improved stability. In ecology, the system is unknown. We know something of the overall performance, and of some of the components, but we do not know all the parts, or how they are put together. Thus, at least in the early stages, simulation will be used to test whether hypothetical systems produce known outputs. In this way we can guide the analysis of real ecosystems. Eventually, of course, the management of known ecosystems becomes a conventional problem in systems analysis, although an unusually large number of links in the system may not be open to modification.

We estimate the total cost of learning to understand one large ecosystem to be several million dollars. A number of different systems in different environments must be worked out before the subject of ecosystem analysis can be generalized. The efforts of the I.B.P. offer the best hope that such a program can be completed in the next decade.

A final contribution I wish to discuss is an effect of the I.B.P. on ecologists, rather than on ecology. There is, even now, a worldwide shortage of ecologists with modern training. The I.B.P. adds to this problem, since the full implementation of all of its projects requires a doubling of the world's population of ecologists. Training is a prominent and necessary feature of the I.B.P. Interest in ecology has been increasing steadily among graduate students in biology, and the opportunities offered by the I.B.P. will hasten this growth.

Parenthetically, an even more serious shortage in the I.B.P. is the lack of taxonomists in the world. All of the ecological work, from the physiological to the systems level, requires a knowledge of the species present. No more than a tenth of the species in existence have been identified, and in no natural system have all of the species been named. Here, also, the I.B.P. includes an urgent training program.

The participation of many ecologists in the I.B.P., and the training of increasing numbers of new ecologists within the I.B.P., will have a profound effect upon the orientation of the profession. The goals of the program are human-oriented, and will promote the acceptance of man as a part of ecology. Ecologists have, in the past, tended to exclude man, and to concentrate on the study of natural or undisturbed systems. There whole concern tends to be for the welfare of such systems. Their recommendations, when problems arise, tend to favor the preservation of nature, or to favor management programs that optimize only the biological side of the problem. It is not surprising that man, in self-interest, has often chosen instead the recommendations of the economist or engineer, who is trained to optimize the human side of the problem.

Now that man has a serious concern for the environment, the ecologist may show a greater concern for man. This change of orientation has already begun, perhaps in response to congressional interest in ecology. Within the last year the sudden support of the I.B.P. by a large number of ecologists, after a strong initial resistance, has been surprising. The ferment that took place at Williamstown last October had all the excitement of a "happening". Interest in the applications of ecology, and in man as a part of ecology, is very strong among our graduate students. Many of them are motivated by a sense of responsibility for social action.

This change of view produces new optimism that the goals of the I.B.P. can be reached. Large numbers of American ecologists are willing to participate. There is even hope that we can be induced to accept such radical concepts as team research and data sharing. If this is accomplished, the eventual effect of the I.B.P. will be to establish an integrated profession, based on regional centers of study, dedicated both to the development of basic science and to its application to human welfare.

Mr. DADDARIO. If there is nothing further, this meeting will adjourn subject to the call of the Chair. Thank you all.

(Whereupon, at 12:05 p.m., the subcommittee was adjourned subject to the call of the Chair.)