Salam, Landau and Lee and Yang postulate a combination of vector and axial vector for the lepton current in β-decay: $\mathcal{L}_\beta = \frac{G_\beta}{\sqrt{2}} J^\mu_{had} \bar{e}(x)\gamma_\mu(1-\gamma_5)\nu_e(x)$ This describes the experimental observation that parity is (maximally) violated.

1958:

Goldhaber et al. demonstrate that the neutrino has lefthanded helicity.

Due to the V-A structure of the weak interaction and the masslessness of the neutrinos, only lefthanded neutrinos and righthanded anti-neutrinos ocurr in β decays.

1961:

Danby et al. perform the first accelerator neutrino experiment and find that there are two species of neutrinos $\nu_\mu \neq \nu_e$.

"The theory of the eightfold way"

Gell-Mann and Ne'eman classify all hadrons according to representations of the (flavor-) SU(3) group with the isospin group SU(2) and U(1) of the hypercharge ($Y = B + S$) as subgroups. $I = (Q_{max} - Q_{min})/2, Y = Q_{min} + Q_{max}$ where $Q_{min,max}$ are the minimal and maximal charges in the isospin multiplet. Gell-Mann-Nishijima relation: $Q = Y/2 + I_3$

Hadrons with same total angular momentum, parity (J^P) and baryon number are arranged in SU(3) multiplets:

[1]: I=0,Y=0, [6]: $I_{max} = 1, Y = -4/3, -1/3, 2/3$, [8]: $I_{max} = 1, Y = -1, 0, 1$, [10]: $I_{max} = 3/2, Y = -2, -1, 0, 1$

1962:

Okubo develops a formula for the masses of baryons belonging to one multiplet (Gell-Mann-Okubo mass formula) by using group theoretical arguments:

$$M = a + bY + c[I(I+1) - \frac{1}{4}Y^2]$$

Gell-Mann uses it to predict the mass of the Ω^-, whose existence is predicted by the theory of the "eightfold way".

1963:

Cabibbo introduces a hadronic current, J^μ_{had}, with a structure slightly different from the leptonic current to explain strangeness changing leptonic weak decays (e.g., $K^+ \to \mu^+ \nu_\mu$) and that $G_\beta / G_\mu \approx 0.98$:

$$d \to d' = \cos\theta_c d + \sin\theta_c s; \; J^\mu_{had} = \bar{u}(x)\gamma^\mu(1 - \gamma_5)d'(x)$$

so that $G_\beta / G_\mu = \cos\theta_c \approx 0.98$.

G_β : coupling constant in β-decay, $n \to pe^- \bar{\nu}_e$

G_μ : coupling constant in μ-decay, $\mu^- \to \nu_\mu e^- \bar{\nu}_e$

Universality of the weak interaction:

$G_\beta = G_F \cos\theta_c$ and $G_\mu = G_F$, where G_F is Fermi's constant.