There is remarkable uniformity in the number of daughter fronds produced, the life of the mother frond, and the history of frond production described above. The effect of changes in the environment on the process is under investigation in this laboratory, and a fuller communication will be published in due course.

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Neutrino Theory of Light

RECENTLY some doubts have been expressed about the neutrino theory of light, and Fock[1] has claimed to have found some general rigorous arguments against the possibility of such a hypothesis, especially in its existing form. We believe that Fock's arguments are not valid, though it seems that Jordan's original work[2] on the derivation of the photon amplitudes $b(k)$ from neutrino amplitudes, $a(k),c(k)$ is somewhat ambiguous, as it contains in fact an indefinite expression of the type $\infty - \infty$; later, Jordan proved the convergence of the result but in a somewhat artificial way.

We wish to remark that all these difficulties can be avoided at once by using the following expansion for the neutrino wave functions satisfying the one-dimensional Dirac equation:

$$\psi(x,t) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{+\infty} \Big[A_\varrho(k) \exp(- ic|k|t + ikx) + C^*_\varrho(k) \exp(ic|k|t - ikx) \Big] dx$$

where $A\varrho(k)$ and $C\varrho(k)$ are readily found to relate to *neutrino* and *antineutrino* respectively[3]. These Fourier coefficients are expressed through independent amplitudes $a(k)$, $c(k)$ obeying the Fermi commutation rules $a^*(k')a(k) + a(k)a^*(k') = \delta(k' - k)$, etc.

For the photon wave, we take the analogous expansion from the well-known paper of Dirac[4] with the coefficients $b(k)$ satisfying the Bose commutation rules:

$$b(k')b^*(k) - b^*(k)b(k') = \frac{ch}{2|k|} \delta(k' - k).$$

Now, we can easily proceed to the construction of the Bose amplitudes $b(k)$ from the Fermi amplitudes $a(k),c(k)$. For this, we consider the absorption of a photon as due either to the absorption of a neutrino and antineutrino of frequencies $(k - l)$ and (l), respectively, or as due to the absorption of a neutrino (antineutrino) of frequency $(k + l)$ and to the simultaneous emission of the same particle of frequency (l) (Jordan's neutrino Raman effect without change of direction). In this way we find:

$$b(k) = \frac{1}{k} \sqrt{\frac{ch}{2}} \left[\int_0^{\infty k_1} a^*(l)a(l+k)\, dl - \int_0^{\infty k_1} c^*(l)c(l+k)\, dl - \int_0^{k} a(l)c(k-l)\, dl \right].$$

($k = k/|k|$ defines the sign of the upper limit) where usually one takes all states above a certain one as unoccupied[5].

With b (k) constructed analogously, one immediately verifies the required Bose commutation rules for $b(k),b^*(k)$ and thus proves the validity of the neutrino theory in a quite straightforward way. Apparently, Fock obtained his result by using, for the wave function, insufficiently general Fourier expansion.

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[2] Jordan, *Z. Phys.*, **93**, 464 (1935). Iwanenko, D., and Sokolow, A., *Phys. Z. Sovjetunion*, **9**, 692 (1936). The purely statistical-thermodynamical developments of the last article are quite independent of any considerations about the connexion of Bose and Fermi amplitudes.

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A Lead Extrusion Phenomenon

DR. DUNSHEATH has referred[1] to the presence, in polished and etched sections of lead cable sheathing, of radial lines which pass through the crystals. It was held as one possible explanation that segregation of dissolved oxide might be responsible.

The presence of similar, but more pronounced, lines has frequently been observed in etched sections cut through lap welds in lead sheet. The appearance of such lines is shown in the photomicrograph (Fig. 1), and

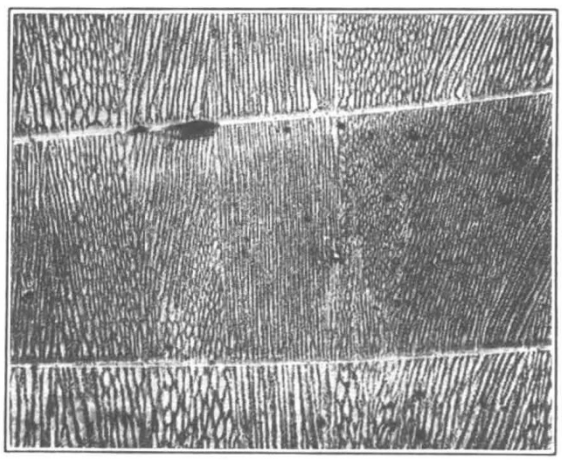

Fig. 1.
× 40 DIAMETERS.

it is deduced from their position and direction that they coincide with the surfaces of successive layers of cast metal with which the weld was built up. As each layer solidifies, a surface skin of oxide is formed; this skin forms the base of the next layer and it is suggested that some oxide is taken into solution during the application of the welding flame each time fresh metal is added. The heat applied is so local and solidification so rapid that any oxide taken into solution would only diffuse to a minor extent.

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