RESEARCH AND DEVELOPMENT IN FARM RELATED FIRMS - ITS IMPACT ON AGRICULTURE

by T. J. Army* and M. E. Smith**

One of the nation's leading magazines on business and industry, Fortune, recently carried an article entitled "Harnessing the R and D Monster." Although the article was not directed specifically to research or development programs in farm related firms or agribusiness, it does indicate that commercial R and D is being closely watched, scrutinized, and questioned by top management. What comes out of this reappraisal of research in industry is certain to directly affect all aspects of agribusiness including farm firms.

Industry has become a major force in agricultural research in the last few decades. Recent estimates indicate that industry spends about $400 million annually for agricultural research. The federal and state governments, in comparison, spend together about $326 million annually.

According to the Fortune article evidence of management's concern or dissatisfaction with R and D is widespread. A number of companies are reducing as well as reorganizing R and D staffs. Symposia are also being held to find new and better ways to manage research. One of the nation's leading industrialists, former Board Chairman Charles Allen Thomas of Monsanto, reportedly feels that the nation's R and D "is now stumbling in a plethora of projects, sinking in a sea of money, and is being built on a quicksand of changing objectives."

We are convinced that R and D in agri-industry will not be curtailed. Fundamental research in the biological and physical sciences will continue at an increased pace, and applied research will undoubtedly become much more effective because of what we term the "systems approach." Some time ago we gave up thinking in terms of plant genetics alone or proper rates of nitrogen, phosphorus, and potassium and have directed our thinking at the total interaction of seed, plant population, soil moisture, pesticides, growth regulators, etc. Today our thoughts extend beyond the production of a particular crop to the systems of cropping, feeding, processing, and distribution. We are extending our horizons to the quality — yes, even the flavor — or farm products as they may be influenced at each stage in the production system.

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1Hubert Kay, "Harnessing the R and D Monster, Fortune, January 1965.
At International Minerals and Chemical Corporation we are nurturing science with a major expansion in facilities and staff while simultaneously developing our overall marketing program geared to the agriculture of the future. This expansion in R and D combined with imaginative, creative marketing and business outlook is designed and is expected to have a major impact on the company's business and profits. It should be clearly understood that R and D by itself will have little impact on the farm firm. But as one component of a forward looking corporate entity R and D can play a major role in a changing agriculture. Our immediate customer is the farmer, but our ultimate customer is everyone who eats. We as a company already are directly influencing farmer practices, preferences, and management. We expect through an expanding, dynamic technology to play an ever increasing role in the operation of the farm firm as it relates to consumer needs and demands for lower cost, better quality food and fiber.

The rapid development of scientific knowledge is making obsolete the so-called Edisonian system of research. This more or less blind approach to problem solving is giving way to sophisticated technology in industry as it has in agricultural research in universities and government laboratories. At IMC we are concentrating heavily in the life sciences. For many it will be a surprise if not somewhat of a shock to learn that a fertilizer company is actively pursuing research on messenger RNA and nucleic acid components. But we are working in molecular biology and we expect to increase our efforts along these lines. We believe that advances in molecular biology will have a major impact on the growth of crops and animals. New insights into plant and animal chemistry are certain to make much of present agriculture ultimately obsolete, and we expect to lead and profit by these changes.

By developing a capability in the forefront of life science research we expect to design new cultural techniques, new practices - new systems for maximizing energy fixation in the form of useful agricultural products.

Let us digress for a moment to discuss how this expansion in what some might even call fundamental research relates to federal or state experiment station programs. First, we see this expansion in our own business as supplementing and strengthening the research efforts of state or federal agencies, not as competition to them. Regardless of all of industry's efforts, we believe that the majority of the entirely new information inputs, 95 percent or higher, will evolve in research laboratories of universities and other public supported research centers. Most research in industry must be conducted indirectly, if not directly for a profit. This, in itself, will give specific direction to all company programs and limit the amount of money, time and effort devoted to probing in depth the unknown. With a highly competent scientific staff in the life sciences we expect not only to keep fully abreast of major scientific breakthroughs but to assist in putting these breakthroughs to work for the farmer. Other agriculturally oriented companies apparently are thinking along similar lines as evidenced by their recruitment programs. We do not want to offend industrial scientists or purists, but we feel that in industry we essentially will be engaged in a very, very, sophisticated development program. Putting it another way we will be expanding on and we will be applying the "basic" research supplied from academia. This approach by industry will call for even
more top quality fundamental and new information from state experiment stations, universities, and federal service centers.

The forceful and directed application or development of scientific inputs into useful products and processes for the farmer is already being felt at the farm level and in fact within some government agencies such as the extension service. As U.S. agriculture continues to "commercialize" these new inputs from agribusiness are in fact being demanded by the farmer. The fertilizer dealer now not only sells fertilizer but must advise on government programs, pest control, cultural practices, financing, etc. The systems approach to business farming is rapidly coming about. It is via this concept of a system that industrial R and D will have its greatest impact on the farm firm.

The systems concept is not new to industry. It has been used very successfully in the nation's space industry.

Segments of the concept have been used in some components of agriculture and agribusiness for many years, i.e., poultry production and pesticide sales. The technical inputs have been supplied by the supplier to the user—the farmer. It seems logical that more and more of the technical decisions made by farmers will be left to the experts—the suppliers who serve them. These technical inputs must be correct; they must be timely; they must be related and interpreted on a system basis.

We at IMC look at the progressive farmer of today and the farmer of tomorrow as an associate businessman in the chemical industry. After all, these men are producing proteins, fats, cellulosues, carbohydrates—all of which are processed chemicals. Furthermore, the proper use of chemical raw materials is the most important factor in the most efficient production of these processed chemicals. So they are running a chemical synthesis factory with their soil, and as complex and as uncontrolled as it may be it is a chemical plant. The goal of this chemical plant operator, the farmer, is not to grow a crop of lettuce, a herd of steers, etc., but to maximize his return on investment. And as a businessman or plant operator he will strive to standardize production processes and to eliminate uncontrolled conditions from his operation. The farmer today is already looking for profit-making crop or animal production system of matched products, practices, and services that will minimize risk and assure him of greater, more consistent profits than he ever had before. It will be the role of industrial research in the life sciences, physical sciences, economics, and marketing to insure that improved profit systems are always on the drawing boards.

The system concept to be operational must be broken down into sub-units or components. Actually, as a practical matter, we must look first at sub-systems and then at the overall complex.

We look at the total agricultural system as composed of three major sub-units or sub-systems:

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1. Plants and animals
2. Soil and water
3. Marketing and distribution

Each of these units, of course, is complex in itself but tied together in a large bundle they will give us the overall "Farm System."

In industry, as previously explained, fundamental technical approaches and skills will be used in solving problems within each sub-unit. For example, I mentioned that research in molecular biology is part of our R and D program at IMC. But industrial research is mostly involved in working across components which essentially is the first element of the system approach. Research on salt tolerance and root penetration of fertilizer bands being conducted in our own laboratories is a good example of research in depth involving a combination of plant, soil, and water components. The development by Mr. Smith of what is now called a weather impact service to evaluate soil moisture conditions in all agricultural areas east of the Rocky Mountains is further evidence of advanced technology across two sub-groupings. There are many other industrially based examples in the field of pesticides, plant breeding, and the like. But it will, for the most part, be the universities and experiment stations who will supply the fundamentals and new knowledge necessary for major breakthroughs such as programming of crop or animal growth through manipulation of DNA or messenger RNA.

Another example of the systems approach or combination of sub-unit operation components can be found in a high yield soybean system that we are now aggressively developing. This is a total crop production system for the soybean farmer based on selected varieties, special fertilizers, pre-emergence chemical weed control, alteration of between row and within row plant spacing to insure maximum energy utilization, a special growth regulator to change the shape of the soybean plant and reduce lodging plus advanced computerized information on moisture supplies. This particular growth regulator, incidentally, is the product of research conducted by the Iowa Agriculture and Home Economics Experiment Station. We expect to develop or assist in developing similar systems for every major crop in every important agricultural area.

The soybean system is but one example, but it clearly represents the concept involved. The farmer of tomorrow will need to have these types of production decisions made for him. These particular decisions can be made by companies truly agriculturally oriented in the modern sense.

To successfully carry out this systems approach on a national or even world wide level is no easy or small task. In 1980 we expect that there will be less than one million high production farmers in the United States. A highly trained salesman with today's techniques could probably effectively serve 50 customers on a year round basis. For this level of operation the industry would need 20,000 college trained farm management specialists who were expert in every technical aspect of crop production. It is highly improbable that such men will ever be available. It is apparent that some other alternative must be found. This alternative is already being used -- it is electronic...
Data processing equipment at the Skokie, Ill. headquarters of International Minerals & Chemical Corp. handles computerized weather impact programs as well as other programs affecting agribusiness and farm management.

Steam distillation apparatus determines volatile fatty acids in animal nutrition research at IMC.
Seed germination is tested under controlled light and temperature conditions in IMC’s microbiological plant growth chamber.

Availability of phosphorus is compared in fertilizer compounds.

Leaf disk assay apparatus is used to test the effect of chemical compounds on tobacco leaves.
data transmission and processing. It is not too far-fetched to visualize expanding use of that alternative. When technically sound profitable production systems and inputs are available, economic and scientific data will be accumulated by the salesman and transmitted to a control data processing center. The computer print-out will go back to the salesman who will then take the results directly to his farmer customer. It is even conceivable that, as electronic communications are improved, data will be transmitted directly to and from the farmer. It goes without saying that much more research is needed to make such concepts operational. But remember, remarkable breakthroughs in data transmission and processing have already been made. We don't believe that we are dealing with any so-called anti-gravity device! In the future, from a central data processing headquarters, planting recommendations, pesticide recommendations, land use maps, etc. could flow routinely from supplier to user. Marketing information would be supplied as needed and danger signals identified whenever they arise. Modern farm service centers of tomorrow are not likely to be solely shopping centers with all items needed for farming such as seed, petroleum products, pesticides and fertilizers. They almost certainly will have the added input of technology as the basis of crop and animal production systems.

The systems approach also would seem to indicate that the role of the county agent will change, with extension agents being grouped into teams, with experts from all the agricultural disciplines.

Instead of a county agent, there might be a clinic of experts covering a wider area, in greater depth. This systems approach would allow extension agents to use their specialized skills to the maximum and for the greater benefit of agriculture.

This system concept is certain to have a major impact on the farm firm and its manager in the next decade or two. In fact, the system concept is going to have a major impact on industry itself. The system will not function without sophisticated technological inputs. The companies that use this system-service approach must be research conscious and maintain highly competent scientific staffs.

As the system concept continues to develop from a relatively simple cropping program, it's reasonable to expect that it will be expanded to the whole agricultural complex. Through computer techniques we will continually add variables that affect the operation of the farm firm. Distribution, processing, and marketing information will be routine inputs in addition to the variables of soil, herbicides, water, and energy now being employed. These will all be put together to define the specific overall agricultural system, not only for a single farm but perhaps for a given geographic area.

Essentially what we have predicted is technical selling and technical support with management guidance for maximum profit systems.

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Many of you are no doubt asking, Where does this leave the agricultural extension service—the historical friend of the farmer?

The trends in industrial research and technology would certainly indicate that the future will bring great changes in the information component of the extension service. It wasn't but a half century ago that the farmer neither cared nor bothered about what was going on in the next county—it was less than a quarter century ago that he became concerned with production in neighboring or distant states. But to be successful today he must wrap his mind around events all over the world and interpret and relate those events in a meaningful fashion in terms of a farm complex that covers only one or two square miles.

Examples of such needed advance interpretations are the impact of Puerto Rican pineapples on Hawaiian farmers and African tobacco production on farmers in our South East. Foreign or distant production or policy changes seriously and rapidly affect all domestic producers. It would seem then that extension should be concerned with this kind of information. It would make itself aware of and keep domestic farmers informed of all of the foreign competition progress, problems, and reorientation. In other words, the "service" would assume some aspects of the G-2 system.

Likewise, the capital risks—the production risks—or rather the profit risks of the farmer will become more severe. Environmental factors such as moisture and temperature will be increasingly important. The service of the future, then, would conceivably be geared to supply this information as needed area by area to protect farmers from surprises and minimize losses. Information and guidance on capital supply and financial problems would have to be an integral part of this "agricultural operations service." In fact, the business or management aspects of the new "service" probably would be the most important item of its total program.

We must recognize, of course, that the present day extension service is performing certain aspects of these tasks. The farm management associations in the Corn Belt are but one example. But the signs seem to point to a complete modernization to support the food and fiber producers and suppliers in the total agricultural business. This change would probably call for the development of regional operational centers staffed with highly skilled technical, business-oriented personnel and equipped with modern data transmission and processing machines. When operational these centers would serve the entire agricultural business community—the farm firm and the farm firm suppliers in a given economic area. Applied research programs involving the system or package concept would insure continued progress and serve as a source of problem feedback to both government and private research departments.

These thoughts should certainly not be considered as a completely defined set of recommendations. They are expressed as a reflection of the signs of the times in agriculture and of the views expressed by recognized agricultural economists, educators, and technologists. All of these signs and these views would indicate, it seems, that the concepts for regional centers touched on here deserve serious consideration.