the best form in which the information about pressure can be conveyed is by a corresponding diagram of isentropic lines which can indeed be superposed without risk of confusion upon the isothermal lines already drawn.

In explanation let me say that everybody recognises that convection is a primary feature of weather; and we are accustomed to think of temperature enhanced beyond that of the environment as the natural preliminary to convection. So it is; but it is temperature in relation to pressure—entropy, in fact—that really counts. It is entropy which decides the equilibrium position of a sample of air, whether it will rise or sink or stop where it is in a particular environment. Entropy depends on temperature and pressure. It is reduced by reduction of temperature, but enhanced by reduction of pressure in accordance with algebraical formulæ which are quite easy to work, and are set out in the report of the recent Leipzig meeting of the International Commission for the Exploration of the Upper Air. The physical significance of an isentropic surface in the atmosphere is that air cannot pass upward from it without access to a supply of heat, nor downward without getting rid of heat. Circulation along an isentropic surface on the other hand can take place without any communication of heat, no matter whether the controlling surface be horizontal or vertical at the position of the sample. Convective equilibrium is the name which our predecessors gave to an isentropic condition in the vertical, and no energy is required for motion where there is convective equilibrium. We are accustomed to think of convective equilibrium as characteristic of a considerable horizontal area; but that can scarcely be so—differences arise from variations in surface-temperature, height, or solarisation, and the minutest difference in a region of convective equilibrium is dynamically operative.

Hence the lines of equal entropy in a vertical section are a guide to the conditions of the circulation of air and may be regarded as essential to the comprehension of the physics of the atmosphere.

Doubtless, in order to deal with particular condi-

tions, diagrams of isentropic surfaces for the particular occasions are necessary, and they can be provided as soon as we can get maps of the distribution of pressure and temperature at successive levels. The diagram of normals is not the final step; but it is at least a first stage, and an important one in the prosecution of productive inquiry; I trust that Dr. Ramanathan will find an opportunity for providing it. Personally, I require the information for tracing possible tracks of air elevated by convection in the tropical regions and descending somewhere else. I have a place ready for it, and if he will supply it I shall be correspondingly grateful.

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June 3.

An Ancient Spearhead.

In the British, London, and Aylesbury Museums are a few iron spearheads, presumably of the Early Iron Age, and evidently copied from the cast-bronze spearheads of the late Bronze Age, which ended about 800 B.C. in Britain. All of these were found in England. Mr. Reginald A. Smith, Keeper of British and Medieval Antiquities, British Museum, informs me that their occurrence has long been a mystery; that, on one hand, it is difficult to account for their

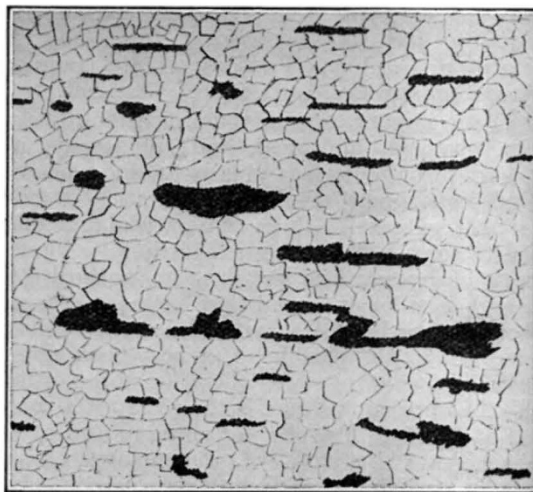


FIG. 1.

shape in wrought iron by reason of the high degree of technical skill required for their manufacture in this way, and that, on the other hand, cast iron, of which they may possibly be composed, is supposed to have been unknown even in medieval times.

I was recently approached by him to know whether it would be possible to put this matter to the test, and a specimen in the British Museum from Golden Lane, City of London, was selected for this purpose. The weapon in question is a narrow leaf-shaped spearhead of Bronze Age type, $7\frac{1}{2}$ inches in length, having a short round socket with flattened sides which are pierced by two holes for a rivet. The blade has a mid-rib extending to the tip, and inside the socket tapers for a length of $5\frac{1}{2}$ inches. Its approximate date is 7th century B.C. It may be a century or two later, but scarcely earlier.

There was no difficulty about preparing a surface suitable for microscopic examination, although owing to the regulations the specimen itself could not be taken out of the Museum, and the necessary work had to be done there. For this reason it was not