THE necessity for condensed expression is, I think, responsible for the questions raised by Dr. Jeffreys. I admit (indeed, insist on) the distinction between sensations and concepts, but left it unstated because I thought it was implied in the language used. The principle of rejection of unobservables must refer only to concepts; we cannot speak of observing sensations because a sensation is an observation, not a thing to be observed. I cannot reject a sensation of whiteness which may come to me, but I can reject the concept, ghost. I do not share Dr. Jeffreys's objection to the phrase, "observing a concept" (for example, observing Neptune). It is unambiguous and far more concise than any alternative which his letter suggests.

I agree completely (though I should express it differently) with Dr. Jeffreys's paragraph containing the question, "Did Neptune exist before it was observed?" If that question has a meaning, the answer is the ordinary commonsense one—yes; for Neptune is conceived as an object existing in space and time. This answer, however, contradicts the principle of rejection of unobservables, so we must ultimately (for scientific purposes of course, not for practical life) give up the concept, and then the question becomes meaningless. It is the task of science to discover the significant substitutes. Twenty years ago the question was asked: Does an electron exist during a transition between two Bohr orbits? We do not now answer yes or no, but abandon the concept of a spatio-temporal electron moving from orbit to orbit.

Dr. Jeffreys's probability problem, as he says, involves continuous variation and therefore is irrelevant. Science aims at the correlation of observations which are discrete. Hence, unless we wish to correlate unobservables at the same time, the only kind of probability which is applicable is that involving integers; for example, statistical probabilities such as the familiar ones deduced from experiments on throwing dice.

The difficulties of mutual understanding in these matters are illustrated in an amusing way by the letters of Dr. Jeffreys and Prof. Levy. The former admits that the views I expressed are prevalent but thinks they may not be mine. The latter regards them as not only not prevalent, but also essentially my own private analysis!

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May 8.

Existence of Three Alum Structures

THE crystals which comprise the alum series have generally been considered to be isomorphous on account of the similarity of their chemical formulæ and of their crystal classes. The more recent evidence of X-ray diffraction shows, however, that there are at least three different structures involved. It is proposed to call these the α, β and γ structures, in order of their discovery.

The α structure is that of potassium alum[1], and of the other common alums which have been examined. The β-structure is that of methyl-ammonium alum[2] and of cæsium alum, though the α-structure can be induced in the former by deposition on rubidium alum. Sodium alum is the sole example so far found of the γ-structure.

The presence of the form {210} on crystals grown from neutral aqueous solution seems to be characteristic of the β-structure. This property provides an easy way of separating cæsium and rubidium alums, for crystals grown from a solution of the two can be distinguished by eye.

The non-isomorphism of the alums raises doubts concerning other series of salts. Nevertheless, it is probable that only in the cubic system can such pseudo-isomorphism exist, for the high symmetry is due to that of the component groups, and may be maintained with different arrangement of these groups. In the other crystal systems it is improbable that the axial ratios and inter-axial angles of a number of crystals of similar chemical constitution would be almost equal unless the crystals were truly isomorphous.

An account of the structure of sodium alum and an examination of the relationship between the α, β and γ structures will be published elsewhere.

H. LIPSON.

George Holt Physics Laboratory,
University, Liverpool. March 13.

[1] Lipson and Beevers, *Proc. Roy. Soc.*, A, **148**, 664; 1935.
[2] Lipson, *Phil. Mag.* (in the press).

Conductivity of Oils and Waxes

A FEW years ago I detected a curious region of negative temperature coefficient of the conductivity of heavy oils, namely, a rising conductivity with decreasing temperature[1]. It occurred in the neighbourhood of the solidifying point. A similar phenomenon has recently been observed by W. Jackson with paraffin wax[2], just below its melting point. The effect is thought to represent probably a characteristic of both oils and waxes, at least of those containing hydrocarbons. It seems therefore desirable to put forward a theory to account for it.

A transition between the glassy and the crystalline phase in a mixture like oil must extend over a certain range of temperature. The conductivity of the oil in this range is therefore that of a two-phase system. The experimental curves suggest that the extrapolated conductivity of the glassy phase in the transition region is lower than that of the crystalline phase. Consequently the region of negative temperature coefficient may easily be explained by progressive crystallisation with decreasing temperature. This theory also accounts for the dielectric absorption which is always very pronounced in the melting region.

Assuming the theory to be correct, it is possible to calculate from experimental conductivity curves, obtained with special oils and waxes, the melting curve, the latter yielding the relative amounts of components of given 'melting point'. This curve permits certain conclusions to be drawn as to the approximate chemical composition of the oil, provided its basic nature is known.

This work has been carried out for the British Electrical and Allied Industries Research Association, and will probably be published in detail in due course.

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Engineering Laboratory,
University, Oxford.
March 9.

[1] *Z. Phys.*, **75**. 613; 1932.
[2] NATURE, **133**, 647; 1934.