tions. But if certain relations exist between the values of a and b , particular integrals, involving one constant of integration only, can be found. In addition, it proves to be the case that the result discovered in 1933 arises if $a = 3$ and $b = 0$.

The density and pressure can be expressed in terms of the known functions f , Q , y and η through the appropriate Einstein equations (2). However, the as yet undetermined function $S(t)$, and its first and second derivatives, also occur in the expressions for the density and the pressure. The function can be found by imposing an additional requirement, for example, a boundary condition. Thus if there is a vacuum outside the spherical mass, the pressure must be zero at the outer boundary. The function S can thus be found and it involves, among other constants, the boundary value of the co-moving co-ordinate r . It is, of course, the case that S determines the speed of the motion, the time to reach a given size, and other similar properties. Speeds up to the local velocity of light are possible.

The detailed analysis of special cases based on the particular integrals of equation (4), and which correspond to collapsing configurations, shows that a wide variety of motions is possible. In general, there are pressure and density gradients within the material. In some cases, a spherical surface on which the pressure is infinite moves outwards through the material²—rather like a shock wave. In other cases, singularities of this kind are absent. The effective times of collapse tend, on the whole, to be short—by astronomical standards at least. The exploding configurations can be dealt with in a similar manner.

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On the Theory of Layer Structures

RECENTLY, Shinada and Sugano¹ and also Ralph² have published theoretical calculations on the optical absorption in layer structures. These calculations are based on a two-dimensional effective mass approximation and the implications are that conclusions drawn from such an approach apply to the actual physical situation met with in layer structures. In our opinion, this view is at variance with the basic principles of quantum mechanics. Indeed, any two-dimensional representation fails to satisfy the requirements of completeness necessary to describe the states of a physical system and, therefore, is liable to miss physically significant facts. Although the electron wave-functions in layer structures may often be represented with sufficient accuracy as products:

$$\varphi(x, y, z) = \chi(x, y)\zeta(z)$$

of two separate components^{3,4}, this does not imply that the two-dimensional component $\chi(x, y)$ alone covers the whole situation. The proper representation of the system involves both components and they must appear explicitly in the definition of any physical parameter. In particular, we note that the optical properties of layer structures are subject to selection rules which depend on the mutual orthogonality properties of the two components, and which cannot, *a priori*, be ignored. This example illustrates that it is necessary to make a careful assessment of the physical significance of two-dimensional approximations as applied to layer structures.

The implications of the ideas outlined here will be discussed in some detail in a forthcoming paper⁵. Here we add that the discrepancy noted by Ralph between his

results and those of Shinada and Sugano is due to Ralph's omission of the energy dependence appearing in the matrix elements of the dipole interaction. Although permissible in isotropic crystals, this omission is no longer justifiable in layer structures.

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Current Transients in Potassium Chloride

A PRELIMINARY investigation has been carried out of current transients in potassium chloride at 150° C. The specimens used were single crystals of AnalaR grade, supplied by Hilger and Watts, Ltd.—the slab size being about 2.5 cm square and 0.4 cm thick. Into each slab a flat-bottomed cylindrical recess of 0.5 cm diameter was drilled and the thickness reduced by polishing on a Selvyt cloth moistened with water. Final thicknesses of specimens lay in the range 0.01–0.02 cm. Silver paint was used as electrodes, and the specimen and its spring-loaded contacts were enclosed in a well-insulated thermostatically controlled chamber in which the temperature was maintained at 150° ± 1° C. The pulse generator used provided linearly rising voltage transients of variable rise time and amplitude. The displacement current to the crystal was balanced by adjusting a variable air condenser in parallel with the specimen and feeding the output voltages from the measuring resistor in series with the crystal and from the balancing resistor in series with the condenser to the differential amplifier of a Tektronix type 502A oscilloscope. The following is a summary of our observations.

(1) Fig. 1 A (lower traces) shows the current in a potassium chloride specimen resulting from the application of two voltage pulses having the form indicated in the upper trace. The second pulse was applied about 2 sec after the first (both are superimposed on the photograph). Before the first pulse was applied, the specimen had not been subjected to high voltage. It can be seen that the magnitude of the first current pulse considerably exceeds the second. At a particular value of the field the current departs from a linear field dependence, increases steeply and then decays.

(2) The second and further successive pulses decrease the magnitude of the current and the position of the decreased current maximum shifts to higher voltages.

(3) The initial high current pulse cannot be repeated by either short-circuiting the specimen after application of voltage or by interchanging the connexions to the electrodes so as to apply the same magnitude pulse in reversed polarity. Regardless of the polarity the high-current pulse is only seen on the first application of voltage.

(4) The initial current can, however, be partially or totally recovered by heating the crystal to a higher temperature (for example, 200° C) and leaving it at this temperature for an hour or two.

(5) The faster the application of voltage the steeper and the higher is the initial current.

(6) If after having applied several pulses of given maximum voltage a pulse of magnitude higher than this series is applied, the current once again shoots up at a threshold voltage exceeding that previously observed, and its magnitude is greater at this higher field. This settles down as before to a very low value on application of further pulses of this magnitude. It is usually found that the residual current at lower fields is now less than before, that is to say, the application of a higher voltage increases