

In addition, subsequent tectonic activity could have destroyed the characteristic spreading pattern.

Alternatively, a case can be made against the idea that the process of seafloor spreading has ever been operative in the Tasman Sea. Historical geological studies of this region¹¹⁻¹³ indicate that from the middle Palaeozoic through the Mesozoic the Lord Howe Rise and Norfolk Ridge were subaerial regions called "Tasmantis"¹⁴. Because a geosynclinal sedimentary environment existed throughout New Zealand and New Caledonia, this land mass has been proposed in order to provide a source of the geosynclinal sediments¹². The idea that the Lord Howe Rise was formerly a positive land area, which has since subsided, would account for its nearly continental crust^{7,8} and apparent lack of Vine-Matthews linear magnetic anomalies. The high heat flow observed by Grim⁹ could have resulted from recent volcanic activity. Seismic profiler data¹⁵ show where outpourings of volcanics have occurred along the Lord Howe Rise. A more detailed survey should be conducted to resolve these two contradictory ideas concerning the source of the anomalous magnetic pattern found in the Tasman Sea.

Members of the Magnetics Division (US Naval Oceanographic Office) helped to gather the data. Dr P. R. Vogt reviewed the manuscript and made several constructive criticisms.

PATRICK T. TAYLOR
JAMES A. BRENNAN

US Naval Oceanographic Office,
Washington DC 203900.

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Cosmology and Quantum Electrodynamics

SEVERAL attempts have been made to develop a quantum theory of the Wheeler-Feynman direct interparticle action electrodynamics. We have developed an approach using an *S*-matrix perturbation expansion. The importance of the approach is two-fold. First, it provides a welcome confirmation of the work of Hoyle and Narlikar¹⁻³; and second, it possesses the following distinct advantages: (i) it uses a formalism which is familiar in the conventional treatment of quantum electrodynamics; (ii) particle wave functions are second quantized; with some effort the theory can be made fully relativistic; (iii) it is completely general; a separation allows the influence of the universe to be taken into account in an overall way, without discussing the specific processes of the system under interest; in this way, the complete equivalence of the conventional and now theories is established for all processes and all orders of the perturbation; (iv) the simplicity and familiarity of many of the expressions provide a ready comparison with the conventional theory. The approach thus provides a foundation on which an axiomatic formu-

lation of direct interparticle action quantum electrodynamics may be constructed that is closely analogous to the conventional theory. In particular, the second quantization of the source particles allows the definition of operators analogous to the photon creation and destruction operators, in a way similar to that used by Klein⁴, and later by Heisenberg^{5,6} in conventional quantum electrodynamics.

The following is a brief outline of the *S*-matrix approach. The conventional perturbation expansion is modified in accordance with a suggestion made by Feynman⁷. The first term in the new expansion is examined. Contributions from all particles in the universe are included without reference to any particular model of the absorbing system (apart from the usual requirement of complete absorption). One immediately recovers a relation familiar from the conventional theory.

$$\langle 0|A_{\mu}(x)A_{\nu}(x')|0\rangle = iD(x-x')\delta_{\mu\nu} \quad (1)$$

—with suitably defined *A*'s. Equation (1) leads straight away to the usual spontaneous transition rate for atoms which has been obtained by Hoyle and Narlikar³ using a similar theory.

A second, more intuitive treatment then reproduces equation (1) using an explicit model of the absorber system. Using this approach, an examination of the second term in the perturbation expansion leads quickly to the important result

$$\langle 0|P[A_{\mu}(x)A_{\nu}(x')]|0\rangle = -iD_{\mathbb{F}}(x-x')\delta_{\mu\nu} \quad (2)$$

P is the Dyson chronological operator.

The recovery of the Feynman propagator *D_F* enables the construction of Feynman graphs incorporating the analogues of internal photon lines. A simple generalization using results (1) and (2) allows the complete formal recovery of the usual *S*-matrix expansion and associated Feynman graphs, to all orders in the expansion. Equation (2) also leads in the usual fashion to the level shift formula for atomic energy levels which has been derived by Hoyle and Narlikar in their treatment³. Full details of this approach will be published shortly.

P. C. W. DAVIES

Department of Physics,
University College London.

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Increased Luminance in the Direction of Reflex Reflexion—a Recently Observed Natural Phenomenon

LABORATORY studies and examination of aerial photographs have indicated that increased luminance in the direction of the reflex reflexion is a widely recurring phenomenon, which should be of interest to workers in several disciplines. The term reflex reflexion is used in accordance with the definition of the International Commission of Illumination: reflexion in which the path of the returning light lies close to the direction of the incident light, whatever the angle of incidence at the reflecting surface.

In 1962, Meacock *et al.*¹ drew attention to the increased luminance of (smoked) magnesium oxide in the direction of reflex reflexion, when incident light is normal to the surface. A repeat of these experiments, in which the