plitudes for short-period nutations. S. Keith Runcorn (U. of Newcastle) attempted to relate continental drift and variations in speed of the earth's rotation.

During a lively discussion of satellites and their possible contributions to problems of measurement of intercontinental distances, Carroll O. Alley (Maryland) and Peter Bender (Colorado) proposed an experiment with a corner reflector on the moon. A laser pulse reflected back to earth and timed would give 15-cm accuracy in intercontinental distance compared with about 10-meter accuracy in other satellite methods that were described. Classical methods with modern instruments give 1-meter accuracy in a year.

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The scientific program at Stresa was organized by William Markowitz. Local arrangements were ably carried out by F. Zagar of the Observatory of Brera, Milan.

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Schladming School Examines Special High-Energy Problems

Theoretical physics in general, high-energy physics in particular are characterized by ever increasing specialization and growing predominance in abstraction. To some extent both of these tendencies are inevitable as physics progresses toward more and more details in a microcosmos of smaller and smaller dimensions, but perhaps this is carried too far today. The theory of elementary particles is presently in its infancy or certainly no further than the kindergarten stage. No great unifying ideas have shown up in the theory of elementary particles comparable to Einstein's 1905 photon paper, his 1917 derivation of Planck's law, Bohr's 1913 papers on atomic structure, Kramers's and Heisenberg's 1925 dispersion paper and the quantum-mechanics papers of De Broglie, Schrödinger, Heisenberg, Born, Jordan, Dirac and Wigner. We are, we hope, in a stage similar to that of quantum theory before the advent of quantum mechanics.

In this situation I think that schools of theoretical physics, winter or summer, have perhaps even greater significance than symposia. As the well known Les Houches Summer School is the brainchild of Cécile DeWitt, the Schladming Winter School of Theoretical Physics held each year since 1962 is the brainchild of Paul Urban, director of the Institute of Theoretical Physics at the University of Graz, Austria.

But although topics at Les Houches change from year to year, topics at the Schladming school are always in elementary-particle physics. The last three schools were concerned with Weak Interactions and Higher Symmetries, Quantum Electrodynamics, and Elementary Particle Theory, respectively. The proceedings have been published in Acta Physica Austriaca (of which Urban is editor) as Supplements I, II, and III, the latter also as a hard-cover book.[1] This year's school was on Special Problems in High-Energy Physics. Approximately 170 physicists attended.

Directions for young people. There is a tendency to invite people to symposia who are at least somewhat established although, as the past has shown, new ideas most often come from young people perhaps not yet established. Furthermore, since everything is in a flux, there are various directions toward which the "established" people guide their doctoral students. Thus postdoctoral people (and predoctoral as well) who come to such schools naturally are specialized, and it is important that they be exposed to a spectrum of directions and also come into contact with a spectrum of people from various institutions.

Two general directions in the theory of elementary particles are field theory and its offspring, S-matrix theory. The first tries to extend the field theory of quantum electrodynamics to weak and strong interactions. The second is perhaps more restrictive in emphasizing the S-matrix as the main observable object.

Field theory. At Schladming an example of the first direction was Gunnar Källén's (Lund) talk on "An Attempt to Calculate Radiative Corrections to a Pure Fermi Decay".[2] He gave a general survey of his calculations of the radiative corrections to beta decay, emphasizing the influence of nucleon structure in general and nucleon form factors in particular. The first calculations of such corrections assumed a simple point-particle model, for example, Dirac particles without structure and without anomalous magnetic moment. They lead to a logarithmically divergent result, necessitating an arbitrary cutoff. The main conclusion of the paper is that the appearance of the logarithmic divergence can be eliminated if strong interaction effects are taken "properly" into account.

An example of an intermediate approach between field theory and S-matrix theory was the lecture series of Fritz Rohrlich (Syracuse) on "Asymptotic Quantum Field Theory."[3] This theory differs from the better known axiomatic quantum field theory in approach but not in content. Both theories aim toward a more satisfactory formulation of quantum electrodynamics avoiding renormalization. Asymptotic theory supposedly permits a wider use of physical intuition in contrast to mathematical rigor, which characterizes the axiomatic approach. Until now, however, the results of quantum electrodynamics could be reproduced only by using perturbation theory but with the claim that the calculations did not involve divergent integrals or renormalization.

S-matrix theory. John C. Polkinghorne's (Cambridge U.) lectures on "S-Matrix Singularity Structure"[4] were more mathematical. The principal properties of an S-matrix are unitarity, Lorentz invariance, connectedness structure, analyticity and crossing symmetry. The purpose was to make as precise as possible the meaning of the "somewhat oracular requirement," that the singularities are the "minimum permitted by analyticity." One can show, that "all physical-region singularities occur only on the positive alpha arcs of Landau curves, and their discontinuities are given by Cutkosky integrals. The problem of singularities outside the physical region still remains."

"Superconvergence and Current Algebras" was the topic of the lectures by V. de Alfaro (Torino). The PCAC hypothesis (pion-pole dominance of axial-current divergence), coupled

with current algebra, has been a remarkably fertile source of important physical results. Every high-energy physicist knows the Adler-Weisberger sum rule giving the correct ratio of the axial-vector and vector coupling constants of beta decay. If a sum rule can be continued to appropriate timelike values of q_1^2 and q_2^2 (in the usual notation), a new kind of sum rule emerges, the "superconvergent" sum rule.

J. J. J. Kokkedee's lectures on "High Energy Scattering of Hadrons" discussed elastic scattering for incident-particle laboratory momentum less than 4 GeV/c in the region of small momentum transfer (forward diffraction peak). Experimental data are available for proton-proton, proton-neutron, antiproton-proton, antiproton-neutron, (positive and negative) kaon-proton and (positive and negative) kaon-neutron reactions. The quark model[5] and the combination of Regge-pole model and current algebra[6] have been quite successful in predicting relations between the various meson-baryon and baryon-baryon cross sections.

Paolo Budini (Trieste) discussed "Algebraic Formulation of Dynamic Problems." This budding procedure uses the "noninvariance" or "dynamic" groups that allow mass splittings from the beginning. Besides nonunitary representations of finite order, recently unitary representations of infinite order have been introduced by several authors. These latter representations were introduced very early (1932!) by Majorana.

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Florida Conferees Discuss Nucleon-Nucleon Interaction

Elastic and inelastic scattering, especially with polarized targets and polarized beams, and related matters like charge symmetry currently occupy the attention of nucleon-nucleon experimentalists. Meanwhile the theorists are looking at elastic-scattering phase shifts, soft-core potentials and various theoretical models. Subjects of this kind came under attack last March at the University of Florida when 93 physicists, 26 of them from foreign countries, met in a conference on nucleon-nucleon interactions.

Experimental. Yuri Kazarinov described recent Dubna measurements of proton-proton and neutron-proton scattering in the 600–650-MeV range. Thanks largely to a long series of proton-proton measurements at Dubna, the scattering matrix for isotopic spin $I = 1$ at 650 MeV is now known with some reliability. Data for the neutron-proton system at this energy are still woefully incomplete, but recent Dubna experiments have included some neutron-proton triple-scattering measurements.

In one of three papers from France A. Michaelowitz (Orsay) described measurements of σ, P and D at 150 MeV and polarization and correlation measurements at 600 MeV. Y. Ducros described P and C_{NN} measurements on polarized targets with the proton synchrotron Saturne at 0.5 and 1.2 GeV. (σ is cross section; P is polarization; D is depolarization and C is spin correlation.)

Philippe Catillon described his 10–25-MeV correlation measurements at Saclay with a polarized target and a polarized cyclotron beam. A new high-current polarized-ion source for the cyclotron will soon be in operation at Saclay.

The conference heard of some other proton-proton work. N. Hoshizaki (Kyoto) reported a new measurement of the 50-MeV differential cross section, and A. Beretvas (Chicago) described recent C_{NN} measurements from 305 to 415 MeV. David Cheng discussed past and future measurements on the Berkeley 184-inch (465-cm) cyclotron. Future Berkeley work will include polarized-target measurements and "conventional" triple-scattering measurements with a polarized beam and an unpolarized target.

The Harwell synchrocyclotron is still actively used for proton-proton and neutron-proton measurements below 150 MeV. C. Whitehead described accurate proton-proton measurements of σ, P and D at 98 MeV and new total neutron-proton cross section measurements below 5 MeV.

Elastic scattering. Five speakers presented phase-shift analyses of nucleon-nucleon elastic scattering data: John K. Perring (Harwell), proton-proton at 50 MeV and both proton-proton and neutron-proton at 25 and 140 MeV; Hoshizaki, proton-proton at 50 MeV; Kazarinov, 9.7, 14.5 and 18.2 MeV; Malcolm MacGregor (Livermore), a recent energy-dependent reanalysis of proton-proton data from 10 to 400 MeV; Gregory Breit (Yale), energy-dependent proton-proton and neutron-proton analyses.

Summarizing these papers one can say that the $I = 1$ phase shifts from 10 to 400 MeV are now well known, and all groups get essentially the same result; $I = 0$ phase shifts are only qualitatively known, and neutron-proton data are barely sufficient to permit a combined proton-proton and neutron-proton phase-shift analysis under assumption of charge independence. The pion-nucleon coupling constant from energy-dependent analyses at Yale and Livermore agrees within the 5% experimental error with the value from pion-nucleon scattering.

One paper from Dubna and two from Florida (by G. Darewych and S. Dutta) discussed nucleon-nucleon-scattering representation with a potential. The innovation is to use a soft core, which appears to give a good fit to nucleon-nucleon elastic scattering and has advantages in going off the