Footnotes

FN1) The intrinsic connection of Riemannian spaces with constant curvature

$$D_\mu R_{[AB][CD]} = 0$$

with the motions induced by a Lie transformation group has been demonstrated by E. Cartan [5].

FN2) The unique structure of the scale invariant coupling $Q(\varphi) \cdot R$ (in 4 dimensions) has been noted by F. Gürsey [6] in discussing Mach's principle. It has been used (with an unphysical sign) by C. Callan, S. Coleman and R. Jackiw [7] to construct a conserved energy momentum tensor for scalars, finite under renormalization.

FN3) For simplicity we consider the case where $\mathcal{D}$ is irreducible i.e. cannot be decomposed into a direct product of mutually orthogonal subspaces each one with constant curvature scalar.

FN4) A geometric interpretation of the electromagnetic gauges assuming G = Ul(e.m.) in 5 dimensions is due to Th. Kaluza [8] and O. Klein [9].

FN5) The method sketched here is due to H. Leutwyler, who presented it as part of a series of seminars on gauge theories at the University of Bern (1977). Even though it is believed that the geometric interpretation of vector gauge fields is widely known I feel that his outstanding contribution deserves special mention.

FN6) The fact that the curvature scalar contains the field strength's quadratically (as noted already by Th. Kaluza and O. Klein [8], [9], [10], FN5)) may answer a question raised by R.P. Feynman whether one could understand why the Yang-Mills Lagrangian just contains the quadratic invariant $W^f_{\mu\nu} W^{\mu\nu f}$.