Which may suggest that the present reviewer holds the second book on our list in rather low esteem. Such is in fact the case. Leaving wholly aside, as unimportant, the flippancy, super-smartness and debonair conceit so manifest in the style in which the book is written,[1] the thing which makes it not only an unreliable guide, but in the reviewer's judgment a positively pernicious one for at least that large group of students who wish to make practical use of the theory of probability in scientific research, is its abandonment of the experiential basis of probability, and the substitution in its place of the thesis that the basis of probability is simply a logical relation, independent in respect of its ultimate philosophical validity of any experience whatever. The author rejects completely the possibility of numerically measuring a probability, except in one particular narrowly defined case. The whole thing is essentially a postulational performance. Keynes sets up certain fundamental postulates, which bear no particular relation to any known phenomenal universe, then proceeds to develop a system of consequences of these postulates, and finally takes as the criterion of validity the logical consistency of the resulting system. This process is, of course, well known in mathematics, and has served in some hands and in some fields a philosophically useful purpose. The reviewer *guesses* (he has no intention to waste the time necessary to check over the symbolic logic to prove it) that Keynes's system *is* logically consistent, if the initial postulates are granted. But this is a sterile triumph so far as the application of probability to scientific research is concerned.

Of course the book is not all bad. No book is. I can not resist quoting one passage, which seems destined to become classic, as an example of the author's powers of clear and penetrating thought, subtle reasoning and lucid exposition. It is this (p. 36):

"When we say of three objects, A, B and C, that B is more like A than C is, we mean, not that there is any respect in which B is in itself quantitatively greater than C, but that, if the three objects are placed in an order of similarity, B is nearer to A than C is. There are also, as in the case of probability, different orders of similarity. For instance, a book bound in blue morocco is more like a book bound in red morocco than if it were bound in blue calf; and a book bound in red calf is more like the book in red morocco than if it were in blue calf. But there may be no comparison between the degree of similarity which exists between books bound in red morocco and blue morocco, and that which exists between books bound in red morocco and red calf. This illustration deserves special attention, as the analogy between orders of similarity and probability is so great that its apprehension will greatly assist that of the ideas I wish to convey. We say that one argument is more probable than another (*i.e.*, nearer to certainty) in the same kind of way as we can describe one object as more like than another to a standard object of comparison."

[1] Which leads to such choice remarks as the following (p. 180): "It may, however, be safely said that the principal conclusions on the subject set out by Condorcet, Laplace, Poisson, Cournot and Boole are demonstrably false. The interest of the discussion is chiefly due to the memory of these distinguished failures."

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SPECIAL ARTICLES

ON THE EXISTENCE OF AN ANOMALOUS REFLECTION OF X-RAYS IN LAUE PHOTOGRAPHS

SPECTROMETRIC observations[1] upon crystals of potassium iodide have pointed to the existence of strong diffraction effects which could not be explained as "reflections" from any imaginable atomic planes. The positions[2] of these X-peaks, as they have been called, have been defined for various angles of diffraction and their wave lengths determined as equal to that of the characteristic radiation of iodine. Possibly related effects[3] have also been observed in the powder photographs from several metals. Very recently a Laue photograph[4] to show the presence of these anomalous reflections has been offered.

Inasmuch as the existence of such diffractions not obeying established laws must of necessity have a great influence upon the interpretations of X-ray phenomena, the study of their properties becomes of importance. Their failure to appear under the prescribed conditions may have even greater significance. The writer has obtained a number of Laue photographs of potassium iodide and no effect corresponding to these X-peaks appears on any of them.

The X-peaks are supposed[4] to show themselves in a Laue photograph taken with the incident X-rays parallel to a cube face as four *spots* symmetrically placed about the center and lying in the same zone as the (100) and (130) reflections. Their distance from the undeviated image will be[4] one centimeter if the crystal-to-plate distance is 2.5 centimeters. The recorded photograph was said to be produced by an

[1] G. L. Clark and W. Duane, *Proc. Nat. Acad. Sci.*, *8*, 90 (1922).

[2] G. L. Clark and W. Duane, *Proc. Nat. Acad. Sci.*, *9*, 131 (1923).

[3] L. W. McKeehan, *J. Opt. Soc. Am.*, *6*, 989 (1922).

[4] G. L. Clark and W. Duane, *J. Opt. Soc. Am.*, *7*, 455 (1923).

exposure which was too short to register any of the normal reflections.

The writer has prepared Laue photographs with the X-rays passing either parallel to or making small angles with the normal to a (100) face. They have been taken both with a crystal-to-plate distance of 2.5 centimeters and with the more commonly employed distance of five centimeters. Some of the exposures were at least ten times greater than necessary for the detection of the ordinary reflections from crystal faces. Four crystal specimens were used; their refractive index was determined to agree within 0.001 with that which has been assigned to pure potassium iodide.[5] Several voltages were used in the preparation of these photographs. The minimum wave length present was directly determined for a particular experiment (1) by calculating from an analysis[6] of the photograph the wave lengths of the rays giving rise to different spots and (2) by taking, under the same conditions of experimentation, a reflection photograph from a calcite crystal. In some photographs reflections were present from wave lengths as low as 0.23 A. U. (the critical absorption limit for the K-series of iodine[7] is 0.374 A. U.). In no instance was anything found upon the photographs at the points which both the published Laue photograph and the accompanying spectrometer measurements indicate as the locations of the X-peaks. Furthermore the general aspect of the Laue photographs is such that there can be no possibility of a confusion of these X-peak spots with the regular reflections occurring upon good photographs.

Potassium iodide, in common with certain other crystals, of which tin tetraiodide[8] is typical, gives hazy diffraction phenomena which are not to be directly accounted for as reflections from planes in perfectly constructed crystals. These diffractions, though they seem to occupy the same positions in different specimens, are not sharply defined; furthermore they are relatively very weak and occur at much smaller angles of deviation than obtain for the X-peaks. As a consequence it is impossible to identify the two.

These hazy diffractions seem related to the well-known "asterism" phenomenon[9] which shows itself as diffraction stripes passing along principal zones of planes in distorted crystals. A number of crystalline substances which deform readily, among which the alkali halides are conspicuous, will usually if not always show some striping from specimens which have not been subjected to external deforming forces. The observed effects with potassium iodide differ from those with other alkali halides in that, instead of a continuous stripe, the intensity is largely localized. Had it been possible to identify these hazy diffractions with the X-peaks, then a proof that the latter were due[2] to X-rays having the frequency of the characteristic radiation of iodine would have led to the possible explanation that the hazy diffractions arise from resonance iodine radiation.[10]

The writer has reexamined photographs of caesium dichloroiodide;[11] Laue exposures also have been made from a number of other crystals which, containing atoms that could emit their characteristic radiations under the action of the primary X-ray beam, might be expected to show X-peak spots. Among the photographs thus produced were ones from barite, barium nitrate and silver nitrate. On none of these was any evidence found pointing to the existence of other than the normal planar reflections.

More details of these experiments, together with reproductions of Laue photographs, will be published soon in the *American Journal of Science*.

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[5] The writer is greatly indebted to H. E. Merwin for this determination.

[6] R. W. G. Wyckoff, *Am. J. Sci., 50,* 317 (1920).

[7] W. Duane, *Bull. Nat. Research Council, 1,* 389 (1920).

[8] R. G. Dickinson, *J. Am. Chem. Soc., 45,* 958 (1923).

[9] G. Aminoff, *Geol. För. Förh., 41,* 534 (1919); E. Hupka, *Physikal. Z., 14,* 623 (1913); F. M. Jaeger, *Proc. Roy. Soc. Amsterdam, 18,* 3; F. Rinne, *Ber. Sächs. Akad. Wiss. Leipzig* (Math.-phys. Klasse), *67,* 303 (1915).

[10] G. L. Clark and W. Duane, *Proc. Nat. Acad. Sci., 9,* 126 (1923).

[11] R. W. G. Wyckoff, *J. Am. Chem. Soc., 42,* 1100 (1920).

THE BIOCHEMICAL SULFUR OXIDATION AS A MEANS OF IMPROVING ALKALI SOILS[1]

THE problem of reclaiming alkali soils, especially black alkali, has been studied at various experiment stations and methods for amelioration of the alkali conditions have been suggested. The methods might be divided into mechanical and chemical. The former consists in either surface washing off of the salts or leaching out. The chemical method consists in treating the soil with gypsum whereby the conversion of the carbonates and bicarbonates into sulfates takes place. Recently Lipman suggested a biochemical method whereby the oxidation of sulfur by microorganisms and the production of sulfuric acid might be utilized in converting the carbonates into sulfates. The advantages of this method over the gypsum method is the difference in the reversibility of the reactions in

[1] The authors share equal responsibility and credit for the work reported.

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