assemblage, these three separate pieces of metal, will act collectively so as to transfer momentum in a quantized manner, and further that the size of the quantum depends primarily on the slit separation. How, consistently with his view of physics, could this be done?

The force of the above argument against Prof. Landé is this. It appears that there is a dualism in the mode of action between matter and apparatus; in particular, the region of the action is (in certain circumstances) dispersed or spread (as well as, in others, localized). The empirical proof of this has as yet been upset by no one. The customary interpretation of the mode of action between electron and apparatus places the source of the spread in the electron; Prof. Landé places it in the apparatus. If the latter interpretation is to be accepted physically it is necessary to provide a suitable interpretation of the collective action of the apparatus.

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[1] Landé, A., *From Dualism to Unity in Quantum Physics* (Cambridge University Press, 1960).
[2] *Op. cit.*, p. xi.
[3] "And here it must be emphasised that position in space-time defines a 'state'." *Op. cit.*, p. 29. See also p. 67 where he interprets Heisenberg as demonstrating only a spread in the observations "of more exactly determined p_x-values".
[4] Duane, W., *Proc. U.S. Nat. Acad. Sci.*, **9**, 158 (1923).
[5] Landé, A., *Op. cit.*, p. 69; italics in original. See also p. xii and p. 70.

Mr. Stopes-Roe sees a difficulty for the pure particle theory of diffraction in the assumption of 'collective action' of the reacting body as a whole, be it a crystal, or a screen with slits, or I may add any measuring instrument. But this collective action is justified, and is always taken for granted in the non-relativistic theory where communication is instantaneous from one to the other end of a body. All quantum mechanics, not only Duane's and Epstein–Ehrenfest's special example of diffraction, rests on this collective action, even to a much farther degree than envisaged by Dr. Stopes-Roe, namely, when symmetry principles are applied not only to a rigid body but even to a gas as a whole. In a relativistic theory of the future this may have indeed to be amended. But I agree with the quantum theorists in all they do on weekdays, when they practise the unitary quantum theory of particles and systems of particles known as quantum mechanics which includes Duane's theory of particle diffraction. I take exemption only from the Sunday talk about a quite obsolete duality with double manifestations and two subjective pictures instead of one physical reality—obsolete since Duane's and Born's statistical particle interpretation. For example, I agree that the equality of the angles of incidence and reflexion of a small particle from a surface of a heavy wall is due to the conservation laws in reaction to the wall as a whole. But I would disagree if a dualist should tell me that this equality is due to a wave interlude, with the particle 'manifesting' itself as spread out over the whole surface and being reflected according to the Huyghens interference principle. The only difference from a crystal is that the wall does not have selective periodicities, hence is not restricted to selective momentum transfer yielding selective angles of incidence and reflexion. Here as there I regard 'duality' as superfluous ideological ballast, which may not hurt the expert but certainly confuses the student, who may as well be told from the very beginning that there is a unitary particle theory of mechanical interaction, good enough for weekdays *and* Sundays.

Let me add that I consider my negative criticism of the 'quantum philosophy' in vogue to-day only as a small part of what can be achieved, namely: a derivation of the perplexing wave-like statistical quantum rules from the non-quantal postulates of symmetry and invariance imposed on the probability structure of events, so that we can understand the origin of the quantum rules on a simple and intelligible basis.

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GEOLOGY

Crystal Fractionation of the Skaergaard Type in Modern Icelandic Magmas

In a recent paper L. R. Wager[1] concluded " . . . it still seems to be an entirely open question whether the slightly unusual composition of the original Skaergaard magma is a sufficient cause for the Skaergaard fractionation trend, which differs so notably from the trends usually obtained from studies of the varying composition of consanguineous basaltic lavas". We have strong evidence from the chemical composition of a group of modern basaltic lavas extruded from the Icelandic volcanoes Eldgja and Katla, that they are an example of the Skaergaard fractionation trend considered to result from crystal fractionation.

Bulk analyses have been made of seven lavas for twelve major elements by classical methods (G. R. R.) and for fourteen trace elements by spectrochemical methods (J. S.). The lavas have been examined in the field by one of us (G. R. R.) and are known to have been extruded in pre-historic times from the linear system of craters forming the extinct fissure volcano Eldgja and the active sub-glacial volcano Katla. The lavas have been examined in thin section, they are fresh, are practically free of phenocrysts and we regard them as chilled magmatic liquids unaltered in their content of major and trace elements.

We have found that there is a natural order in our determinations such that when our lavas are placed with the sequence and spacing of Figs. 1 and 2 the determinations for each element tend to lie as a straight line, the slope of which varies with each element. Furthermore, these lines are similar in their heights and slopes to those obtained by plotting the composition of the Skaergaard liquids over the range of 70–80 per cent solidified.

The factors controlling the concentration of the elements in the Skaergaard liquid are the formation, during slow cooling, of a primary precipitate of crystals and the selective action of these on the trace elements present in the magma, such that the residual magma is enriched in those trace elements rejected by the early primary precipitate crystals and impoverished in those accepted by these crystals.

It is most unlikely that the resulting co-variation among many elements could be produced by any process other than the crystallization of basaltic magma in depth as in the Skaergaard intrusion. We