Places of Birth and Training of Physicists

by ***Bernard C. Murdoch*** *and* ***Marsh W. White***

In the September issue of *Physics Today* the authors of the present article summarized the activities of some 1700 physicists who received their PhD's in the period between 1936 and 1948, showing where they work and what they do. This article, an extension of the same ONR-sponsored study, shows where these physicists were born and where they received their doctorates. Many of the basic data reported here were collected by M. H. Trytten, director of the National Research Council's Office of Scientific Personnel.

There is no obvious formula for predicting the future scientific manpower needs of the United States, but if we depend upon experience gained during the past several years there is every reason to suppose that these needs will become increasingly pronounced for quite some time to come. A number of federal agencies, acting in concert with certain of the professional organizations, are now methodically investigating each of the many factors involved in the present scientific manpower picture in order to see what may be done to insure the country's long-term scientific future. The existing state of international unrest may well extend over a considerable number of years, and it is necessary under the circumstances to know as precisely as possible where we stand with respect to an adequate potential reservoir of scientific and technical manpower. This of course depends largely upon the rate at which American scientists are being trained, as well as upon the quality of the finished product, but any meaningful assessment of the problem must also include a better understanding of some other factors.

It is important, for instance, to know something of the conditions, educational and otherwise, favoring the production of scientists. In the case of physicists, and the present article is concerned only with this variety of scientist, there are some regions of the United States which quite evidently produce conspicuously larger crops of physicists than do others. One may speculate as to the reasons for this, but it seems apparent that more comprehensive statistics are needed before complete and satisfactory answers can be reached.

The present study, which is only a part of a research project sponsored by the Office of Naval Research and administered by the American Council on Education under the direction of Douglas E. Scates, is intended to give a geographic picture of the training of some seventeen hundred persons who received the doctor's degree in physics during a period which extends from 1936 through 1948. The basic data compiled in the course of this study have been punched on IBM cards. Duplicate sets of cards are available for such further studies as may seem in order, in the office of Ralph M. Hogan, head, Manpower Branch, Human Resources Division, Office of Naval Research, and in that of M. H. Trytten, director, Office of Scientific Personnel, National Research Council.

Information having to do with this group of physicists has been obtained which shows where individuals were born and where they were educated. From the data it is possible to get a very clear picture, at least for the cases under study, of the comparative fruitfulness of different sections of the country in the production of physicists. A further piece of information which is of particular interest in view of the results has to do with the migration of physicists living in certain regions from the state of their birth to some other state in order to receive their doctoral training.

Where They Were Born

During the thirteen years covered in this study, more physicists who were born in the Middle Atlantic census division received their doctorates than did those from any other division. The East North Central division was the second most favored birthplace, actually leading the Middle Atlantic division for six of the thirteen years. Figure 1 shows the percentage of all of the degrees awarded each year in physics to persons born in the various census divisions. It can be seen at a glance that the Middle Atlantic and the North Central divisions

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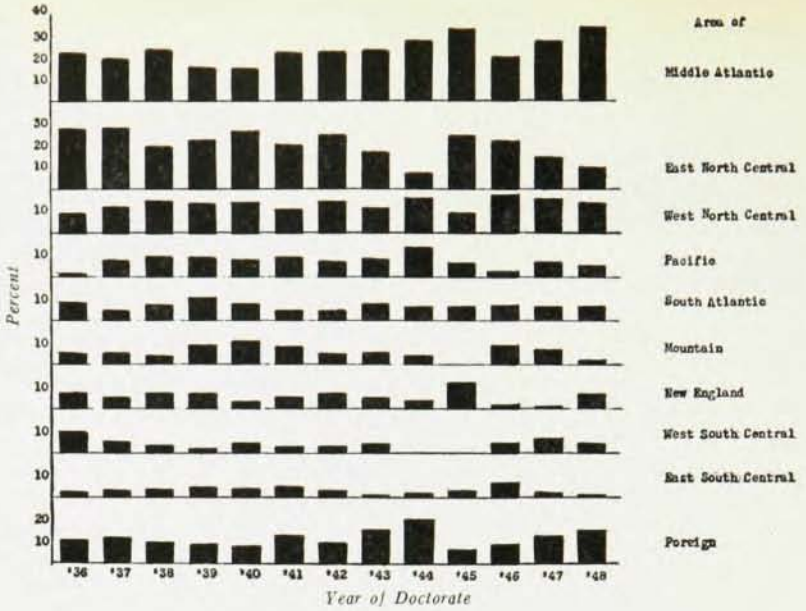

Figure 1. Percent of annual number of doctorates awarded to physicists born in each geographical area

have consistently led all other sections of the country. The two South Central divisions have been most barren of native sons who have gone on to the doctor's degree in physics. The number of physicists born in foreign countries who have taken their doctorate training in this country is strikingly large in comparison with numbers reported from some of our local census divisions.

It might normally be expected that the most largely populated areas of the country would produce the most persons who obtain doctorates in physics. The data obtained for this study, however, indicate that this is only partially true and that the correlation between population and number of physicists born in the area is far from perfect. The map (Figure 2) shows the number of persons born in each state who received a PhD in physics during 1936–1948. New York State because of its large population naturally leads in this respect, followed by Pennsylvania, Illinois, and Ohio. The shading on the map clearly indicates the fact that most of these physicists were born in states bordering upon the Great Lakes section of the country, although California and Texas have also been large producers of young professional physicists. While the average for the country was about thirty-two of these physicists per state, only eleven states exceeded this number. During the same interval ten other states were producing four or fewer persons each who were to obtain a physics PhD. In twenty-six states the total production of these physicists was less than thirteen per state, or one per year for the period of this study.

The Middle Atlantic census division, with 286 physicists, produced 22.7 percent of the persons receiving doctor's degrees in physics during this period. When this group is added to the East North Central number of 264, or 20.8 percent of the total, it is seen that these two sections are responsible for about half of these physicists. During the same period the entire South produced less than 14 percent of this important group of scientists.

These data become more meaningful when they are expressed in terms of some factor which tends to reduce to a common denominator the different areas of the country. A fair basis for such a comparison is to establish the number of persons born in the area who later become physicists in terms of each million of population in the respective areas. Such a tabulation is given in Table 1. The 1910 population was used as a base because the average physicist used in this study was born near this year. On this basis of comparison the divisions of the North yield their superior positions to the Western

TABLE 1. Birthplaces of Physicists, by Number Born in Each Census Division

Group of States in Which Born	*Number of Physicists*	*Percentage of Total*	*No. per million of 1910 Population*
Middle Atlantic	286	22.7	14.8
East North Central	264	20.8	14.4
West North Central	163	12.9	14.1
Pacific	90	7.1	21.1
South Atlantic	83	6.6	6.8
Mountain	75	5.9	28.9
New England	70	5.5	10.6
West South Central	52	4.0	5.8
East South Central	39	3.2	4.6
Foreign	144	11.4	—
Total	1266	100.1	
No Report	429		
	1695		

divisions. This fact becomes more significant if the comparisons are made on a regional basis, rather than on a census division basis, namely:

Region of Birth	*No. per million of 1910 Population*
West	24.3
North	14.0
South	5.9

This tabulation shows that the chances for a person born in the West in 1910 to become a physicist were four times as great as for a person born in the South. For those born in the North the chances for becoming a physics PhD were nearly two and one-half times as great as if he had been a Southerner. As may be seen from Table 1, the Mountain division produced over six times as many physicists per million of population as did the East South Central division. Whether or not it turns out that there is an altitude or latitude effect in producing physicists, this statement seems to have profound significance and it is conceivable that such data may reveal a great potential for our country's human resources in the sciences.

Where They Studied

Worthwhile information is obtained by considering the migration of physics students from the regions of their birth to other sections of the country where they obtained their PhD's. Significant trends in this respect may be revealed by a study of the data shown in Table 2. As an aid in examining this rather formidable-looking table consider the first row and column, for the New England census division.

Of the seventy persons born in this area only thirty-five received their physics doctorates in the same section. The remaining thirty-five received their doctorates as follows: fourteen in the Middle Atlantic division, ten in the East North Central, five in the South Atlantic, six in the Pacific. No students at the doctorate level migrated to the West North Central, East South Central, West South Central, or Mountain divisions. In the Mountain division only two of the seventy-five physicists born in the division received their doctorates in the same region. The other seventy-three spread out to most of the other divisions, twenty going to the nearby Pacific division, twenty to the East North

Figure 2. Number of physicists born in each geographical area. Of those counted, 144 were foreign born.

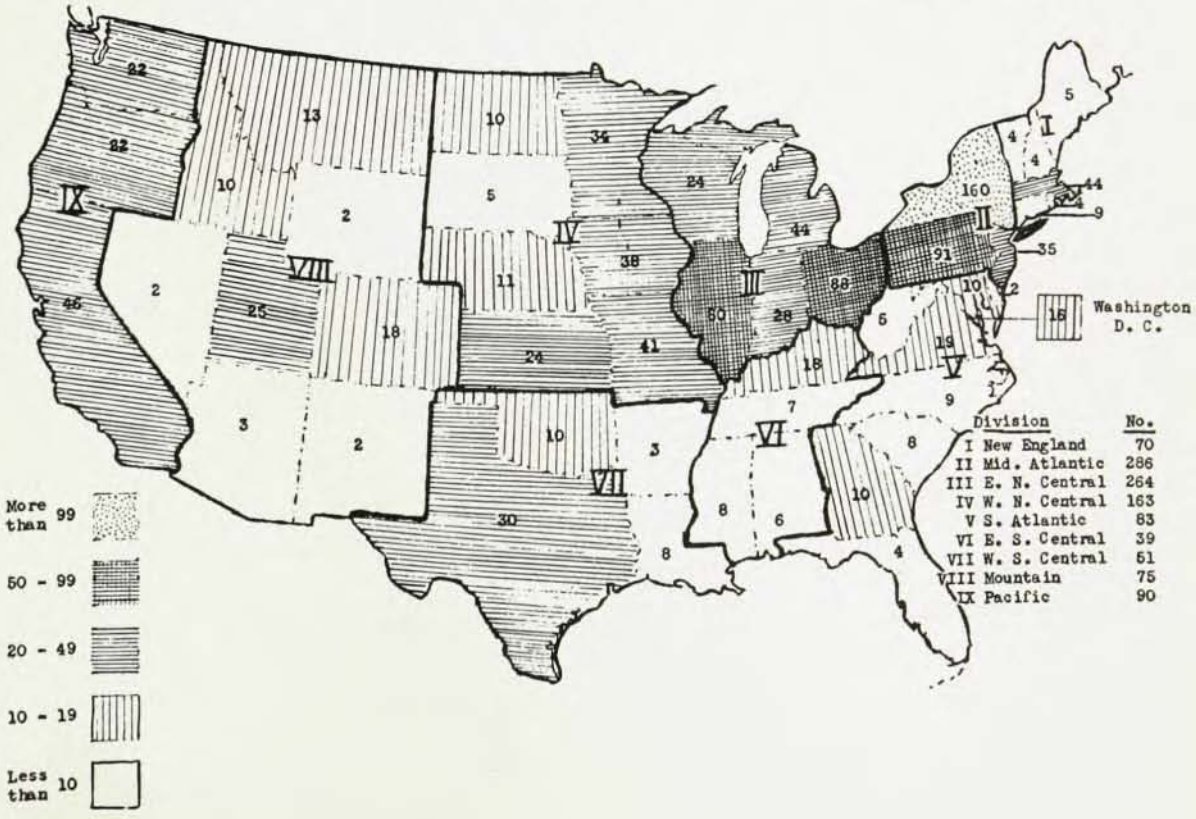

TABLE 2. Place of Birth of Physicists by Place of Doctor's Institution

Location of Doctor's Institution	Place of Birth: New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Foreign	No Information	Total
New England	35	61	29	18	14	2	11	5	8	25	96	304
Middle Atlantic	14	126	30	12	20	8	6	19	10	34	103	382
East North Central	10	41	160	47	15	13	11	20	10	30	114	471
West North Central	0	2	14	47	1	1	3	5	2	8	24	107
South Atlantic	5	26	3	10	31	10	3	3	3	6	28	128
East South Central	0	0	0	0	0	2	1	0	0	0	0	3
West South Central	0	1	4	2	0	1	13	1	2	1	12	37
Mountain	0	1	0	2	0	1	0	2	0	1	0	7
Pacific	6	28	24	25	2	1	4	20	55	39	52	256
Total	70	286	264	163	83	39	52	75	90	144	429	1695

Central, nineteen to the Middle Atlantic, five to the West North Central, and none to the East South Central division. Almost every person who had any connection with the Mountain division was a person who was born there but who received his doctor's degree elsewhere. The divisions most barren in the awarding of PhD's in physics are the East South Central, with three in thirteen years, and the Mountain, with seven during this period. The foreign-born students studied mostly in the Pacific, Middle Atlantic, East North Central, and New England regions with a few in the West North Central and South Atlantic sections.

The number of physicists who have had some connection through birth or location of institution granting their doctorates in each specific census division is differentiated in Figure 3. This chart portrays three different groups for each region: Those born in the division but who received their doctorates in another division (slanted lines); those born and receiving their doctor's degree in the same section (unshaded); those born outside the division and who came into the section to obtain their doctorates (solid shading).

It will be observed from Figure 3 that more physicists had some connection, either through birth or migration for graduate study, with the East North Central division than with any other. The Middle Atlantic region is a close second, with New England and the Pacific divisions following considerably behind. At the bottom is the East South Central, only slightly below the West South Central and the Mountain divisions. The East North Central, Middle Atlantic, New England, and Pacific divisions were the favorite regions into which students migrated to receive their doctorates. Almost no students traveled into the Mountain, West South Central, or East South Central sections. Furthermore, the large majority of students born in these last three regions moved to other sections of the country to obtain their doctorates.

Educators and university administrators might well contemplate the reasons why students travel so far for graduate study. It is not suggested that this is undesirable, providing that some sections of the country are not in the process overcrowded with graduate students, leaving others denuded. Graduate schools in many institutions are becoming seriously overcrowded, with little time available for personal contact between senior professors and students, while many fine, small institutions could satisfactorily handle additional numbers of prospective physics doctorates.

Data concerning the migration of those who have obtained their physics doctorates to different locations for their professional work, other information concerning the ages when PhD's were received, and important facts concerning the baccalaureate origins of this portion of the physicist population will be presented in future articles.

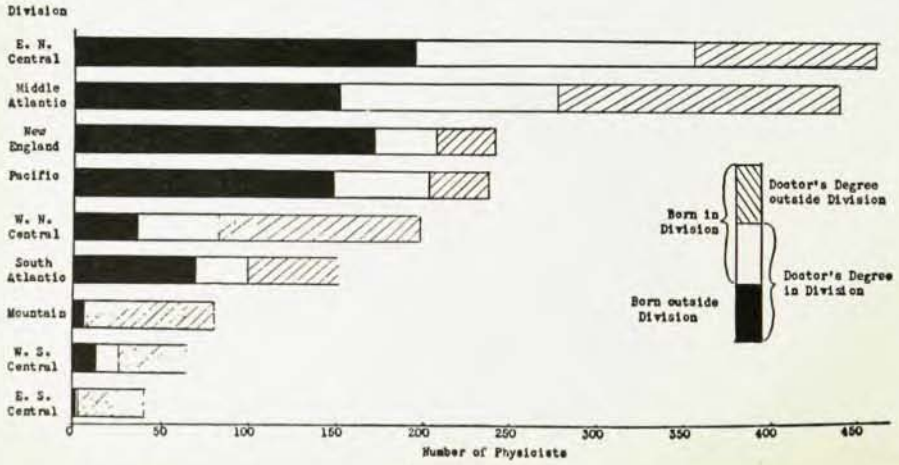

Figure 3. Number of physicists connected with divisions and differentiated according to place of birth and place of doctorate. (For the 1,266 physicists whose place of birth was known.)