

Mr. BROWN. Yes; as well as the hardware results which might develop.

Dr. MACARTHUR. That is very true. Hardware innovations that come out of basic research usually come 5 to 10 years later so you have got to wait for a period of time to see what the result of that work is. At the time the work is done, you just have to go on the quality of the work, and its relevance, in general, to DOD's needs.

Mr. BROWN. So you consider this factor when you are making your continuing evaluation process? It seems to me it would be rather difficult to look at a man engaged in some fundamental research at the end of a year and say, well, you have not produced any results. Basic research does not conform to that kind of a pattern.

Dr. MACARTHUR. That is right.

On the other hand, any lab director who comes in and says I spent all my discretionary funds on basic research and don't expect any answer for 7 or 8 years; we would not look very kindly on that.

Mr. DADDARIO. Mr. Mosher.

Mr. MOSHER. No questions.

Mr. DADDARIO. We have a series of questions which I will ask you to answer for the record, if I may.

Dr. MACARTHUR. I will be very happy to, sir.

Mr. DADDARIO. We would like to hear our next witness. We already have extended the time beyond which we had intended, but we appreciate your testimony and the comments of Mr. Glass. We will be in touch with you so we can fill out these questions for the record.

Dr. MACARTHUR. We will be very happy to. Thank you.

QUESTIONS SUBMITTED TO DR. DONALD M. MACARTHUR BY THE SUBCOMMITTEE ON SCIENCE, RESEARCH AND DEVELOPMENT

Question 1. In your testimony you indicate that one reason why industry has not become more involved with national problems such as crime or pollution is that government agencies have not defined the problems precisely enough. What do you propose to remedy this problem? How would you define problems with a large social factor involved so that industry could participate?

Answer. All mission-oriented agencies should have a supporting R&D program to improve their capability, to perform their missions more effectively and to define their specific needs. There is a general *misconception* that supply and demand, and the profit motive, will *always* lead industry to orient their efforts toward developments that will improve the agencies' operational capability. There are too many important situations where this type of motivation just did not produce the desired results. In fact, legislative or executive action (or the anticipation thereof) by state and federal governments in areas such as pollution and health compelled industry to take the required action.

If industry is to be expected to invest its own resources, the specific technical goals to achieve the broad needs of governmental agencies have to be clearly delineated. These technical goals should include criteria and specifications for the developed products that will meet the agencies' needs. In the absence of specific technical goals and performance specifications, there is less incentive for industry to invest their own resources because of the high risks involved. Industry might, for example, be faced with a situation where they have invested substantial R&D funds to develop a product they think an agency needs, but if the agency has not defined its technical needs, product-development is clearly a high-risk venture. Government agencies do not need to guarantee production except in unique situations. In fact, such guarantees might inhibit long-range innovation and short-range competition. But the government must provide both direction and incentive for private participation.

Clearly, the next question is how to define the technical goals applicable to the complex social problems facing the country today. A "systems approach" can help to define our "operational" needs and the technologies to meet those needs. DoD and NASA have successfully developed systems techniques over the years