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CHAPTER V

SUPPLY AND DEMAND FOR MATHEMATICIANS AND PHYSICISTS

THE numbers of mathematicians and physicists in the United States are not large: the 1950 census reported only 7,359 mathematicians and 11,520 physicists.[1] We propose to study chiefly the even smaller number of persons in these sciences who possess a Ph.D. In 1951 the number of living Ph.D's in mathematics was about 2,100 and the number in physics about 3,500.

These professions do not constitute a significant fraction of the nation's labor force. They do constitute a significant share of the highest stratum of intellectual ability in the population, however, and large relative increases in their numbers probably would involve an appreciable lowering of the number of superior members of other professions. Our reason for choosing to study the factors determining the numbers of mathematicians and physicists is not, however, to emphasize either their unusual capacities or the strategic role they play in the advance of natural science.

Instead, we choose these fields because they pose a very different problem in analysis from that encountered in engineering and chemistry. Most mathematicians and physicists are college teachers, as can be seen from the summary of employment of the Ph.D's included in the 1951 National Registers.[2] There are significant proportions in industry (see Table 36), but the universities are the predominant source of demand for their services. Despite the small size of these two professions, together they are approximately as large as any of the other pure sciences except chemistry, and therefore as good a group as any for the study of supply and demand forces.

1. *Demand Factors*

The educational demand for mathematicians and physicists is broadly determined by the average number of college students per teacher of these subjects, and the trend of enrollments. Certain

[1] Unpublished tabulations of the 1950 census of population, prepared for the National Science Foundation, Bureau of the Census, June 23, 1953.

[2] Since only about two-thirds of the living Ph.D's in each field were included, there is an unknown but possibly appreciable bias in the figures. It is generally believed that the emphasis upon membership in professional societies led to fuller reporting of college teachers.

financial data must also be taken into account, but this simple classification of demand factors will permit a discussion of the main determinants of demand by universities and colleges.

TABLE 36

Distribution of Mathematicians and Physicists with Ph.D.'s among Fields of Employment, 1951

Field of Employment	*Mathematicians*	*Physicists*
Colleges and universities	87.4%	58.4%
Manufacturing	3.7	25.0
Government	6.2	10.7
Other	2.7	5.9
Total	100.0	100.0

Source: *Manpower Resources in Mathematics,* National Science Foundation, 1954, p. 18. *Manpower Resources in Physics, 1951,* Office of Education, 1952, p. 39.

a) FACULTY-STUDENT RATIOS

Since there is no comprehensive and continuous information about the composition of college and university faculties by branch of instruction, we have collected such information for three types of institutions in three well-spaced years. These data, expressed as ratios to total enrollments, are summarized in Table 37. The thirty-five institutions were chosen with such objectives as achieving variety in location and quality of institution, but the largest and the best known institutions are much overrepresented.[3] Our chief interest in these data, however, is methodological: they illustrate a type of information which could easily be collected on a large scale, and for a considerable period in the past.

The faculty-student ratios display no strong trend over the last quarter century. The ratio for mathematicians fell sharply from 1939 to 1951, but this was due entirely to a reduced ratio in liberal arts colleges—the ratio was stable in universities. On the other hand the ratio for physicists rose in the whole period, but the rise was restricted to state universities. It would be easy to rationalize the

[3] The institutions chosen are as follows: *State Universities:* California, Colorado, Illinois, Kansas, Maryland, Michigan, Missouri, Nebraska, Washington, Michigan (State), Ohio (State), Purdue, and Texas Agricultural and Mechanical College. *Private Universities:* Baylor, Boston, Columbia, Duke, New York, Northwestern, Notre Dame, Western Reserve, Yale, Southern California, California Institute of Technology, and Massachusetts Institute of Technology. *Private Liberal Arts Colleges:* Amherst, Antioch, Bates, Beloit, Bowdoin, Centre, Colby, Dartmouth, Grinnell, Haverford.

changes that we observe, but they are not sufficiently general to deserve much confidence.

TABLE 37

Faculty per 1,000 Students in 35 Colleges and Universities, Selected Years

	MATHEMATICS		PHYSICS	
	Average	*Standard Deviation of Average*	*Average*	*Standard Deviation of Average*
1925–1926	3.31	0.14	2.57	0.18
1938–1939	3.32	0.10	2.71	0.17
1950–1951	2.86	0.12	2.87	0.20

Source: Basic data for 35 state universities, private universities, and liberal arts colleges from *American Colleges and Universities*, American Council on Education, 1928, 1940, 1952. Means and standard deviations were calculated for each type of school separately, and these were combined with total enrollments in the three types of schools used as weights; enrollment data are from *Atlas of Higher Education in the United States* (John D. Millett, editor, Columbia University Press, 1952, Tables 21 and 22).

Until faculty-student ratios are collected for more years and more schools—and both types of extension can readily be made—one might take the ratios as 3.3 in mathematics and 2.8 in physics in making at least rough predictions of future faculty requirements. But it is possible also to search more deeply for the factors which govern the faculty-student ratio, and we shall sketch some of the variables which we have investigated. They fall into two classes: enrollment characteristics; and financial data.

Enrollment characteristics

One would expect the ratio of mathematics (or physics) faculty to students to be higher, the larger the fraction of students enrolled in mathematics (or physics) courses. Enrollment data, classified by field, are not available for the individual institutions, so we studied instead the percentage of degrees conferred in physical sciences, mathematics, and engineering in 1950. The 1951 faculty-student ratios proved to be fairly highly correlated with the percentage of such degrees: the correlation coefficient was 0.714 for mathematics teachers and 0.750 for physics teachers. This would suggest that in predicting the future ratio of faculty to students in these areas one should make some allowance for the drift of students toward the physical sciences and engineering.[4]

[4] In 1926–1930, bachelor's degrees in the physical sciences (including mathematics) and engineering accounted for 10.0 per cent of all first degrees;

We also investigated the share of graduate students in total enrollment in 1950 in these thirty-five institutions. Graduate students are taught in small classes and require much more individual attention from teachers, so the larger the share they are of the student body, the more faculty should be required. (Unfortunately we could not segregate the graduate students specializing in mathematics or physics.) For all graduate students, our expectations were not confirmed: the correlation coefficient was —0.071 for mathematics and 0.191 for physics.

We also studied the change in enrollment from 1948 to 1950. A university cannot quickly reduce the number of its faculty when enrollments drop: some of the faculty are appointed for indefinite tenure; and hardly any can be dismissed as suddenly as enrollments may decline. And when enrollments rise, classes can be allowed to increase in size more quickly than the institution can, or desires to, make long run commitments for more staff. This expectation that the faculty-student ratio will be higher in schools whose enrollments have fallen than in schools whose enrollments have risen is known to hold for the experience of American institutions in the postwar period, but it is not confirmed for mathematics or physics: the respective correlation coefficients are 0.140 and 0.095. It should be noted that even when the short-run changes in enrollments are influential, they are relevant only in short run predictions of the faculty-student ratio. This single test, admittedly not complete evidence, suggests that adjustments for short-run fluctuations in enrollments are not necessary in predicting short-run changes in the number of mathematics and physics teachers.

All of the correlations we have so far given are simple correlations, and some change markedly when other variables are introduced. But we shall postpone discussion of the partial correlations until the financial characteristics of the employing institutions are discussed.

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in 1931–1935, 11.0 per cent; in 1936–1940, 10.4 per cent; in 1941–1945, 11.7 per cent; in 1946–1950, 13.9 per cent; in 1951–1953, 11.9 per cent. This rise is due to the growing importance of engineering degrees, rather than to growth in science degrees. The proportion of doctorates in the physical sciences and engineering has grown more rapidly; for the same periods, the comparable percentages are 10.5, 10.9, 10.8, 8.6, 14.1, 16.2. For this degree, only engineering has shown a large relative growth (Dael Wolfle, *American Resources of Specialized Talent,* Harper, 1954, pp. 292–293, 298–299).

Financial characteristics

Two financial characteristics of the employing institutions of higher education have been examined: the level of income; and the amount of research funds.

The wealth of an institution has an obvious effect upon the ratio of faculty to students: the wealthy institution can afford to have smaller classes (and also, what we here ignore, better trained teachers). We measure income of the educational institutions by their total current receipts less receipts from auxiliary enterprises and sales of goods and services (most of which recoup expenditures upon these activities). One uniformly obtains a very high correlation between income per student and the faculty-student ratio: 0.753 for mathematicians, and 0.928 for physicists.

Finally, a considerable number of university faculty are employed in research work, and with the large expansion of grants from the federal government this source of university employment has been growing rapidly. We have sought to measure it by expenditures upon "organized research," per student, in 1950.[5] Again very high correlation coefficients were obtained; 0.666 for mathematicians, and 0.911 for physicists.

Looking back over this list of five possible influences upon faculty-student ratios, we have found three that appear significant: the percentage of degrees conferred in natural sciences, mathematics and engineering; the income per student; and research grants per student. But there are high intercorrelations between some of the factors we examined,[6] so multiple regressions were also calculated. Eliminating variables which were statistically nonsignificant in the first regression equation, we obtained:

$$\begin{aligned} M &= 0.0084 - \underset{(0.015)}{0.049\,G} - \underset{(0.0011)}{0.032\,R} + \underset{(0.0007)}{0.0031\,Y} + \underset{(0.013)}{0.041\,D} \\ P &= 1.334 - \underset{(0.018)}{0.068\,G} + \underset{(0.0013)}{0.0022\,R} + \underset{(0.0008)}{0.0013\,Y} + \underset{(0.016)}{0.013\,D} \end{aligned}$$

[5] We also examined the federal contracts for research per student for the same year. Federal grants are so closely correlated with total research funds ($r = 0.990$) that there is no need for considering them separately.

[6] The correlation between income per student and research funds per student was 0.979, and holding all the other factors we have mentioned constant it was 0.696. It would have been preferable to measure research expenditure as a percentage of total expenditure, but the calculations are laborious, and we did not redo them.

where the standard errors are given below the regression coefficients, and

M = mathematics teachers per 1,000 students, 1951
P = physics teachers per 1,000 students, 1951
G = percentage of graduate to all students, 1950
R = expenditures on organized research per student, 1950
Y = income (except from enterprises) per student, 1950
D = percentage of degrees conferred in natural sciences, mathematics, and engineering, 1950

These regression equations explain most of the variation among schools in the faculty student ratios: the multiple correlation coefficient (adjusted for degrees of freedom lost) is 0.895 for mathematicians, 0.947 for physicists.

Yet the economic significance of some of the regression coefficients is at least as limited as their statistical significance. It is not easy to explain why those institutions with relatively *few* graduate students have relatively *high* faculty ratios especially since the proportion of graduate degrees granted in the natural sciences is higher than the proportion of first degrees.[7] One expects research expenditures to favor physicists more than mathematicians, as our equations suggest, but the sign of the regression coefficient for mathematicians is opposite to what we expect.

The chief suggestion one may wring from this exploratory statistical work—aside from the obvious one that much more work needs to be done in this area—is that perhaps the upward drift of the faculty-student ratio in physics is a genuine phenomenon. The cross-sectional analysis suggests that the growth of organized research favors employment of physicists in universities, and we know that there has been a continuous growth in this type of expenditure in universities for two decades.

b) THE TREND OF COLLEGE ENROLLMENTS

In addition to estimates of the future faculty-student ratio, one must have also estimates of future enrollments in order to predict the demand of institutions of higher education for mathematicians

[7] Conceivably, there may be an inverse relationship among institutions between the proportion of all students enrolled in graduate programs and the proportion of mathematics students enrolled in graduate programs, since mathematics departments perform a service function for such major undergraduate departments as engineering.

and physicists. We set forth the main facts upon which such a prediction must be made in Tables 38 and 39.

TABLE 38

College Enrollments, 1900–1954

	Enrollments (000)	*Per Cent of Population 18–21 Inclusive*
1900	237.6	4.01
1910	355.2	4.84
1920	597.9	8.14
1930	1,100.7	12.19
1940	1,494.2	15.32
1946	1,214.8 [a]	12.74
1948	1,360.5 [a]	14.67
1950	1,730.0 [a]	19.65
1952	1,878.3 [a]	21.92
1954	2,180.8	25.70

[a] Excluding veterans, who numbered 462,100 in 1946; 1,256,800 in 1948; 929,000 in 1950; and 423,600 in 1952.
Source: *Biennial Survey of Education,* Office of Education.

There has been a steady increase in the proportion of the population aged 18–21 attending institutions of higher education, at the rate of almost a doubling of the proportion every twenty years (see Chart 1). Although there were reductions in the proportion in the thirties due to depression, and in the forties due to war and the subsequent postwar flood of veterans, there is little evidence of retardation in the growth of college enrollments relative to population. It would not be very bold to predict that the proportion would be three-tenths by 1965—in the absence, of course, of radical limitations imposed by war or threat of war.

TABLE 39

Estimated Population of College Age (18–21), 1940 to 1965

Year	*Population* (000)
1940	9,753.5
1950	8,805.0
1955	8,537.1
1960	9,459.9
1965	11,765.3

Source: Data for 1955 to 1965 are number of persons 18–21 inclusive, in the absence of deaths or immigration.

The growth of the population of college age reflects the changes in the birth rate of twenty years before, in the absence of catastrophic mortality or mass immigration such as we have not experienced for several decades.[8] We are now at approximately a trough in the number of persons aged 18 to 21 (see Table 39), but soon the number will increase substantially: by 11 per cent from 1955 to 1960, and by 38 per cent from 1955 to 1965.

Let us join these two predictions for 1965—an increase of almost two-fifths in the proportion of college age population, with perhaps three-tenths of this group attending college. Then college enrollments will be roughly 3.5 millions in 1965, or 75 per cent above the record levels of 1954. One can easily defend an alternative estimate that is somewhat higher or lower—especially somewhat higher—but only developments of a magnitude for which we have no precedents in recent history would justify a prediction of only a small increase in college enrollments.

Since we have found that there is no strong tendency for the faculty-student ratio to change in mathematics, we can predict that

[8] It is conventional to follow the Office of Education in relating college and university enrollments to the population aged 18 to 21. Actually a very considerable number of college students come from outside this range; in October 1954 the figures were:

Age	*Students in College or Professional School*
14 to 17	151,000
18 to 19	758,000
20 to 24	924,000
25 to 29	425,000
30 to 34	155,000

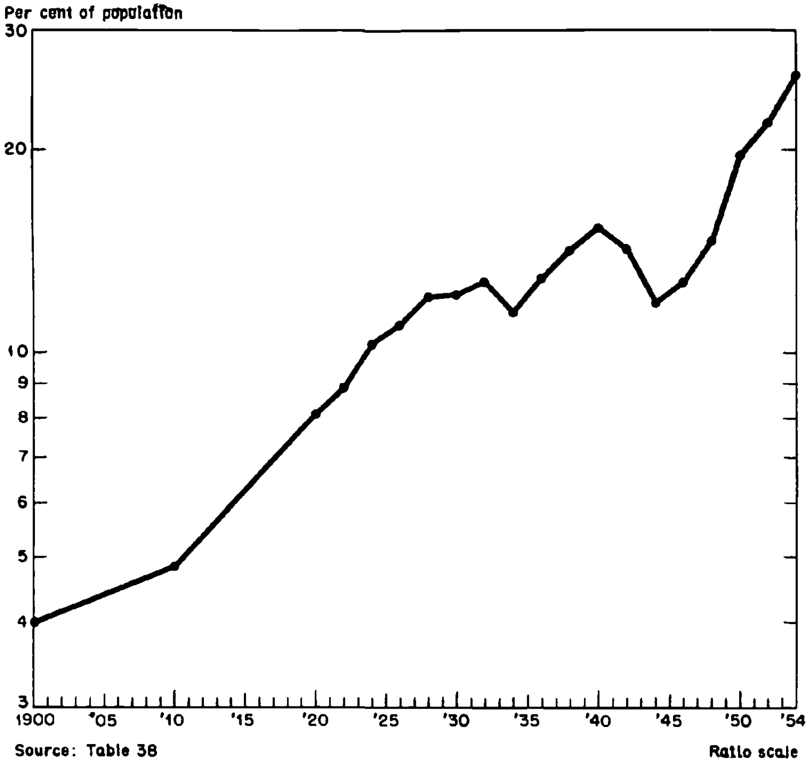
Source: "School Enrollment: 1954," processed, Bureau of the Census, Series P-20, No. 54, January 20, 1955, Table 5.

The lack of a broader age base, perhaps with weights proportional to enrollments, suggests short run predictions on this basis cannot be accepted with great confidence. A broader age base would tend to yield slightly lower forecasts of college enrollments. To demonstrate this we have computed two indexes. One is based on the number of persons who will be in the 18–21 age bracket in each year 1950–1970, derived from corrected birth registrations. The other is based on the number of persons, aged 17–24, who will attend college in each year 1950–1970, if the proportions of persons at college at each age in this eight-year bracket remain at their 1950 levels (derived from corrected birth registrations and data on college enrollments by age brackets in the *Census of Population, 1950,* Vol. II, par. 1, Chap. C). The first index moves in proportion to the changes in the numbers of persons in the age bracket 18–21; the second, in proportion to the age bracket 17–24, weighted by the proportions attending college in 1950. With both indexes computed to a 1950 base, the first index reaches 110 in 1960, 139 in 1965 and 163 in 1970; the second index reaches 106 in 1960, 133 in 1965 and 159 in 1970.

at least as a first approximation, colleges and universities will require about three-fourths more mathematicians in a decade. If there is a moderate upward tendency in the faculty-student ratio in physics, the college and university demand will increase somewhat more rapidly than in mathematics. Since our analysis of the faculty-student ratio in particular rests upon very tentative and almost illustrative calculations, we are not inclined to press these predictions in detail, but they surely are tolerably reliable so far as general orders of magnitude go.

Chart 1

College Enrollments as Percentage of Population 18–21 Inclusive, 1900–1954



There remains one further question in principle: is there a college demand for fully trained mathematicians and physicists—by which we mean those possessing the doctorate—or is the demand readily met by the employment of those with lesser formal training?

The history of the composition of the faculty possessing the doctorate in a small sample of institutions is presented in Table 40 and summary figures for a somewhat larger group of institutions are

TABLE 40

Percentage of Mathematics and Physics Teachers with Doctorates in 21 Institutions, 1900–1954

	MATHEMATICS			PHYSICS		
	State Universities	*Private Universities*	*Liberal Arts Colleges*	*State Universities*	*Private Universities*	*Liberal Arts Colleges*
1900	45.2	47.4	35.6	26.1	66.2	50.0
1910	49.5	64.7	35.0	39.8	92.2	69.0
1920	66.1	51.5	46.7	48.8	53.0	67.2
1930	63.6	62.8	48.2	61.5	64.0	82.1
1940	67.4	73.3	67.6	77.8	81.7	90.8
1945	78.7	67.2	67.3	65.0	79.8	73.0
1950	73.5	59.3	64.1	85.1	76.4	83.3
1954	74.5	82.5	62.1	90.2	87.7	76.9

Source: Catalogues of the following institutions: *State Universities:* California, Indiana, Kansas, Missouri, Washington, Louisiana (State), Purdue; *Private Universities:* Brown, Columbia, George Washington, Johns Hopkins, New York, Western Reserve, Yale; *Liberal Arts Colleges:* Antioch, Colgate, Dartmouth, Lafayette, Oberlin, Swarthmore, Washington and Lee. Unweighted averages of percentages for the individual institutions.

given in Table 41. The main drift of the data is in keeping with expectations: there has been a large increase in the proportion of the faculties in mathematics and physics who hold the doctor's degree, with the most rapid increase coming in the first two decades of the present century. The decline from 1940 to 1950, one may reasonably assume, was compelled by the vast expansion of enrollments during the war. We have not examined in detail the variations among schools in the percentage of faculty holding doctorates—an

TABLE 41

Percentage of Mathematics and Physics Teachers with Doctorates, 1930, 1940 and 1950

	Mathematics	*Physics*
1930	59.2	67.9
1940	69.1	82.9
1950	66.3	81.8

Source: Covers same 35 institutions that are used in the faculty-student analysis. Weighted averages, with enrollments as weights.

inquiry that could be conducted in a manner similar to the earlier study of inter-school variations in the faculty-student ratio. But it seems probable from the historical record that there will be a moderate upward drift in the proportion of mathematicians and physicists in universities holding the doctorate, so that the demand for fully trained members of these professions will increase moderately more than the demand for all teachers.

One investigation of the composition of university faculties was made because it was naturally suggested by general economic theory: that the numbers of more experienced faculty members are smaller when their relative salaries are higher. Unfortunately it was necessary to accept academic rank as a measure of experience (and ability), and this may well have been a serious or fatal defect in the investigation: the weak institution may have lower standards for the higher ranks relative to the lower ranks. But for the forty-eight land-grant institutions for which we could get 1952 data on numbers and salaries (for the entire institution, not mathematics and physics only), there is no evidence that the institutions substitute less experienced for more experienced teachers when the latter's salaries rise relatively.[9]

2. *The Supply of Mathematicians and Physicists*

In a broad way it may be stated that there cannot be a serious problem of supply of faculty in institutions of higher education. For the very presence of a much increased demand (that is, a much increased student body) carries with it a much increased supply of trained individuals. Indeed there has been much more concern with the problem of finding appropriate employment for a rapidly increasing population of highly trained persons than in finding teachers to train them.

To this broad generalization there are obviously several qualifications. The first is that the supply of highly trained individuals (say, possessors of doctorates) need not keep exact pace with current college enrollments, so that for a time there may be a relative scarcity of such teachers. Since the average doctorate in physics is received

[9] The correlation coefficient between the ratio of the number of full and associate professors to assistant professors and instructors and the corresponding ratio of average salaries was 0.06. Similarly, there was little relationship between the ratio of the number of full (and associate) professors to assistant professors (and instructors) and the average salaries of all faculty members. The data were made available by the Office of Education.

about six years after the bachelor's degree, the period of shortage of highly trained individuals can obviously be at least this long.[10]

But the proportion of college graduates going on for advanced degrees has been rising. Graduate students were 4.3 per cent of all college and university enrollments in 1930, 7.1 per cent in 1940, and 8.9 per cent in 1950, and presumably this upward movement will continue. The pool of new doctorates will therefore at least keep pace with current enrollments.

It will still be possible for the supply of teachers of given competence and experience to shrink relative to teaching demands whether because of increased competition from employers in industry and government, or from the even longer lag in developing a large number of experienced mathematicians and physicists. It is obviously almost impossible to discuss in quantitative terms the deterioration of faculty standards that might arise in staffing the much larger number of classrooms of a decade hence. Since the enrollments are increasing less rapidly than from 1940 to 1948, and it is not anticipated that there will be a virtual suspension of advanced training such as occurred then, one can say that the deterioration should be substantially less than it was in the immediate postwar period.

The second qualification of our broad generalization that the demand and supply of college teachers move together is that there can be an imbalance between the demands and supplies of any one kind of highly specialized personnel. A large expansion of enrollments in courses in mathematics may be matched, but not appropriately staffed, with a large increase in the number of qualified teachers of modern language.

One may give both a specific and a general answer to this question of whether specialists are trained in proportions corresponding to the demands for them, i.e., in such proportions that the salaries of the various kinds of specialists move in parallel fashion. The specific answer is that there is no reason to doubt that so far as mathematics and physics are concerned, there will be at least an adequate proportion of doctorates in these fields. Since 1940 there has been a substantial increase in the relative number of doctorates taken in

[10] For the average delay between receiving bachelor's and doctor's degree in physics, see D. E. Scates, B. C. Murdoch, and A. V. Yeomans, *The Production of Doctorates in the Sciences, 1936–1948,* American Council on Education, 1951, p. 133.

these fields.[11] The enormous growth of the public interest in physics and mathematics, and the rise in the prestige, and probably in relative monetary earnings, of doctorates in these fields are such that there is no presumption that there will be a relative inadequacy of specialists in these fields. On the contrary, it is other fields, such as the humanities, that have reason for concern.

The general question—do specialists choose their fields in such a way as to maintain a relative balance of supply of the fields (measured by earnings)—is more difficult to answer. We do not have the data to determine whether there are large fluctuations in the relative salaries of professors in the various disciplines, and in the absence of such data all complaints of shortages—as we have already noted in the discussion of engineering shortages—must be viewed as highly subjective, and possibly quite imaginary.

Even over periods of say five years the numbers in any one branch of the professions cannot be increased greatly unless it is possible to plan the expansion years in advance: the period of training puts a minimum length upon the period of readjustment of the rate of recruitment. The question naturally arises—is it possible to recruit instead the experts from related sciences when one science needs to expand rapidly?

The answer to this question is rendered especially difficult by the fact that we do not possess definitions of the various sciences which are satisfactory for our purposes. The conventional boundaries, like physics, mathematics and chemistry, are the product partly of historical experience (and hence are slowly changing) but also of convenience in university and professional organization. A more suitable division for our purposes would be one constructed perhaps on the basis of the similarity of the formal education. Thus if physics and physical chemistry had the same training to the extent of 80 per cent of their graduate work, and for physics and geology the common training were only 20 per cent, we could say that the former pair of disciplines were much closer than the latter pair. Indeed if we found that the common training for two branches of physics was less than 80 per cent, we could say that physics and physical chemistry were closer in training than say acoustics and classical physics, and predict greater mobility in the former case.

[11] In 1941–1945, 7.0 per cent of all doctorates were in the physical sciences (physics, metallurgy, mathematics); in 1946–1950, 8.5 per cent; in 1951–1953, 9.5 per cent (Wolfle, *op. cit.*, p. 298).

As it is, to be told that of a sample of the better known physicists in 1949, some 37 per cent had worked in another general field such as chemistry, electronics, and mathematics is fundamentally ambiguous.[12] Electronics may simply be a branch of physics—it is so treated in another government study of the same time [13]—so the occupation mobility may be misstated, or at least represent an unknown amount of real mobility.

The National Scientific Registers have been examined in both physics and mathematics for educational background.[14] In both disciplines there is relatively little mobility among those with doctorates. Of the physicists with a Ph.D., 89 per cent had the degree in physics; in mathematics the corresponding percentage was 93. Of course at lower levels of training there is greater movement, so, for example, only 70 per cent of the physicists with a bachelor's degree had taken that degree in physics, and another 17 per cent had engineering degrees.

One cannot complete this type of calculation and estimate how many Ph.D's in physics are still in this line of work but a part of the answer we seek can be found in the two studies just referred to. They allow the following tabulation:

	Ph.D. Conferred in	
	Mathematics	Physics
Employed in mathematics	1,360	38
Employed in physics	34	2,621

These fragments of information suggest that it is valid to treat the various disciplines separately when one is dealing with periods of time too short to allow major additions by recruiting graduate students.

[12] *Occupational Mobility of Scientists*, Bureau of Labor Statistics, Bull. 1121, 1953, p. 16. Some of the shifts are spurious, or at least misleading: thus when a physics professor becomes dean of sciences, a shift to the separate discipline of general science was recorded.

[13] *Manpower Resources in Physics, 1951*, Office of Education, June 16, 1952, p. 5.

[14] *Ibid.; Manpower Resources in Mathematics, 1951*, National Science Foundation, December 1, 1953.