so that $M_o M_o^{\dagger}$ is multiple of the identity. In that case M_o is, up to a constant, a unitary matrix. There then exists an SU(N) subgroup of gauge transformations; $G = G$, $H = M_o G M_o^{-1}$; that leaves M_o invariant. Such a model will therefore contain $N^2 - 1$ massive and $N^2 - 1$ massless vector mesons.

In a similar fashion the other two asymptotically free models described above contain massless vector mesons even when the scalars have a non-vanishing vacuum expectation value. Basically the problem is that asymptotic freedom requires large gauge groups and small scalar representations. For such representations the potential in lowest order perturbation theory, being restricted to renormalizable couplings, is not sufficiently complicated to allow for complete spontaneous symmetry breaking.

We clearly have not exhausted all gauge groups and all scalar representations. One interesting possibility that we have not fully explored is that the symmetry breaking occurs beyond the tree approximation, ala Coleman and Weinberg.[44] As we noted above a perturbation theory calculation of the potential is unreliable for small values of the classical fields (which corresponds to small momenta). However perturbation theory is reliable, for asymptotically free theories, for large values of the classical fields. Therefore there exists the possibility that the potential has a stable minimum for large vacuum expectation values of the scalar fields and that these are calculable using the renormalization group. This possibility is rendered more likely by the fact that in many models the quartic scalar coupling constants (λ and η) can be negative for $p^2 = -\mu^2$ but become positive as $-p^2$ increases, approaching