*A Survey of U.S. Agricultural Research by Private Industry III*

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This is the third in a series of surveys conducted by the Agricultural Research Institute to obtain data on the areas of emphasis and magnitude of expenditures by private industry for agricultural research. The first of these surveys provided information for the fiscal year 1965 (6). The second covered a period of 1976 and 1977 (7). Thus, to the extent that the data reported here are typical of the expenditures by industry, they should provide an indication of the priorities in the various areas of agricultural research and also in budgetary support, and the changes in expenditures that have occurred over the 19-year period since the first survey was conducted.

Several very significant developments affecting research policy and administration in both the public and private sectors may have had more profound effects on agricultural research than has the lapsed period of time. We make no attempt to evaluate the quantitative significance of each of these events nor to enumerate all of them, but some of the more significant changes are:

1. The Agricultural Research Service of the U.S. Department of Agriculture has articulated quite clearly and published the objectives of its research program plans (1). It has also established research priorities and developed a 6-year implementation plan to arrive at established objectives (2). As might be expected, these programs and their objectives have been criticized by various groups largely on the basis of percentage of the budget and of scientist time allotted to each of the areas of research. However, the rationale for accomplishing the

planning is above criticism. It has served to make research planning in the Department more effective and it has provided a basis for evaluating scientist and budgetary needs. Further, the existence of these research program plans has opened a path for more communication on research needs and has made available for discussion the agenda and the dimension of the research programs. It has also stimulated more two-way discussions between the private and public sectors.

2. The experiment stations in many of the states have been aggressively reviewing and revising their programs in research. The Experiment Station Committee on Organization and Policy (ESCOP) has taken the lead in this effort.
3. Although better communications have developed between the private and public sectors in research, much improvement still needs to be made, particularly in the effectiveness of industry in keeping the public research leaders informed of broad industry problems with some order of significance and priority.

   The recent rulings of the Commerce and Justice Departments suggest that when industry-wide problems are of such magnitude that no one company could or should finance research programs attempting to solve them, cooperative efforts by a group of companies would be permissible under anti-trust laws provided all participating companies have equal access to the results of the research.
4. There has been a noticeable dichotomy in the attitudes of various companies in the emphasis on basic, applied and developmental research. Certain companies have adopted policies of building for the future by investing substantially in basic research, while others have decidedly decreased the emphasis on relevant basic research and are focusing primarily on product development programs. Thus, the total research budget does not necessarily indicate the emphasis on basic versus applied or developmental research in private industry.
5. The present depressed situation in the agricultural economy has made it imperative that both the general public and governmental agency officials be made aware of the fact that agriculture is attempting to solve some of its problems through research.
6. Some of the more vocal critics, both public and private, of the Agricultural Research Service programs, have failed to recognize the need for balanced research programs which emphasize basic, applied and developmental research to solve both present problems and respond to longer range needs. This would include research to solve post-harvest, distribution and marketing problems as well as problems in the production area and the exploitation of biotechnology to solve them.

## Procedure

This survey was conducted following an expression of interest from the U.S. Department of Agriculture for more up-to-date information on both the nature and extent of industry research relating to food and fiber production, utilization and marketing systems. A mailing list was compiled by an outside consultant who contacted agricultural trade associations which were national, state, and local in scope. In addition, two publications providing a listing of agricultural companies were consulted. Such a list obviously does not include every agricultural business but it does include those which are most likely to be conducting and financing research.

The objectives of this third survey were:

1. To bring up to date the data on private sector research to supplement data already available on agricultural research being conducted by public research agencies.
2. To identify for USDA, the Office of Management and Budget, and members of Congress, the major areas of research emphasis by private industry so that public funding of research can be appropriately complementary.
3. To provide valid data to correct misconceptions on the magnitude of support and areas of emphasis in private sector research programs in relation to public sector research.
4. To help guide our efforts to assure that public and private research are directed toward the most pressing agricultural problems.
5. To assist decision makers in avoiding unnecessary duplication in research, thus helping to assure that public funds are directed more efficiently and effectively toward the solution of the most pressing agricultural problems.

A less detailed questionnaire than was used in the first two surveys was developed in the hope of getting a much better response than was obtained in the second survey. This questionnaire was patterned to a considerable extent after that used by Kalton and Richardson (4) who made a survey of seed industry research expenditures and scientist years[1] devoted to research in the plant breeding area in 1982 and 1983. They received over 80% response to their questionnaire, which is exceptionally good. The estimated annual expenditure for plant breeding research was about $115,000,000.

A total of 648 questionnaires were mailed in the ARI survey, and a total of 326 responses were obtained including 119 reporting no research, and 6 reporting research programs but not providing adequate data.

[1]One scientist year equals one full time scientist for one year, including persons with a B.S., M.S. and Ph.D. degree. This is in contrast to the public sector where scientist year refers to a Ph.D. or the equivalent.

Two-hundred-and-one responses provided useable data. This was considered a good response. Data from 155 responses to the Kalton and Richardson (4) survey are included in this report of the ARI survey, with no identification as to the individual companies reporting. [The results of the Kalton and Richardson (4) survey were published in *Diversity.*] These data were included because it was considered vital that information be obtained from this segment of the agricultural industry but it was not felt desirable or practical to repeat a survey that had been made just one year previously.

Ruttan (5), in his book, *Agricultural Research Policy*, indicated that the private industries were spending in the neighborhood of 1.6-2.0 billion dollars annually for agricultural research in 1979. These estimates were somewhat higher than indicated in the previous ARI surveys for 1965 and 1976-77.

All questionnaires that were sent out were coded by the Agricultural Research Institute office. Only that office had access to the code and the code is to be destroyed as soon as the survey is completed. Thus, all information is confidential as to the identity of the companies[2] that provided the individual segments.

## Scientific Personnel (Combined ARI and Kalton-Richardson Data)

In Table I we have listed 13 areas of research which we consider to be distinctive and, in addition, a 14th classification for others not falling within the 13. In this table we have summarized from the questionnaires returned the number of companies reporting research in each category and the number of scientist years spent in research for that particular category in terms of Ph.D., Master of Science and Bachelor of Science degree personnel. Some companies, of course, are involved in more than one area of research and therefore there is a discrepancy between the total number of responses received and the total number of companies listed in this table.

On the basis of the companies that reported, it is evident that the pesticide industry, in the combined areas of synthesis and screening and the areas of product development and registration, devotes more scientist years in the Ph.D. category than do other industry classifications. This is followed by plant breeding; biotechnology; and human food product development, processing and nutrition in that order. The number of M.S. scientist years employed follows the same pattern except that

[2]The term "company" or "companies" is used throughout this report as a general term to include the various organizations in the private industry sector that provided data in this survey. Included are: companies, corporations, cooperatives, associations, foundations and other for-profit and not-for-profit entities.

## TABLE I

### Number of Scientist Years Devoted to Agricultural Research by Degree and Area of Research Within the Organizations (Combined ARI and Kalton-Richardson Data)

| Major Areas of Research | No. Companies* | Ph.D.** | No. Companies* | M.S. | No. Companies* | B.S. |
|---|---|---|---|---|---|---|
| 1. Agricultural Economics | 11 | 10.4 | 15 | 24.7 | 12 | 18.9 |
| 2. Biologics — Animal Health (Drugs, Botanical Products) | 15 | 74.6 | 10 | 69.8 | 14 | 131.6 |
| 3. Biotechnology | 41 | 287.6 | 26 | 134.8 | 24 | 167.9 |
| 4. Pesticides | | | | | | |
| a) Synthesis & Screening | 23 | 408.7 | 19 | 144.6 | 25 | 222.7 |
| b) Product Development & Use Registration | 38 | 851.6 | 30 | 455.0 | 32 | 618.0 |
| 5. Plant Nutrients (Fertilizers minor elements, etc.) | 23 | 53.9 | 21 | 37.0 | 27 | 47.7 |
| 6. Natural Fiber Processing (Cotton, wool, wood, etc.) | 5 | 5.8 | 4 | 7.0 | 3 | 23.8 |
| 7. Animal Nutrition & Feeds | 47 | 95.5 | 30 | 58.7 | 30 | 111.5 |
| 8. Human Food Product Development, Processing & Nutrition (Foods, vegetable oils, etc.) | 57 | 262.5 | 53 | 324.3 | 51 | 595.0 |
| 9. Farm Machinery & Equipment | 11 | 32.5 | 22 | 66.1 | 32 | 230.0 |
| 10. Tobacco Production & Processing | 1 | 0.5 | 1 | 1.0 | 1 | 0.7 |
| 11. Packaging Materials & Containers (Plastic, paper, metal, etc.) | 8 | 14.7 | 12 | 23.3 | 21 | 68.9 |
| 12. Energy Research (Solar, wind, biomass, etc.) | 12 | 31.0 | 7 | 42.5 | 11 | 10.9 |
| 13. Plant Breeding | 108 | 518.9 | 92 | 348.6 | 109 | 610.8 |
| 14. Other than above | 31 | 186.4 | 25 | 253.0 | 23 | 476.0 |
| TOTAL | 431 | 2,834.6 | 367 | 1,990.4 | 415 | 3,334.4 |

*Number of total companies varies because of working in multiple areas. **Includes D.V.M.'s.

human food research surpasses biotechnology as a major participant at this level. At the B.S. level, again the pesticide industry employs the largest number followed by plant breeding, human food and farm machinery.

The larger number of scientist years devoted to research in the pesticide segment of the industry is to be expected given the fact that a large amount of chemical screening is needed to identify prospective compounds. The companies that are in this business are well-established and to a considerable extent, larger companies, than those in the other groupings. Biotechnology is a new industry and largely made up of small companies and therefore would not have the extensive staffs employed by some of the older, more established businesses. It would be anticipated that the staffs and research budgets of the biotechnology companies will increase as products are developed and the business becomes well established and productive. Several of the companies operating in the pesticide area, for example, are also involved in the biotechnology area.

The number of scientist years reported in the survey provides an estimate of the magnitude of the research effort within companies (Table II). The minimum number of Ph.D. scientist years, M.S. or B.S. for all companies shows very little difference in range. The total range is from 0.01 to 0.5 for Ph.D.'s, 0.01 to 1.0 for M.S. and 0.1 to 1.3 for B.S. in the companies that reported. The maximums, however, show decided differences. The greatest number of Ph.D. scientist years employed by any one company in an identified area is 182 for the product development and use registration area of the pesticide business, ranging down to 0.5 in tobacco. The number of scientist years at the M.S. level ranges from 220 in the unspecified group (other) to 1, also in tobacco production and processing. At the B.S. level, the highest number reported was in the unspecified group (other) where 400 were employed by one company of the unspecified group (other) and only 0.7 in the tobacco classification. Thus, the total scientist years devoted to agricultural research by these 356 companies was 8, 159 of which 2, 835 were at the Ph.D. level, 1,990 at the M.S. level and 3,334 at the B.S. level.

It may be of even greater interest to note from the data provided in Table I the total scientist years spent in each of the 13 major areas of research identified. This ranges from a total of 2,700.6 in the pesticide area to a low of 2.2 in tobacco production and processing where a very large amount of the work is done in public institutions but supported by the tobacco industry, and 36.6 in the natural fiber processing area. The figure of 54 in the area of agricultural economics probably represents only those studies devoted to the general economy whereas much of the economic analysis work on markets or products is included in the specific product areas.

## TABLE II

### Minimum and Maximum Number of Scientist Years Reported (Combined ARI and Kalton-Richardson Data)

| | Ph.D. | | M.S. | | B.S. | |
|---|---|---|---|---|---|---|
| | Minimum | Maximum | Minimum | Maximum | Minimum | Maximum |
| 1. Agricultural Economics | 0.1 | 2.0 | 0.7 | 5.0 | 0.1 | 6.0 |
| 2. Biologics — Animal Health (Drugs, Botanical Products) | 0.1 | 35.0 | 0.1 | 55.0 | 0.2 | 60.0 |
| 3. Biotechnology | 0.2 | 68.0 | 0.3 | 36.0 | 0.1 | 54.0 |
| 4. Pesticides | | | | | | |
| a) Synthesis & Screening | 0.1 | 85.0 | 0.1 | 35.0 | 0.1 | 58.0 |
| b) Product Development & Use Registration | 0.1 | 182.0 | 0.1 | 63.0 | 0.1 | 95.0 |
| 5. Plant Nutrients (Fertilizers, minor elements, etc.) | 0.1 | 18.0 | 0.2 | 8.0 | 0.1 | 14.0 |
| 6. Natural Fiber Processing (Cotton, wool, wood, etc.) | 0.3 | 2.5 | 0.5 | 3.0 | 1.3 | 20.0 |
| 7. Animal Nutrition & Feeds | 0.01 | 17.0 | 0.1 | 15.0 | 0.1 | 42.0 |
| 8. Human Food Product Development, Processing & Nutrition (Foods, vegetable oils, etc.) | 0.1 | 51.0 | 0.3 | 46.0 | 0.3 | 110.0 |
| 9. Farm Machinery & Equipment | 0.3 | 20.0 | 0.2 | 20.0 | 0.1 | 80.0 |
| 10. Tobacco Production & Processing | 0.5 | 0.5 | 1.0 | 1.0 | 0.7 | 0.7 |
| 11. Packaging Materials & Containers (Plastic, paper, metal, etc.) | 0.1 | 4.0 | 0.1 | 8.0 | 0.1 | 15.0 |
| 12. Energy Research (Solar, wind, biomass, etc.) | 0.1 | 20.0 | 0.01 | 40.0 | 0.1 | 3.0 |
| 13. Plant Breeding | 0.2 | 61.0 | 0.2 | 54.0 | 0.1 | 95.0 |
| 14. Others than above | 0.3 | 90.0 | 0.2 | 220.0 | 0.1 | 400.0 |

## Research Expenditures (Combined ARI and Kalton-Richardson Data)

In Table III we have calculated the research expenditures for 356 companies which supplied useable data on this subject by using the midpoint of the range reported for research expenditures multiplied by the number of companies reporting in each category. In the questionnaire respondents were asked to provide only a range of expenditures and not an exact figure. It was felt that this would be more acceptable to those companies reluctant to provide exact figures on research expenditures. Thus, for the 356 companies, a total of $1,370,775,670 was reported as having been spent per year in the survey period by industry in agricultural research.

## Extrapolation From Questionnaire Data to Entire Industry (Combined ARI and Kalton-Richardson Data)

We will make three sets of assumptions to provide estimates of total agricultural research expenditures by private industry:

1. The first assumption is since the incentive of receiving a copy of the final report was offered to induce the return of questionnaires, all of those doing no research responded by checking one box and returning the questionnaire.

   Under this assumption, the 322 who did not reply would all be conducting research, and it would be assumed at about the same rate per company as those who did respond. On the basis of $1,303,450,000 having been spent on in-house research by the 356 companies that reported useable data and $67,325,670 in support of outside research, the total would be $1,370,775,670 and the mean expenditure per company would be $3,850,493. The additional 322 companies that did not report would also be operating on the same basis as the 356 which reported, and would have spent $1,239,858,746. By adding this to the 356 total of $1,370,775,670, we arrive at a figure of $2,610,634,416 for the total of all companies doing research. This obviously is not a precise figure since ranges were used in reporting and extrapolations were used to arrive at this figure.
2. Under our second assumption, the 322 companies that did not report included the same percentage of companies not doing research as the original 648 companies which were asked to fill out questionnaires in the ARI survey. On this basis, an additional 197 satisfactory questionnaires would have been received. Since the original 356 companies spend an average of $3,850,493 per com-

## TABLE III

### Total Research Expenditures (In-House and Outside) (Combined ARI and Kalton-Richardson Data)

| Dollars | No. Companies Supporting In-House Research | Dollars | No. Companies Supporting Outside Research | Dollars |
|---|---|---|---|---|
| 0 | | | 215 | |
| Under 100,000 | 104 | 5,200,000 | 81 | 4,716,500 |
| 100,000 - 500,000 | 110 | 33,000,000 | 30 | 3,400,000 |
| 500,000 - 1,000,000 | 47 | 35,250,000 | 14 | 9,300,000 |
| 1,000,000 - 5,000,000 | 51 | 153,000,000 | 14 | 34,059,170 |
| 5,000,000 - 10,000,000 | 16 | 120,000,000 | 2 | 15,850,000 |
| 10,000,000 - 20,000,000 | 13 | 195,000,000 | | |
| 20,000,000 - 30,000,000 | 4 | 100,000,000 | | |
| 30,000,000 - 40,000,000 | 3 | 105,000,000 | | |
| 40,000,000 - 50,000,000 | 3 | 135,000,000 | | |
| 50,000,000 - 100,000,000 | 3 | 225,000,000 | | |
| Over 100,000,000 | 2 | 200,000,000 | | |
| Total | 356 | 1,303,450,000 | 356 | 67,325,670 |
| Total Research Expenditure | **$1,370,775,670** | | | |
| Mean for 356 Companies | **$3,850,493** | | | |

pany, the additional 197 companies would have spent in total $758,547,121 which, added to the original $1,370,775,670, would provide a grand total of $2,129,322,791 for the 553 companies doing research under this scenario.

3. Under the third assumption, the 322 companies that did not return questionnaires were doing research, but at a lower level of expenditure per company. More recent figures obtained by Kalton (1984), reported in the 155 questionnaires included in this survey, indicate an average expenditure of $1,041,613 per company in the plant breeding area. Using this figure as an average for the 322 not reporting, these companies would have invested a total of $335,399,386, which, added to the total of $1,370,775,670 for the 356 companies reporting, gives an industry total of $1,706,175,056.

   This is probably a conservative figure since the mailing list used undoubtedly did not include all companies conducting agricultural research. Since ranges of expenditures were used rather than exact figures, it is probable that the second assumption provides the best estimate of private industry annual expenditures in agricultural research — approximately 2.1 billion dollars.

   The range of expenditures ($1.7 - 2.6 billion) indicated by this survey shows a marked increase over the figures from the 1965 industry survey, in which a total of $460 million was estimated from 247 questionnaires. These figures may be compared with the more precise figures supplied by Eddleman (3) for the state and U.S.D.A. research programs, which increased from $429.9 million in 1967 to $1,703.6 million in 1983. In both periods, industry expenditures appear to be equal to or somewhat in excess of public outlays for agricultural research.

If the total expenditure to support the research of 8,159 scientist years in-house was $1,303,450,000, average cost per scientist year regardless of the academic rank was $159,756. The expenditures for each area of research were calculated by multiplying the total number of scientist years reported for each area by the average cost per scientist year and are presented in Table IV. It is apparent from these data that the pesticide industry has a larger research budget than any of the other major areas. This is followed by plant breeding, human food, biotechnology, farm machinery and equipment, biologics, and animal nutrition and feeds. If the calculations for those expenditures are made with a differential for the Ph.D., M.S., and B.S. scientist years, the amounts would be changed but there would probably be very little, if any, change in the ranking of the different research areas.

## TABLE IV

### Amount of Money Spent per Area of Research (Combined ARI and Kalton-Richardson Data)

| Major Areas of Research | Total SY | Total Dollars @ $159,756 per SY | Rank |
|---|---|---|---|
| 1. Agricultural Economics | 54 | 8,626,824 | 12 |
| 2. Biologics | 276 | 44,092,656 | 7 |
| 3. Biotechnology | 590 | 94,256,040 | 5 |
| 4. Pesticides | | | |
| a) Synthesis & Screening | (776) | (123,970,656) | |
| b) Product Development and Registration | (1,925) | (307,530,300) | |
| Total Pesticides | 2,701 | 431,500,956 | 1 |
| 5. Plant Nutrients | 139 | 22,206,084 | 9 |
| 6. Natural Fiber Processing | 37 | 5,910,972 | 13 |
| 7. Animal Nutrition & Feeds | 266 | 42,495,096 | 8 |
| 8. Human Food | 1,182 | 188,831,592 | 3 |
| 9. Farm Machinery & Equipment | 329 | 52,559,724 | 6 |
| 10. Tobacco Products & Processing | 2 | 319,512 | 14 |
| 11. Packaging Materials | 107 | 17,093,892 | 10 |
| 12. Energy Research | 84 | 13,419,504 | 11 |
| 13. Plant Breeding | 1,478 | 236,119,368 | 2 |
| 14. Others | 914 | 146,016,984 | 4 |
| Total | 8,159 | 1,303,449,204 | |

## Research Categories (ARI Data Only)

Table V presents the distribution of research expenditures in the categories of relevant basic research, applied research and developmental research as reported in the questionnaires received from the ARI survey. The definitions for relevant basic research, applied research and developmental research as included in the questionnaire are as follows:

***Relevant Basic Research*** — Research conducted to determine the basic cause or mechanism of why certain results or reactions are obtained.

***Applied Research*** — To develop knowledge or information directly relevant to technology or to product development or to market possibilities.

***Developmental Research*** — To develop a new or improved technology or product or to support market testing and introduction or to maintain product performance and quality or to meet regulatory requirements.

The data reveal that 82 of the 201 reporting companies (40.8%), conduct no relevant basic research. Five companies classified their research programs as 100% in this category.

Fifteen companies reported 100% of their programs in the applied research area. There were 15 companies (7.5%) reporting no applied research. This group would depend very heavily on public research institutions to supply the information needed for the development of products and programs.

In the developmental research area, 29 compaies (14.4%) reported no expenditures. Seven companies reported 100% of their research budgets being utilized in the developmental research area.

Not all of the companies reporting research expenditures provided complete breakdowns on the percentage of their budgets spent in basic, applied or developmental research. The useable data obtained from the 201 responses in the ARI survey reveal that the companies reporting spent a total of $1,145,000,000 in agricultural research, which was allotted as follows: $171,649,930 to relevant basic research; $498,379,030 to applied research and $474,947,740 to developmental research. This would indicate that private industry is devoting 15.0% of its agricultural research expenditures to relevant basic research, 43.5% to applied research and 41.5% to developmental research.

If the 119 companies that reported doing no research are added to the 82 doing research but reporting no basic research, we have 62% of the 326 companies that responded in the ARI survey not doing any basic research. This figure becomes important when the complementary roles of public and private research programs are considered.

## TABLE V

### Approximate Percent of Total Research Budget in Each Category*
### (ARI Data Only)

| Range (%) | Relevant Basic Research | | Applied Research | | Developmental Research | |
|---|---|---|---|---|---|---|
| | No. Companies | % | No. Companies | % | No. Companies | % |
| 0 | 82 | 40.8 | 15 | 7.5 | 29 | 14.4 |
| 1 - 10 | 68 | 33.0 | 18 | 9.0 | 5 | 2.5 |
| 11 - 20 | 19 | 9.4 | 25 | 12.4 | 25 | 12.4 |
| 21 - 40 | 16 | 8.0 | 49 | 24.4 | 41 | 20.4 |
| 41 - 80 | 11 | 5.5 | 69 | 34.3 | 77 | 38.3 |
| 81-99 | | | 10 | 5.0 | 17 | 8.5 |
| 100 | 5 | 2.5 | 15 | 7.5 | 7 | 3.5 |
| TOTAL | 201 | | 201 | | 201 | |

*Plant breeding figures were not included because of lack of useable information on this question.

## Summary and Conclusions

1. The results of the surveys reported here provide the basis for estimating that the private sector of the agricultural industry spends from approxmately $1.7 to $2.6 billion per year on agricultural research, depending upon the assumptions made in extrapolating from the data provided in the completed questionnaires to a total for all companies asked to provide data in the ARI survey. Our best estimate is that private industry is investing approximately $2.1 billion annually in agricultural research.
2. The 356 companies (201 in the ARI survey and 155 from Kalton, et. al.) that reported their research expenditures provide budgets of approximately $1,303,450,000 per year for in-house research programs.
3. One-hundred-and-forty-one companies that reported supporting research through grants or contracts to universities, foundations, or other private or public organizations, reported a total expenditure of approximately $67,325,670. However, since the questionnaire specified that the amount be stated to the nearest $50,000, small grants and fellowships or scholarships would not have been reported. For that reason, this total is probably under-reported.
4. The total research expenditures of the 356 companies reporting was $1,370,775,670 for the support of both in-house and outside research.
5. The 356 companies reporting supported a total of 2,835 scientist years at the Ph.D. level; 1,990 at the M.S. level; and 3,334 at the B.S. level — a total of 8,159 scientist years at all levels.
6. The cost per scientist year for in-house research was $159,756, if the assumption is made that there is no cost differential for the three academic ranks.
7. The greatest expenditure of research funds reported by the companies responding was in the area of pesticides.

*8. Eighty-two companies of the 201 providing data reported no relevant basic research while 5 companies reported 100% basic research.

*9. Fifteen companies reported no applied research and 15 reported 100% applied research.

*Since the Kalton-Richardson survey did not provide enough useable data on a break-down into relevant basic, applied or developmental research, observations 8, 9, 10, 13 and 14 are based only on data from 201 ARI responses.

*10. Twenty-nine companies reported no developmental research and 7 reported 100% developmental research.

11. Six-hundred-and-forty-eight questionnaires were sent out in the ARI survey to companies that presumably should be conducting research. A total of 326 replies were received. Of these, 201 provided the data requested, 119 reported doing no research and 6 reported doing research but did not provide adequate data.

12. The data obtained in the two surveys which are combined in this report should provide a reasonably valid estimate of the amounts and type of research work that is being conducted in the private sector.

*13. One-hundred-and-nineteen companies reported doing no research, and 86 of those reporting indicated no basic research, revealing that 62% of the companies responding to the ARI survey are not funding basic research.

*14. The 119 companies reporting no research constituted 36.5% of the companies which returned the questionnaire in the ARI survey and 18.4% of the 648 companies contacted. This group would depend upon the public sector to provide the necessary research —basic and applied.

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