are then finite functions of the renormalized charge g, gauge parameter α, and the renormalization point μ. (When g and α appear without subscripts they will refer to their renormalized values).

The choice of renormalization point, μ, is arbitrary. Any change in μ can be compensated by a corresponding change of the charge, the scale of the fields and the gauge parameter. The renormalization group equations reflect this fact. These equations are most simply derived[37] by noting that the unrenormalized 1PI's $\Gamma_u^{(n)}(\Lambda;g_u)$ (we suppress the momenta and vector index labels of these 1PI's), when expressed as functions of the cutoff, the bare coupling constant g_u and the gauge parameter α_u are independent of μ:

$$\mu\frac{\partial}{\partial\mu}\ \Gamma_u^{(n)}\ (\Lambda,g_u,\alpha_u) = 0 \tag{2.16}$$

Using equation (2.15) and the chain differentiation rule we have:

$$\{\mu\ \frac{\partial}{\partial\mu} + \beta(g,\alpha)\frac{\alpha}{\alpha g} - n\gamma(g,\alpha) + \delta(g,\alpha)\frac{\partial}{\partial\alpha}\}\ \Gamma^{(n)}(g,\alpha,\mu) = 0 \tag{2.17}$$

where:

$$\beta(g,\alpha) = \mu\frac{\partial g}{\partial\mu}\Big|_{g_\mu,\alpha_u,\Lambda\ \text{fixed}}, \tag{2.18}$$

$$\gamma(g,\alpha) = \tfrac{1}{2}\mu\ \frac{\partial\,\ell n Z_3}{\partial\mu}\Big|_{g_\mu,\alpha_u,\Lambda\ \text{fixed}}, \tag{2.19}$$

$$\delta(g,\alpha) = \mu\ \frac{\partial\alpha}{\partial\mu}\Big|_{g_\mu,\alpha_u,\Lambda\ \text{fixed}}. \tag{2.20}$$

The fact that β,γ,δ are finite functions of g and α is an immediate consequence of (2.17) and the fact that $\Gamma^{(n)}$ is finite when expressed in terms of the renormalized parameters.