THE NORTHWEST CONFERENCE ON COLLEGE PHYSICS

A summary by ***Ronald Geballe***

MORE than 120 college and university physics instructors met at the University of Washington in Seattle on May 5 and 6, 1961, for a discussion of problems in undergraduate physics teaching. They represented 50 institutions in the states of Alaska, Idaho, Montana, Oregon, and Washington and the province of British Columbia, including virtually all of those which offer college-level physics courses. This conference, sponsored jointly by the National Science Foundation and the University of Washington, was the first of its kind held in the Northwest. From the enthusiasm of the participants it may be judged to have served a strong and recurrent need.

The Conference also served as an occasion for the biennial joint meeting of the Oregon and Washington sections of the American Association of Physics Teachers. Their business sessions were conducted Saturday morning. Questionnaires filled out by individual participants and by representatives of the institutions gave a first picture of the scope and nature of college teaching in this part of the country.

The program was planned by a committee representing junior colleges, liberal-arts colleges and universities. It was intended to raise questions and promote discussion at several levels ranging from the specific course to the broadest role of science. It called for some speakers who were willing to advance views on topics outside the fields with which they normally are identified and thus to occupy exposed positions. We were fortunate to find, for example, a chemist who told an audience of physicists his views on teaching physics to nonscientists, an experimentalist who questions the values of instructional laboratories, a product of large universities who prescribed for the small colleges. For some of the broadest vistas we enjoyed the authoritative remarks of the chairman of the Commission on College Physics and the perspective of another physicist widely respected for his studies and writings on the history and meaning of science. The latter address, of considerable current interest to a popular audience, was given in the evening and attracted a gathering several times the size of the conference. To emphasize the subject matter of physics, the conference ended with a talk on the structure of the atomic nucleus as related to the known properties of the nucleons.

Some of the talks are summarized in the following paragraphs:

Davis pointed out the scarcity and ambiguity of existing information on the effects of PSSC as exhibited by the college performance of its graduates. He cited evidence that what little benefit is demonstrable seems to stem primarily from the laboratory, and he emphasized that the role of the teacher is no less critical than in any other curriculum. In the discussion

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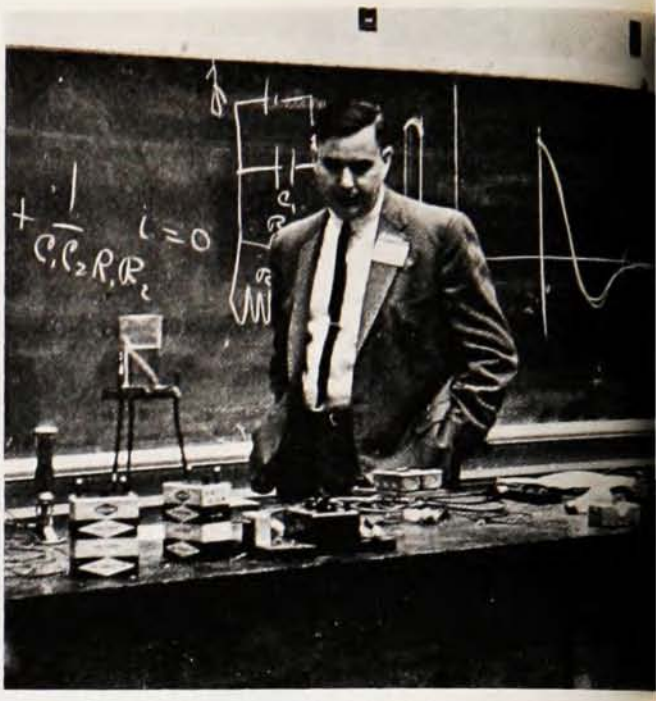
The conference in session at the University of Washington in Seattle. A summary of the program appears on page 32.

following the talk it was discovered that no more than a third of the college teachers present had read any of the PSSC texts and less than a quarter had seen PSSC in action. These data illustrate his contention that PSSC thus far has had little impact on college physics.

Maybury, stressing the need to understand the nature of the differences between science and nonscience students, referred to Whitehead's analysis of learning into a "romance" period followed by a "discipline" period. Most science majors have passed through the first of these, as relating to science, before they come to college; the nonscience group generally have an interest focused on man, his problems, and his nature which can be exploited by the teacher. While teaching some of the important basic physical phenomena, one should recognize that abstractions of physics not only are difficult for nonscience students to grasp (as they are for science majors also), but, because they are the products of individual genius, they provide a means for bringing students into contact with the human aspects of physics. Analogy is helpful; there are other systems, such as religion and art, which make use of it and have, therefore, a certain parallelism with scientific theory which can be used in striving for contact with nonscience students. Laboratory experience should be provided in a course for nonscientists; there is a need for extremely simple experiments which minimize the need for technique and furnish data out of which a student can fashion, through his own thought, abstract concepts.

The audience spent a rapt and rapid hour watching and listening to Jensen, who put a dense array of homemade, low-cost apparatus on display. He demonstrated about two dozen experiments, many of which were built of those ubiquitous products of our culture, tin cans and plastics. Among the most vivid were a "give away" double slit made from masking tape

H. C. Jensen and his "do-it-yourself" oscilloscope.



D. Burch: Is the general physics lab worth the effort?

stretched on glass; a plastic vacuum discharge tube, a small mercury battery embedded in plastic as an inexpensive standard cell, a copper-sulfate solution analogy of a cyclotron, a plastic ring dissectible into segments which as rocking pendula have interesting and amusing properties, a string in tension energized with a discarded electric razor, an ac motor using a 35-mm film can as armature, and a bread-board oscilloscope which Jensen assembled while lecturing.

The debate on the value of laboratories featured erstwhile office mates who agreed on little more than to limit the scope of their argument to the introductory college physics laboratory as commonly taught. Reversing the conventional order of debate, Burch took the offensive by criticizing each of the commonly agreed objectives that came from the Storrs Conference in 1957. The objective "contact with phenomena" means contact with either common or uncommon phenomena; the former provides no new and stimulating contact, the latter either reduces to contact with complex equipment or requires careful supervision and stylized experiments. Laboratory experiments cannot be realistic demonstrations of "a process of inquiry leading to theory". In the first place, good inductive generalizations cannot be drawn from a three-hour laboratory experience; it is dangerous to encourage students to think they can. Moreover, true additions to our knowledge of physics are not products of inductive thought, rather they are creative acts of people with certain talents. Laboratories fail to reinforce principles because students never commence an experiment with the notion that the book and the lecturer might be wrong. Finally, the phrase "physicist for a day" is meaningless. Plotting a graph of attitude as a function of time, Burch showed that the course of life for an experimental physicist bears no similarity to that of an elementary physics student. Altogether, limitations of space, time, money, and the employment of graduate assistants preclude realization of high aims for most laboratories.

Nicodemus sought to discover why the topic should be debatable, since physics depends so intimately on laboratory investigation. The administrative effort required, always considerable in the past, is becoming a continually greater strain as enrollments rise. It has become a real effort to devise and make room for new experiments growing out of new discoveries. Many feel that effort is better spent in the more advanced levels. Lecture demonstrations provide an alternative with many advantages. None of these is a worthy counter to the adjuration of Dr. M. Santur of Turkey as quoted in *International Education in Physics*, namely, that "If physics as a way of thinking is to take its rightful place along with other humanities, preferably at the forefront, and if it is to influence the attitude of mind of large masses, a great effort has to be made. The laboratory as the temple of the cult must play a crucial role" (p. 66). Admitting the differences between elementary and research laboratories, one still can cite specific cases of elementary students who have discovered things for themselves; it is well known that even more of them have exploited the opportunity to make mistakes for themselves. Simple theory may tell a student that a one-centimeter

R. W. Williams explains a demonstration spark chamber.

G. Pake: Can four-year colleges prepare physics majors?

prism should resolve the sodium doublet, but when he tries it he may learn that a two-centimeter prism is needed and that things grow worse as the arc grows hotter. These "experiences with phenomena" can be effective. Insofar as "reinforcing the principles" is concerned, it seems necessary for some students to read, hear, and see a phenomenon before assimilating it. Nicodemus cited the formulation of laboratory objectives at MIT as reported by Brown (Am. J. Phys., 1957) which emphasized the importance of showing connections between textbook material and basic experiments, and of encouraging a feeling for order of magnitude, for the significance of variables of differing pertinence, for understanding and minimizing extraneous effects, understanding the approximate nature of experiment, and appreciating the limited validity of mathematical solutions to problems. To meet these would require major overhaul, including the elimination of busy work and perhaps of some traditional experiments altogether. An effort in this direction would stimulate the interest and enthusiasm of the teaching staff.

Marcley's contribution was a compendium of very specific suggestions to those engaged in apparatus development. He gave sources of ideas for apparatus, outlined essential machine and hand tools (including comments on quality), and listed sources of information about experimental techniques and ways of learning about materials for construction. Teachers were alerted to watch for ideas and information arising from the new National Science Foundation Program for Improvement of Equipment. One trusts that his suggestions will be made available in a more complete and widely distributed form. In the meantime, his lists have been given to conference participants.

Pake's concern over some newly perceptible differences between the graduate performance of students from four-year liberal-arts colleges and that of students from undergraduate colleges of universities provoked intense discussion. Since his talk already has appeared in print (Am. J. Phys., Oct., 1961), only a brief mention of his main points will be given. As evidence for apprehension, he cited the awards of NSF predoctoral fellowships to first-year graduate students from liberal-arts colleges (9% of the total in the period 1954–59) in comparison with the enrollment in these colleges (40% of the total) and the increasing difficulty he has observed with which graduates of four-year colleges gain admission to graduate schools and with which they progress through graduate study. Data from MIT substantiate the latter observation; during the period 1930–50 the first-year grade averages of students were nearly independent of the college of origin, but from 1950–54 students originating in universities scored on the average one whole grade above those from colleges. Assuming that the quality of admitted students has been constant, he suggested five other reasons, which include high teaching loads for overworked staff, staff vacancies which cannot be filled, shortages of funds and therefore of equipment, the lack of research activity and finally, a "critical size effect" which is a consequence of specialization and which causes grave difficulties for a small faculty attempting a research program. Arguing that four-year

colleges offer the most favorable environment for bridging the cultural gap between scientist and non-scientist, he held that helping colleges to acquire strong physics faculties thus would serve two important ends. His specific suggestion was the recognition of a new principle guiding the award of research grants by the National Science Foundation: the separation of proposals originating in four-year colleges from those submitted by universities and the assurance of funds allocated specifically for research in the former kind of institution. At the same time he recommended that the faculties of four-year colleges ameliorate the critical-size effect by using such a new system of grants to establish research programs in limited areas, to promote growth in staff size and to initiate master's-degree programs. He concluded by expressing no easy optimism about the outcome, only a conviction that such a program would give the colleges a fighting chance.

B. A. Jacobsohn lectures on the structure of the nucleus.

The Planning Committee, whose members were R. B. Bennett (Whitman College), J. S. Blair (University of Washington), A. B. Butler (Washington State University), K. C. Clark (University of Washington), B. C. Mills (Centralia College), F. L. Scarf (University of Washington), Larry Schecter (Oregon State University), and the author of this report, express their sincere gratitude to the speakers, to the Office of Short Courses and Conferences of the University of Washington, to Dean J. L. McCarthy of the Graduate School of the University of Washington, and to the National Science Foundation.

Program, Northwest Conference on College Physics
University of Washington
May 5 and 6, 1961

Friday Morning

"The Goals of Physics Teaching." Kenneth C. Clark, University of Washington

"Post-PSSC College Physics." Kenneth E. Davis, Reed College

"Can Real Physics Be Taught to Liberal Arts Students?" Robert Maybury, University of Redlands

Friday Luncheon

"A Mathematician Looks at Physics." Carl B. Allendoerfer, University of Washington

Friday Afternoon

"Equipping Small Colleges: How to Live Beyond Your Means." Harald C. Jensen, Lake Forest College

Debate: "Are Labs Worth the Effort?"
No: David S. Burch, Oregon State University
Yes: David B. Nicodemus, Oregon State University

Friday Evening

Public Lecture: "Can Our Culture Survive the Rise of Science?" Gerald B. Holton, Harvard University

Discussion: "Honors Programs." Larry Schecter, Oregon State University

Saturday Morning

"Resources for Apparatus Development." Robert Marcley, American Institute of Physics

Display of Selected Lecture Demonstrations. Ray W. Kenworthy, University of Washington

Business Meetings of AAPT Sections
Oregon Section: Larry Schecter, Oregon State University
Washington Section: L. A. Sanderman, University of Washington

"Can Four Year Colleges Prepare Physics Majors?" George Pake, Stanford University

Saturday Luncheon

"Role of the Commission on College Physics." Walter C. Michels, Bryn Mawr College

Saturday Afternoon

Panel Discussion: "Problems of Physics Teaching in Small Colleges"
Chairman: Boyd C. Mills, Centralia College
Speakers: Robert B. Bennett, Whitman College
Harvey Van Arkel, Everett Jr. College
John S. Blair, University of Washington

"Recent Advances in Physics." Boris A. Jacobsohn, University of Washington

Final Remarks: Ronald Geballe, University of Washington