VI. THE INCORPORATION OF SCALAR PARTICLES

We shall now consider non-abelian gauge theories which include scalar fields. There are a variety of reasons for considering such theories. One might want to incorporate spin zero fundamental fields as such, or one might want to employ such fields to provide masses for the vector mesons by means of the Higgs mechanism. Indeed the only known way of breaking the gauge symmetry spontaneously is via scalar mesons which develop non-vanishing vacuum expectation values. We have explored whether one can incorporate a sufficient number of scalar mesons to break the gauge symmetry completely, or at least retain only an abelian gauge group. In both these cases one would thereby have a theory which is both asymptotically free and which possesses an S-matrix in perturbation theory (and not just off-shell Green's functions).

It is well known from the proofs of the renormalization of Higgs theories[35] that their ultraviolet behavior is that of the underlying symmetric theory. In other words the symmetry breaking is a "generalized mass term" and does not affect the asymptotic (Euclidean) behavior of the theory. The argument that this so is implicit in the proof of renormalizability of Higgs theories,[35] where one shows that the subtractions which render the symmetric theory finite are sufficient to make the asymmetric theory finite.

Let $\Gamma^{(n)}(p_1,\ldots,p_n;v)$ be any Green's function of the asymmetric theory, where v is the vacuum expectation value of a scalar field which breaks the symmetry. $\Gamma^{(n)}$ may be represented as a functional derivative (n-times), with respect to the fields, of the generating