a task and on having produced so interesting and useful a work.

PHILIP M. MORSE

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

AMERICAN AGRICULTURE IN 1936

Year Book of Agriculture—1936. Printed by the U. S. Government Printing Office. For sale by the Superintendent of Documents—price $1.25 cloth. 1936.

THE old Annual Report series of the Department of Agriculture was divided in 1894, as the result of legislative action, into two parts, one, the purely business and executive matters, and two, the annual survey of the department's work by the secretary and popular scientific papers calculated to be of interest to farmers. The second series was named the Year Book. In addition to the papers mentioned, the Year Book contained in an appendix statistical matter in reference to agriculture. This had grown to several hundred pages and, while highly useful, was somewhat out of place in this type of publication. Hereafter, the statistical matter, with the exception of a few pages of general statistics, is to be published as a separate volume and is not included in the Year Book for 1936. Aside from the general review of the agricultural situation and the work of the department, by the secretary, the book is devoted to a survey of plant and animal breeding with special reference to "superior germ plasm."

It is a useful historical review of work that has been done in these fields, with special emphasis on the genetic and cytological aspects. A glossary of genetic terms is included.

The treatment is largely historical, leading up to the objectives now dominant and the improved techniques now available. The material for the germplasm part of the book was assembled by the Committee on Genetics.

The book should be helpful to plant and animal breeders and to students interested in these general subjects. With the index it includes 1,189 pages.

A. F. WOODS

SPECIAL ARTICLES

THE INDIANA GROUP IN AMERICAN MEN OF SCIENCE[1]

IT seems fitting at this half century meeting of the Indiana Academy of Science to make a survey of the men of science produced in this state and also of those from other states who now make Indiana their home. In order to do this one's mind turns naturally to Cattell's "American Men of Science," published in 1933. It would certainly be interesting to see what part Indiana has played in furnishing her quota of the 22,000 scientists noted in this edition. Indiana is noted for her fertile acres, and "out where the tall corn grows" is a favorite expression which not only locates but also stresses the fertility of our state. The lack of large cities in the state means that her 3,238,503 residents of 1930 are scattered in small centers and country communities. It is noted in the summary of "American Men of Science" (1932) that Ohio and Indiana have in residence less than half of the leading men of science they have produced. Hence, there must be some reason conducive to such results, for it surely could not be just a matter of accident.

GROUPS INCLUDED IN THE STUDY

It was decided to limit this study to three groups, namely: First, those born in Indiana; second, those who spent four years in Indiana colleges and have secured the bachelor or equivalent degrees from Indiana colleges; and third, those from other states who now make their home in Indiana. If those who spent from a few months to a few years, doing graduate work, were included, it would add considerably to the total number involved but would only tend to complicate matters and make an interpretation of the data more difficult. It was found that Indiana has a total of 1,109 out of the 22,000 names of scientists, or about 5 per cent. In order to get some information bearing on the early life of those of the 1,109 who were born in Indiana, they have been grouped in Table 1 according to the size of the town in which they were born. On this basis of Indiana's population of 3,238,503 in 1930, this amounts to one native-born scientist to every 4,534 citizens, or counting the 1,109 scientists belonging to the Indiana group, there is one scientist for every 2,920 persons. It has been estimated by Dr. A. D. Little in "The Fifth Estate" that it costs the state about $500,000 to find and develop a man to the extent that he is capable of advancing science. If this is the truth, it means that Indiana has spent about 500,000 times 714 or $357,000,000 for the

TABLE 1

NUMBERS AND PER CENT. BORN IN LARGE, MEDIUM AND SMALL TOWNS OR COUNTIES OF INDIANA

(1)	Small town or county (under 1,000)	440 or 61.6	per cent.
(2)	Medium size town	190 or 26.6	" "
(3)	Large towns (over 50,000)	84 or 11.8	" "
	Total	714 or 64.4	" "

[1] Presented at the fiftieth meeting of the Indiana Academy of Sciences.

promotion of science. This has been a splendid investment, since "wealth is the product of brains, and labor is productive only as it is guided by intelligence."

THE COLLEGE GROUP OF SCIENTISTS

In a study of the graduates holding bachelor degrees from Indiana schools, it was noted that there are 640, which is 57.7 per cent. of the 1,109 scientists connected with the state. These were found to be distributed among the different institutions of the state as shown in Table 2.

TABLE 2
THE NUMBER AND DISTRIBUTION OF SCIENTISTS AMONG INDIANA COLLEGES

Indiana University	240	Butler	19
Purdue	151	Notre Dame	10
Wabash	58	Hanover	10
DePauw	54	Franklin	4
Earlham	46	Marion	3
Valparaiso	30	Ind. Central College	3
Ind. State Normal	22	Total	640

CHOICE OF OCCUPATIONS

It was but natural to lay stress in different degrees on certain branches in the different colleges depending on natural advantages of location or personality of teachers. Thus, the inspiring personality and genius of David Starr Jordan as teacher and investigator, for example, left a trail of enthusiasm for zoology which is still much in evidence. All the schools at one time or another have had inspiring personalities who influenced their students to follow their speciality. These choices are evident to some extent in the number choosing the different professions, as shown in Table 3.

TABLE 3
CHOICE OF OCCUPATION OF THE 1,109 INDIANA SCIENTISTS

Chemistry	236	Animal and Dairy Husbandry	22
Physics	125	Agronomy	18
Engineering	90	Astronomy	18
Philosophy, Education, Psychology	74	Horticulture	18
Botany	72	Pharmacy	16
Mathematics	71	Agriculture	11
Zoology	50	Nutrition, Home Economics	9
Geology, Meteorology	50	Metallurgy	9
Medicine	49	Pathology	9
Plant Physiology and Pathology	41	Soils	8
Biology	39	Embryology, Histology	5
Bacteriology	30	Forestry	5
Parasitology, Entomology	29	Genetics	5
		Total	1,109

It is probable that the recent great industrial development and world war were largely responsible for the great call for chemists—hence, the number noted.

PRESENT DISTRIBUTION OF INDIANA SCIENTISTS

A study of the present location of the 1,109 scientists reveals that only about one third of them or 329 are now living in Indiana and only 46.1 per cent. of those born in Indiana are now in the home state. This indicates that Indiana has furnished other states over twice as many scientists as are living in the state. Since 61.6 per cent. of these came from small towns and country districts, it looks as if it takes the open country with its rugged people to produce that degree of vision, trained intelligence, open-mindedness and persistence required to become a scientist. The distribution of part of the 1,109 scientists among 15 states in order of their numbers is as follows: Indiana 329, New York 83, Illinois 79, Pennsylvania 59, California 54, Washington, D. C. 53, Ohio 50, Michigan 31, Wisconsin and Massachusetts, 24 each, Texas 19, Connecticut 16, North Carolina 13, Tennessee and Washington, 12 each.

It is evident that the South and West (except California) have not had the attraction that the East has afforded.

AVERAGE AGE OF INDIANA SCIENTISTS

The age of these scientists is of importance in this study. In the last fifty years, Indiana has been becoming less rural or has had a greater concentration of residents in cities than ever before. It was found that the average age of the 1,109 scientists was 47, or they were born in 1887, a time when a greater rural population existed than at present, but even at that time it was estimated to be only 62 per cent. in cities. Hence, most of the people lived in cities even then and ought to have supplied most of the scientists. This they failed to do.

WOMEN SCIENTISTS AND STARRED NAMES

Among the 1,109 names, it was found that at least 31 were women. Some of the female names may not have been recognized, due to their similarity to those of men. However, this would not change the total of 1,109. There are also 27 names in the group starred, indicating famous scientists. These starred names are probably worthy of their fame, but it seems to the writer that states like Ohio and Indiana that can produce twice as many scientists as they have in residence, or quantity production, have something to be proud of in addition to those starred. Whether it is country life, good ancestry, etc., it shows a desirable environment.

CONCLUSION

In conclusion the 329 scientists still living in Indiana make up what I like to call Indiana's "Fifth Estate." They are not supposed to know much about financial matters (since the depression it is doubtful whether the bankers know either). They are not often trusted to sit in Congress (lately some brain trusters seem to be desirable there), but these are the men and

women who have the ability to generalize, the power to think and the initiative to find a way to do and invent new things. In short, they have the genius to create that which makes life pleasant.

R. H. CARR

PURDUE UNIVERSITY

TOXICITY OF SELENIUM-CONTAINING PLANTS TO APHIDS

IN the course of studies[1] of the effects of selenium on wheat it was noted that aphids, *Rhopalosiphum prunifoliae* (Fitch), did not attack plants injured by selenium in solution cultures or soils. Since both rats and larger animals are able to detect the presence of selenium in their food and are reluctant to eat it,[2] the question arose as to whether the aphids found the selenium absorbed by the plants distasteful and migrated, or whether they died as the result of sucking the selenium-containing juice. The following experiments were accordingly designed to determine their behavior under conditions of artificial infestation.

Nutrient solutions, in 600 cc flasks, were made to contain various concentrations of sodium selenate ranging from amounts so small as to supply but 1 p.p.m. of selenium to concentrations as high as 12 p.p.m. Known numbers of aphids were placed on wheat plants growing in these solutions, and records of survival made daily. By placing each flask in the center of a large saucer of water it was possible to prevent migration and to account for the aphids that dropped from the plants.

Aphids placed on 2-months-old plants supplied with concentrations of selenium greater than 3 p.p.m. all died within a few days, while those with lower concentrations lived for as long as a week, although without reproducing actively. Similar results were observed with the red spider, *Tetranychus telarius* (L.). The plants were stunted by concentrations greater than 3 p.p.m. selenium.

The experiment was repeated with younger plants one month old. Comparatively few aphids survived on the plants grown with but 1 p.p.m. selenium, although some reproduction did take place. No damage to the plants themselves was apparent at this concentration. A few aphids survived for several days on plants supplied with 3 and 4 p.p.m., but did not reproduce. As the selenium concentration increased, it was necessary to add more aphids daily in an attempt to keep the plants infested with living aphids. Only on the control plants without selenium did the insects live and multiply normally.

The aphids were evidently sensitive to concentrations of selenium in the plant too low to visibly affect the plant itself. This was also obvious in some experiments with wheat, rye, oats and barley grown in soil treated with sodium selenate at a rate of 10 p.p.m. selenium, a concentration having little effect on the plants but almost completely inhibiting aphid infestation. For some reason more of the aphids persisted on the rye plants than on the others, although here also the number was greatly reduced. Adjacent control plants without selenium were all severely infested.

It is concluded that this species of aphid is killed by selenium taken up by plants from small amounts in the substratum. Evidently concentrations even lower than 10 p.p.m. in the soil would prevent serious attack. Whether or not this sensitiveness can be utilized as a means of insect control, with non-food crops or ornamentals, is problematical in view of the extreme toxicity of selenium to both plants and animals. Certainly the utility of the more readily absorbed selenium salts, such as the sodium selenate used in the experiments reported in the present paper, would seem limited to cases where the land is not to be utilized for food crops or where rapid leaching or irrigation insures complete removal of any residual toxicity.

The toxicity of selenium-containing plants to aphids is in accordance with their singular toxicity to higher animals. Selenium absorbed by vegetation on virgin soils has been shown to be the cause of a sometimes fatal disease of live stock.[3] White rats are injured by concentrations as low as 6 p.p.m. in a diet containing seleniferous grain.[4] The toxicity of selenium has led to various recommendations for its use in insecticides. It has been found especially effective in combatting red spiders,[5] although caution in its use has been urged.[6] It is not recommended by the Department of Agriculture because of the danger of contaminating foodstuffs, and because of a question as to possible injury to the persons making the applications.

A. M. HURD-KARRER

BUREAU OF PLANT INDUSTRY

F. W. POOS

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

U. S. DEPARTMENT OF AGRICULTURE

THE RÔLE OF CERTAIN INORGANIC ELEMENTS IN THE CAUSE AND PREVENTION OF PEROSIS

IN carrying on experiments on the cause and prevention of perosis, an anatomical deformity of the

[1] A. M. Hurd-Karrer, *Jour. Agr. Res.*, 49: 343–357, 1934.

[2] K. W. Franke and V. R. Potter, SCIENCE, 83: 330–332, 1936.

[3] K. W. Franke, T. D. Rice, A. G. Johnson and H. W. Schoening, *U. S. Dept. Agr. Circ.* 320, 1934.

[4] H. E. Munsell, G. M. DeVaney and M. H. Kennedy, *U. S. Dept. Agr. Tech. Bull.* (In preparation.)

[5] C. B. Gnadinger, *Ind. Eng. Chem.*, 25: 633–637, 1933.

[6] E. M. Nelson, A. M. Hurd-Karrer and W. O. Robinson, SCIENCE, 78: 124, 1933.