where $\sqrt{2}\, g_{\pi NN}\, \gamma_5$ and $-g_\pi q_\mu$ represent the coupling of the pion to nucleon and the external field (lepton pair) respectively. Thus if we make the assumption that the original $1/q^2$ term is a hypothetical limit $m_\pi \to 0$ of this pion contribution, we obtain by comparing Eqs. (9) and (11)

$$g_{\pi NN}\, g_\pi = 2m_N\, G_1(0)\, G_0\, \cos\theta/\sqrt{2} = 2m_N\, G_A/\sqrt{2} \tag{12}$$

This is the Goldberger-Trieman[8] relation which relates $g_{\pi NN}(g_{\pi\ NN}^{\ 2}/4\pi = 14.6)$, G_A $(= 1.18\times10^{-5}/m_p^{\ 2})$ and g_π, the $\pi - \mu\nu$ decay constant. Originally it was obtained using simple dynamical assumptions and dispersion relations.

Because in actuality $m_\pi \neq 0$, the real axial vector current cannot satisfy $\langle n|\partial_\mu a_\mu|p\rangle = 0$ (unless $G_1(q^2)$ has the form $[q^2/(q^2+m_\pi^{\ 2})]\ G_1'(q^2)$, $G_1'(0) \neq 0$, in which case, however, $G_1(0) = 0$ or $G_A = 0$, in contradiction with β decay. Thus $\partial_\mu a_\mu \simeq 0$ only to the extent that $m_\pi^{\ 2}$ can be ignored compared to other parameters such as q^2 or $m_p^{\ 2}$. In this sense it is known as the partially conserved axial vector current (PCAC) hypothesis. To show this situation more clearly, we use here a formulation due to Gell-Mann and Lévy.[9] Take the isotopic axial vector current $a_\mu^{\ i} = i\bar{q}\gamma_\mu\gamma_5\tau^i q$. Its divergence $\partial_\mu a_\mu^{\ i}$ has the same quantum numbers as the pion field ϕ^i. This is true at least if there are no hidden quantum numbers that can distinguish them. Then we can use $\partial_\mu a_\mu^{\ i}$ as the <u>definition</u> of pion field after proper normalization

$$\partial_\mu a_\mu^{\ i}(x) = C\phi^i(x) \tag{13}$$