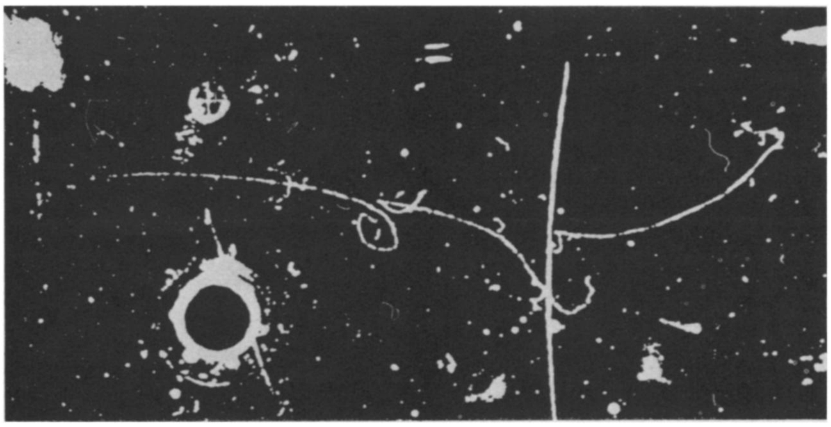
Two steps toward a unified field theory



CERN Courier

Track of electron struck by antineutrino begins above big circle at left.

An old dream of physicists is to devise a unified field theory, a theory that would encompass all four of the known physical forces or interactions into one framework. It would provide a single mathematical expression from which all the phenomena of gravitation, electromagnetism, and the strong and weak forces of the subatomic world could be derived. It is thus a kind of modern-day philosopher's stone.

A union of two of the forces would be a start on the way to a totally unified theory. Albert Einstein spent years of effort in the latter part of his life on an unsuccessful attempt to unify gravitation and electromagnetism. In recent years it has seemed more advantageous to start with the electromagnetic and the weak interactions. Mathematical and physical similarities between these two kinds of fields indicate that a relation may more easily be found than in some other cases. Among physicists working on such theories, Steven Weinberg of Massachusetts Institute of Technology and Abdus Salam of the International Center for Theoretical Physics in Trieste are prominent. Two recent experimental events lend support to the quest. One provides direct evidence in favor of unifying theories; the other *can* be taken in favor of them.

The first event, from the CERN laboratory in Geneva, is causing great excitement among particle physicists. It comes from neutrino experiments done in the laboratory's large bubble chamber called Gargamelle. The evidence is found in one out of 800,000 photos analyzed, and it consists of the track of an electron that begins abruptly in the middle of the plate. The track is interpreted as the result of an interaction between an electron and an antineutrino of the muon variety (which would be invisible in the bubble chamber).

Such an interaction is prohibited by the older theory of the weak interaction, which holds that particles can interact weakly only if they exchange a unit of electric charge. Thus for instance, an interaction such as neutrino plus neutron yields proton and electron is allowed since here the neutrino and neutron exchange a unit of negative charge so that the neutron becomes a proton (with a positive charge of 1) and the neutrino becomes an electron. In the interaction observed at CERN (antineutrino plus electron yields antineutrino plus electron), no exchange of charge occurs. Such interactions, forbidden by the old theory, are required by the unifying theories such as Weinberg's. Thus the observation may be taken as evidence in support of them.

But one event does not make a certainty. More have to be found. Physicists at CERN, at the National Accelerator Laboratory in Batavia, Ill., and most likely at other places where neutrino experiments are in progress are sorting through their records to see if they can find other instances of weak interactions taking place without charge exchange.

The other recent experimental event involves the possible detection of evidence for the existence of the intermediate vector boson. The intermediate vector boson is the particle that theory requires as the carrier of the weak interaction. It would carry the effect of the weak interaction from one particle to another, and so would be exchanged between particles whenever a weak interaction took place. The old theory called for two bosons, one negatively charged and one positively (so as to be able to transfer the charge between parties to the interaction). The new theories call also for a neutral one to provide for the interactions without charge exchange. Weinberg's theory predicts the mass of the boson to be around 38 billion electron-volts—about 40 times the mass of the proton.

Evidence for a particle of this mass is found in a kink in the cosmic-ray spectrum found by a group from Leeds University in England, Walter Kellermann, Gordon Brooke and John Baruch. The kink appears in spectra taken near sea level at Haverah Park, England, but not in spectra taken from mountain tops or satellites. Thus it has to be due to something that happens when cosmic rays strike the atomic nuclei in the atmosphere. The Leeds group thinks this is the production of a new particle that might be the intermediate vector boson.

The Leeds group propose calling their particle the mandela after Nelson and Winnie Mandela, black activists in prison in South Africa. It is not the first time that a scientific name has been chosen for political reasons, but if the name sticks, it would be the first particle to bear a personal name.

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and Libya's oil minister frankly admitted his country's recent take-over of all foreign oil companies was "a move toward implementing the principle of using oil as a political weapon."

President Nixon responded that "radical elements" in Arab oil producing states would "lose their market" if expropriation continues, but critics pointed out that the United States, acting alone, is in no position to stage a boycott and that such off-the-cuff threats could only make matters worse.

Repercussions of the Administration's latest gambits can be expected soon. Sen. Edmund Muskie (D-Me.) has already called upon Love to justify before a Senate subcommittee lowering the clean air standards and the lack of mandatory fuel allocations. On a larger scale, full hearings on revision of the Clean Air Act will begin soon, and SCIENCE NEWS has learned that already a concerted drive is developing to ease air quality standards and restrict the act's provisions to major urban areas.

As Train observed earlier, the public is beginning to feel the pinch of the Clean Air Act, but not yet able to see the results. Environmentalism thus probably faces a very tough fight in the months ahead. □