On New Possible Lepton Interactions.

M. B. GAY DUCATI (*), J. LEITE LOPES and J. A. MARTINS SIMOES (**)
Centre de Rechérches Nucleaires, Université Louis Pasteur - Strasbourg

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Experimental data increasingly accumulated (1) on the recently discovered tau-lepton strongly suggests that this particle has the same properties (electromagnetic and weak interactions) as the electron and muon: like them the tauon seems to exist together with a neutrino which has its own lepton number; and its weak decays into electrons and muons are apparently well described by a V—A charged current similar to that for the muon and the electron (2).

The existence of such a heavy lepton with a mass greater than the mass of the baryons of the SU_3 octet and decuplet is a new addition to the well-known puzzle of the reason for such a mass increase when one goes over from electrons to muons. In fact, besides these fermionic leptons, the weak-interaction intermediate heavy bosons are also attributed (3) a still larger mass, despite the fact that they do not supposedly display strong interactions; and they also exist together with a zero-mass particle, the photon, as leptons exist together with their neutrinos.

If the masses of these bosons are mathematically accounted for by the Higgs mechanism in gauge theories, such as the Salam-Weinberg model, the lepton masses require as many coupling constants between the Higgs field and the lepton fields as there are different nonvanishing leptonic masses and this is not an explanation for this mass spectrum.

Quantum field theory attributes at least part of the mass of a particle to the self-energy due to its interaction with other fields. The renormalization procedure, however, adds this (divergent) self-energy to a bare-particle postulated mass. The theory is thus left with no means to explain mass spectra in a way independent of cut-off parameters.

The Higgs mechanism—which expresses a dynamical effect due to degenerate vacuum states—hopefully indicates a new way to understand the bare-particle mass. Clearly, the contribution of the universal interaction of leptons with the weak gauge fields is

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(2) C. BALTAY: *Tokyo Conference* (1978).
(3) J. LEITE LOPES: *Nucl. Phys.*, **8**, 234 (1958); S. WEINBERG: *Phys. Rev. Lett.*, **19**, 1264 (1967); A. SLAM: *Phys. Lett.*, **13**, 168 (1964).

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