Appendix A

Early History of Research in Physics Education Programs

By the late 1960s, it was evident to physicists concerned about education that research was needed on how students learn physics and on how to teach physics most effectively. An article and a Letter to the Editor that were published in the American Journal of Physics in the 1970's encouraged the physics community to think about student reasoning in addition to physics content. [See McKinnon and Renner (1971), "Are Colleges Concerned with Intellectual Development?" *Am. J. Phys.* **39**, 1047-1052, and Arons and Karplus (1976), "Implications of accumulating data on levels of intellectual development." *Am. J. Phys.* **44**, 396,.]

A Ph.D. program for graduate students with a strong background in physics (or in another science or mathematics) was developed at the University of California, Berkeley, through the efforts of Robert Karplus, Alan Portis and Frederick Reif, who were in the Physics Department. The program, which was established as an interdisciplinary Graduate Group in Science and Mathematics Education, became known as SESAME. Students with the equivalent of a Master's degree in physics could earn a Ph.D. through the SESAME program, which had different requirements from the Physics Department. Karplus, Portis, and Reif supervised several dissertations. Since then, the advisors of graduate students in the SESAME program have been faculty in the College of Education.

In the 1970's, Arnold Arons supervised the dissertation of a student who received a D.A. in physics at the University of Washington. This program, which did not have the same requirements as a Ph.D., lasted only a short time. In 1979, the Physics Department at the University of Washington awarded the first Ph.D. in physics for research in physics education to a student supervised by Lillian C. McDermott, director of the Physics Education Group. By the end of 1998, ten students in the group had earned a Ph.D. in physics under her supervision.

By the middle of the 1980s, other Ph.D. programs focusing on research in physics education had begun to produce a few graduates, sometimes with a Ph.D. in a physics department and sometimes with another Ph.D. label. There are today about a dozen such Ph.D. programs in the USA. We have compiled a list that we hope is reasonably complete (see page 161).