For the total free energy $f = f_1 + f_2$ we obtain, using (2) and (4):

$$f = H_T \frac{B^2}{\sqrt{B^2 - E^2}} - \tfrac{1}{2} H_T^2, \quad . \quad . \quad (5)$$

which is valid for $0 \leqslant B^2 - E^2 \leqslant H_T^2$ or $\xi \leqslant 1$.

This expression is a generalisation of formula (1) obtained for the pure magnetostatic case. It can be derived from a Lagrangian

$$\mathrm{L}(E, B) = H_T \sqrt{B^2 - E^2} - \tfrac{1}{2} H_T^2, \quad . \quad . (6)$$

which is connected with the free energy f by the well-known relation

$$f = \mathrm{L} - E \frac{\partial \mathrm{L}}{\partial E}.$$

By its derivatives, L defines the quantities D and H as functions of B and E:

$$\left. \begin{aligned} D &= -\frac{\partial \mathrm{L}}{\partial E} = \frac{E}{\sqrt{B^2 - E^2}} H_T \\ H &= \frac{\partial \mathrm{L}}{\partial B} = \frac{B}{\sqrt{B^2 - E^2}} H_T \end{aligned} \right\} \quad . \quad . \quad (7)$$

As to the connexion between the macroscopic current density J and the field, an independent statement is still required. In the normally conducting regions e will be accompanied by a current j according to Ohm's law:

$$j = \sigma e,$$

where σ is the conductivity of the normal phase. This current is to be continued into the supraconducting regions without an accompanying electric field. The component of the macroscopic current J parallel to E will therefore be given by

$$J = \sigma e = \frac{\sigma E}{\sqrt{B^2 - E^2}} H_T = \sigma D \quad . \quad . \quad (8)$$

Finally, we assume the macroscopic Maxwell equations and the customary boundary conditions: H_{tg}, B_n, E_{tg}, $D_n + J_n$ continuous.

Though this reasoning cannot, of course, claim to be more than a first and quite provisional attempt, and hysteresis and other disturbing effects will certainly complicate the real state of affairs appreciably, it seems that on the basis of the equations communicated above a consistent theory can be built up. Formally it may be considered as a kind of limiting or degenerate case of the Born–Infeld field theory. There a Lagrangian of the form $a^2\sqrt{1 + b^{-2}(B^2 - E^2)}$ or $a^2\sqrt{1 + b^{-2}(B^2 - E^2) + b^{-4}(B\,E)^2}$ with $a = b$ forms the basis; the Lagrangian (6) corresponds to the limiting case $b \rightarrow 0$, $a^2/b = H_T$.

I have succeeded in applying this theory to the phase transition in a supraconducting wire caused by the magnetic field of a current through the wire, and to other problems which I hope to discuss *in extenso* elsewhere.

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Nebular Spectra due to Elements of the Second Period

MEASUREMENTS of the hot spark spectrum of sulphur in the Schumann region have enabled me to classify partially the singlet system of S III and to locate the new terms with respect to the known triplet system by means of numerous intercombinations. It has been possible to find two singlet terms in K VI from Ekefors'[1] data and to locate them with respect to the known triplets by intercombinations. The new terms are listed in Table I.

Table I

S III		K VI	
$s^2p^2\,{}^3P_0$	0·00	$s^2p^2\,{}^3P_0$	0·00
${}^3P_1$	297·2	${}^3P_1$	1,131
${}^3P_2$	832·5	${}^3P_2$	2,927
$s^2p^2\,{}^1D_2$	11,320	$s^2p^2\,{}^1D_2$	18,973
$s^2p^2\,{}^1S_0$	27,163		
$s\,p^3\,{}^1P_1$	136,839	$s\,p^3\,{}^1P_1$	223,840
$4s\ {}^1P_1$	148,398		
$5s\ {}^1P_1$	211,327		

The isoelectronic sequences from Si I for the forbidden transitions which might be expected in nebulæ obey the irregular doublet law very accurately. Interpolated values for the 'nebular pair' in Ar V (ground ${}^3P_1$, ${}^3P_2 - {}^1D_2$) accurate to a few cm.$^{-1}$ may be found. Table II lists the computed wave-lengths for these forbidden transitions together with the name commonly assigned them.

Table II

Element	Nebular pair ($3p\,{}^3P_{1,2} - 3p\,{}^1D_2$)	Transauroral line ($3p\,{}^3P_1 - 3p\,{}^1S_0$)	Auroral line ($3p\,{}^1D_2 - 3p\,{}^1S_0$)
S III	9535 9069	3721·1	6310·2
Ar V	7008 6436·5	2694 ± 65	4610 ± 50
K VI	6229 5603	2375 ± 65	4097 ± 75

Lists of unknown spectrum lines found in nebulæ or novæ have been published by Swings[2] and amended by Stoy[3]. In those lists we find λλ 6311, 6435 and 7007 A. These lines have all been very tentatively proposed as being due to Ar V. Prof. Bowen suggested to me last summer as a result of my data on P II that the first line might be the auroral line of S III. These data now confirm this and show, as well, that the last two lines form the nebular pair of Ar V. The S III transauroral transition, if present, coincides with H_μ. The K VI nebular pair correspond to no lines in Swings' list. The two unknown lines, 4571·5 and 4064, are possibilities for the auroral transition in Ar V and K VI respectively, but if either one can be thus correctly identified, the other cannot be considered.

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Quantum Energy of γ-Rays Excited by Slow Neutrons

IN the course of investigation on γ-rays excited by neutrons, we have recently determined the absorption curves of the secondary electrons due to γ-rays emitted from 24 elements, namely, H, Al, Cl, K, Ti, Cr, Mn, Fe, Ni, Co, Cu, Zn, As, Se, Br, Y, Ag, Cd, Sb, I, Sm, W, Au and Hg, under the bombardment of slow neutrons, by means of the method of coincidence of two counters. The form of the curves obtained differs considerably from element to element,

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