non-reversible in this region, and decrease of ΔV then leads to conductivity hysteresis. This effect is independent of the direction of ΔV, and thus occurs with both A.C. and D.C. potentials.

Güntherschulze[3] has explained semi-conductivity for 'Silit', a mixture of silica-carbide, graphite and alumina, on the basis of electron acceleration in the nominally insulating particles of alumina, the penetration involving larger particles with increasing ΔV. This mechanism can be applied to compressed dust, which forms a similar material. Fröhlich[4] has shown that, if the dielectric stress on such particles exceeds a critical value, their insulating properties will be destroyed entirely, and the conductivity of a given path thus increased. Dielectric breakdown increases cumulatively with time; but if ΔV is reduced below its critical value after, say, one minute, sufficient nominally insulating particles are left to restore normal semi-conductivity at a higher level. The empirical equation also applies for decreasing values of ΔV. α is not affected by hysteresis, and varies only slightly with increasing compression, but β increases with hysteresis by 32 per cent at 10 lb./sq. in. (Fig. 1, Curve A) and by 124 per cent at 50 lb./sq. in. (Fig. 1, Curve B), and with compression by 150 per cent between 10 lb./sq. in. and 50 lb./sq. in.

Dèchêne[5] has reported a decrease of contact resistance between particles with increasing compression. This gives rise to a reduced interfacial contact potential and a larger potential gradient across insulating layers, which leads to a more pronounced hysteresis at 50 lb./sq. in. (Fig. 1, Curve B). But at high values of compression, conduction tends to become predominantly metallic. The leakage currents are then sufficiently large to cause considerable heating in the sample, and the positive temperature coefficient of the metallic conductors gives rise to a somewhat erratic hysteresis effect at 100 lb./sq. in. (Fig. 2, Curve A), and to a falling conductivity at higher values of ΔV at 200 lb./sq. in. (Fig. 2, Curve B).

Conductivity hysteresis is thus dependent on the compression of the dust, and it reaches a maximum at a condition of sedimentation which may well be found in dust deposits containing oil and moisture and subjected to intermittent vibration.

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Nuclear Thermodynamics and Showers

THE properties of a thermodynamic assembly consisting of atomic nuclei, nucleons, electrons and positrons, at high densities and at temperatures for which $kT \sim mc^2$ (m being the electron mass), have been studied by several investigators[1]; but the application of the results to the problem of the relative abundances of atomic nuclei in the universe has so far met with little success. It is generally recognized, however, following Bohr, that thermodynamical concepts provide a useful basis for discussing the general features of nuclear phenomena.

The purpose of this communication is to point out the possible bearing of the study of such dense, high-temperature assemblies on the phenomenon of the 'explosion' showers associated with cosmic rays. One may, in fact, estimate, on the basis of these ideas, the relative probabilities for the emission of light nuclei from a highly excited heavy nucleus, like those recently observed in the multiple disintegration processes produced by cosmic rays[2]. Further, an elementary calculation allows us to estimate the number of mesons and electrons (positive and negative) in an excited nucleus. In the following table, r denotes the ratio of the meson concentration to the electron concentration (this quantity may be taken as comparable with the ratio of the numbers of mesons and electrons emitted in explosion showers); E denotes the (average) energy per particle (electron or meson); and n the total number of electrons present in a heavy nucleus (mass number, 200).

E (MV.)	n	r
5·0	13×10^{-3}	41×10^{-9}
15	55×10^{-2}	67×10^{-4}
35	70×10^{-1}	85×10^{-3}
69	54	13×10^{-2}
∞	∞	1

A detailed paper will be published elsewhere.

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A Short Method for Calculating Maximum Battery Reliability

THE method devised by Thomson[1] for obtaining test weights which give maximum battery reliability can be simplified to lead to much shorter computation.

The correlation between a set of tests, the a variates, and their second application, the α variates, can be symbolized by the matrix $\begin{bmatrix} R_{aa} R_{a\alpha} \\ R_{\alpha a} R_{\alpha\alpha} \end{bmatrix}$, where, under the conditions set out by Thomson, $R_{aa} = R_{\alpha\alpha}$ and $R_{a\alpha} = R_{\alpha a}$. Treating battery reliability as a special case of Hotelling's battery prediction[2], Thomson finds its maximum value by maximizing $u'R_{a\alpha}R_{\alpha\alpha}^{-1}R_{\alpha a}u$ under the condition $u'R_{aa}u = 1$, where u is the vector of test weights which make battery reliability a maximum. Thomson, therefore, requires to solve the equation

$$|R_{a\alpha}R_{\alpha\alpha}^{-1}R_{\alpha a} - \lambda R_{aa}| = 0 \quad . \quad . \quad (1)$$

for its largest root λ_1. This root is equal to r_m^2, where r_m is the maximum battery reliability and the weights u are in the ratio of the elements of any row of the matrix $\text{adj}(R_{a\alpha}R_{\alpha\alpha}^{-1}R_{\alpha a} - \lambda_1 R_{aa})$.

In the method I now suggest the weights u are the same for both applications of the test battery (ref. 1, p. 359) and battery reliability is given by

$$r = \frac{u'R_{a\alpha}u}{u'R_{aa}u}, \quad . \quad . \quad . \quad . \quad (2)$$

and *maximum* reliability follows by maximizing $u'R_{a\alpha}u$ under the condition $u'R_{aa}u = 1$. We thus require to solve the equation

$$|R_{a\alpha} - \lambda R_{aa}| = 0 \quad . \quad . \quad . \quad (3)$$

for its largest root λ_1, which in this case is equal to the maximum reliability r_m. The weights u are given by any row of the matrix $\text{adj}(R_{a\alpha} - \lambda_1 R_{aa})$.

Use of equation (3) avoids the awkward triple product $R_{a\alpha}R_{\alpha\alpha}^{-1}R_{\alpha a}$ in equation (1) and so shortens