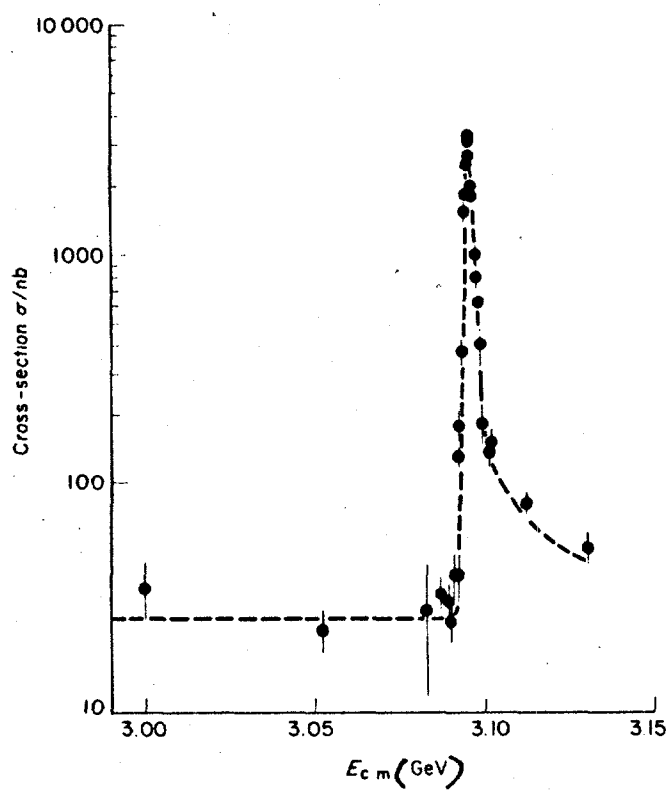

Fig. 17. Cross-section σ for the annihilation of high energy electrons and positrons resulting in the formation of hadrons, plotted as a function of the collision energy $E_{c.m.}$ of the electrons and positrons, as observed by Richter and collaborators at the SPEAR storage ring at SLAC.

selection rule has to be based on the existence of a new 'quantum number' or characteristic property of the particle involved. In short, the November Revolution signalled the discovery of a new kind of fundamental object in Nature.

Whenever a label or quantum number changes in some way, then, depending on the dynamics in question, the rates of processes can be inhibited; if nothing changes, then only the available disintegration energy and the masses of the particles involved determine how fast reactions will 'go'. Starting from this hypothesis, consensus developed rapidly that the new peaks at 3·1 GeV observed at Brookhaven and SLAC must be states of a new kind of quarkonium, that is, objects composed of a new quark and its antiquark. The quark involved is a new example of that species, beyond the three quarks originally postulated by Zweig and Gell-Mann in 1964 to account for the multiplicity of particles then known†. The existence of a fourth quark, dubbed the 'charmed' quark, had been suspected before, but these new discoveries not only confirmed its existence but at the same time, as discussed above, provided a new laboratory in which the interaction between these new quarks could be investigated.

† A discussion of the quark model can be found in the article by F. E. Close in *Contemporary Physics*, 1979, **20**, 293.