men, the first speaker being Mr. Charles F. Stewart, a reporter on the *Cleveland News*. He most entertainingly described how, after a thorough physical examination had shown him to be in good health, the various quacks and charlatans in Cleveland, one of whom was able to expend $80,000 a year for postage stamps alone, pronounced him suffering from various diseases of an unmentionable nature. Among the other speakers were Mr. Eugene O'Dunne, of Baltimore; Mr. Thomas W. Barlow, of Philadelphia, and Mr. Anthony Comstock, of New York.

It seems as if politics can not be run without a boss or the laws upon our statute books be properly enforced without special societies for this purpose. The success of such a movement started from without the medical profession, but with every aid extended to it by physicians, will be even more marked than if it had been undertaken under the auspices of such an organization as the American Medical Association. The chief difficulty to cope with will be to formulate a working plan so that the various branches will be able to cooperate most efficiently with the parent chapter. As was pointed out in the remarks of Dr. Charles A. L. Reed, of Cincinnati, one of the first things to do is to make the laws of our different states bearing upon public health and morals uniform. Thus it would be advisable to have the present United States pure food and drug law passed by the legislature of each state, and to frame a law making it a penal offence to offer to perform a criminal operation and to revoke the license of any physician who upon due process of law has been convicted and sentenced for the performance of such illegal act. To prosecute work of this character and the sanitation of to-day there should be created a national department of health with its head a member of the Cabinet, as so ably advocated by Professor Norton, of Yale. H. W.

SPECIAL ARTICLES.

A STATISTICAL STUDY OF AMERICAN MEN OF SCIENCE. III.

THE DISTRIBUTION OF AMERICAN MEN OF SCIENCE.

From a conventional point of view the distribution of men of science would not be regarded as a psychological problem, perhaps not even as a scientific problem. But in recent years the distribution of plants and animals has received increasing attention in botany and zoology, and apart from its pertinence as a correct description of the world in which we live, it has proved, on the one hand, to have certain practical applications, and, on the other hand, to throw light on certain general problems of heredity and evolution. Similar results may accrue from a scientific study of the distribution of human ability and performance.

The birthplace and the present residence of the thousand leading men of science of the United States are shown on the accompanying table, the divisions used being those of the census. Figures are given separately for the five hundred (I.–V.) who are more distinguished and for the five hundred (VI.–X.) whose reputations are less, followed by the totals and their number per million of the population. As the average age of the scientific men is about 45 years, their birth rate is referred to the census of 1860.[1] Thus the first line of the table shows that 29 of the 1,000 scientific men were born in Maine, and four now reside there. Of the 29 scientific men born in the state, 19 are among the 500 who are more eminent and 10 among the 500 who are less eminent. The number born was at the rate of 46.1 per million of the population at the approximate time of their birth, or one for each 22,000. The scientific population of the state is now only at the rate of 5.7 per million of the population, or scarcely more than one for each 200,000.

There are striking variations in the origin and in the present residence of scientific men throughout the United States. Massachusetts and Boston have been the intellectual center of the country. The birth rate of these leading men of science is in Massachusetts 108.8 per million population; it is 86.9 in Connecticut,

[1] This is not exact, as the age distribution is not symmetrical, and the rate of increase of the population in the different states is not uniform, but the results are as nearly correct as is necessary.

and decreases continually at greater distances from this center. It is reduced to about one half in the surrounding states—46.1 in Maine, 46 in New Hampshire, 57.1 in Vermont and 47.2 in New York. There is a further reduction to one half in Pennsylvania—to 22.7—and this proceeds as we go southwards, the rate being 8.8 in Virginia, 5 in North Carolina, 2.8 in Georgia, 2.1 in Alabama, 1.3 in Mississippi and 1.4 in Louisiana. In the north central states the conditions are intermediate between New York and Pennsylvania. Thus the birth rate per million is 32.1 in Ohio and 36 in Michigan. Here again it decreases as

TABLE I. DISTRIBUTION OF THE THOUSAND MEN OF SCIENCE.

	Birthplace.			Per Million 1860.	Residence.			Per Million 1900.
	I.-V.	VI.-X.	Total.		I.-V.	VI.-X.	Total.	
North Atlantic Division.								
Maine	19	10	**29**	*46.1*	0	4	**4**	*5.7*
New Hampshire	7	8	**15**	*46.0*	2	6	**8**	*19.4*
Vermont	9	9	**18**	*57.1*	0	2	**2**	*5.8*
Massachusetts	60	74	**134**	*108.8*	74	70	**144**	*51.3*
Rhode Island	4	1	**5**	*28.6*	7	1	**8**	*18.7*
Connecticut	26	14	**40**	*86.9*	27	16	**43**	*47.3*
New York	99	84	**183**	*47.2*	93	99	**192**	*26.4*
New Jersey	9	19	**28**	*41.6*	17	18	**35**	*18.5*
Pennsylvania	32	34	**66**	*22.7*	28	37	**65**	*10.3*
South Atlantic Division.								
Delaware	0	2	**2**	*17.8*	0	1	**1**	*5.4*
Maryland	12	14	**26**	*37.8*	24	23	**47**	*39.5*
District of Columbia	1	2	**3**	*39.9*	69	50	**119**	*426.9*
Virginia	5	8	**13**	*8.8*	8	2	**10**	*5.4*
West Virginia	1	0	**1**		2	1	**3**	*3.1*
North Carolina	1	4	**5**	*5.0*	3	3	**6**	*3.2*
South Carolina	2	3	**5**	*7.1*				
Georgia	1	2	**3**	*2.8*	0	1	**1**	*1.4*
South Central Division.								
Kentucky	6	2	**8**	*6.9*	1	2	**3**	*1.4*
Tennessee	5	1	**6**	*5.4*	2	1	**3**	*1.5*
Alabama	1	1	**2**	*2.1*	1	1	**2**	*1.1*
Mississippi	1	0	**1**	*1.3*				
Louisiana	1	0	**1**	*1.4*	0	1	**1**	*.7*
Texas	0	3	**3**	*4.9*	2	5	**7**	*2.3*
North Central Division.								
Ohio	42	33	**75**	*32.1*	13	21	**34**	*8.2*
Indiana	17	11	**28**	*20.7*	4	8	**12**	*4.7*
Illinois	24	18	**42**	*24.5*	36	27	**63**	*13.1*
Michigan	12	15	**27**	*36.0*	22	5	**27**	*11.1*
Wisconsin	11	24	**35**	*45.1*	11	12	**23**	*11.1*
Minnesota	1	3	**4**	*23.2*	3	10	**13**	*7.4*
Iowa	6	14	**20**	*29.6*	5	2	**7**	*3.1*
Missouri	4	10	**14**	*11.8*	7	14	**21**	*6.7*
North Dakata					0	2	**2**	*6.2*
South Dakota					0	2	**2**	*3.9*
Nebraska	1	1	**2**	*69.3*	4	5	**9**	*8.4*
Kansas	5	2	**7**	*65.3*	2	3	**5**	*3.4*
Western Division.								
Montana					0	2	**2**	*8.2*
Wyoming					0	1	**1**	*10.8*
Colorado	0	3	**3**	*87.2*	3	5	**8**	*14.8*
New Mexico					0	2	**2**	*10.2*
Arizona					1	1	**2**	*16.3*
Washington	1	0	**1**	*86.2*				
California	5	6	**11**	*28.9*	23	30	**53**	*35.7*
Alaska					0	1	**1**	*15.7*
Hawaii	1	0	**1**					
Philippine Islands					2	1	**3**	
Total	**432**	**435**	**867**	**27.6**	**496**	**498**	**994**	*13.3*

	Birthplace.			Per Million 1860.	Residence.			Per Million 1900.
	I.—V.	VI.—X.	Total.		I.-V.	V.-IX.	Total.	
Canada	11	23	**34**	*28.7*	1	1	**2**	
Brazil					1	0	**1**	
Cuba					0	1	**1**	
England	10	15	**25**	*29.6*	1	0	**1**	
Ireland	2	1	**3**	*1.8*				
Scotland	6	3	**9**	*37.9*				
Wales	0	1	**1**	*10.7*				
West Indies	0	1	**1**	*69.1*				
Germany	15	4	**19**	*7.1*				
Austria-Hungary	4	2	**6**	*10.4*				
Norway	1	0	**1**	*2.9*				
Sweden	2	1	**3**	*5.2*				
Denmark	0	2	**2**	*12.9*				
Switzerland	4	4	**8**	*68.9*				
Russia	4	2	**6**	*7.4*				
Italy		1	**1**	*2.1*				
Spain	0	1		*137.3*				
Turkey					1	0	**1**	
India	4	0	**4**	*193.3*				
China	1	1	**2**	*18.7*				
Total	**64**	**62**	**126**		**4**	**2**	**6**	
Grand Total	**496**	**497**	**993**		**500**	**500**	**1000**	

we go southward. The rate is 45.1 in Wisconsin, 24.5 in Illinois, 11.8 in Missouri and 6.9 in Kentucky. Westward the total number of scientific men is too small and the population has been too rapidly increasing for the figures to be reliable. Each individual should be considered in connection with the population at the time of his birth, but even in this case the validity of the results would be small.

Of the 1,000 scientific men, 126 were born in foreign countries—34 in Canada, 38 in Great Britain and 19 in Germany. The birthplace of seven is not known. The number per million is for the native population 13.2, and for the foreign-born population 12. These figures have, however, no significance, as the foreign-born population contains a much larger proportion of adult males. The percentage of the white native population in the United States over 40 years of age is 18.4, and of white foreign-born is 44.4. The native population consequently produces more than twice as many scientific men as the foreign-born, even without regard to the excess of males among the foreign-born, the inclusion of the colored races among the native-born and the fact that many of the foreign-born have been called to this country on account of their scientific standing. The different nations contribute scientific men in very unequal measure, the numbers per million foreign-born being as follows: Switzerland, 68.9; Scotland, 37.9; England, 29.6; Canada, 28.7; Austria-Hungary, 10.4; Russia, 7.4; Germany, 7.1; Sweden, 5.2; Italy, 2.1; Ireland, 1.8; France, 0. These differences can not be attributed to race, as they do not represent the scientific productivity of these nations, but only of the classes that have emigrated to this country. While it is not possible to deny that the variations are dependent on the kinds of family stocks, it is probable that they are due in much larger measure to social and economic conditions. The native-born sons of Irish-born parents may not be inferior in scientific productivity to other classes of the community.

The inequality in the production of scientific men in different parts of the country seems to be a forcible argument against the view of Dr. Galton and Professor Pearson that scientific performance is almost exclusively due to heredity. It is unlikely that there are such differences in family stocks as would lead one part of the country to produce a hundred times as many scientific men as other parts. The negroes may have a racial

disqualification, but even this is not proved. The main factors in producing scientific and other forms of intellectual performance seem to be density of population, wealth, opportunity, institutions and social traditions and ideals. All these may be ultimately due to race, but, given the existing race, the scientific productivity of the nation can be increased in quantity, though not in quality, almost to the extent that we wish to increase it.

There may be no significant difference in the distributions of the first and second groups of 500. Some states have produced men of higher average standing than others, but the differences are within the range of possible chance variations. Thus Maine has produced 19 men of the first rank and 10 of the second. But if 29 pennies are tossed up, there is one chance in 14 or 15 ($P = .068$) that there will be 19 or more heads. It is, however, true, as a matter of fact, that Maine, Connecticut, Ohio, Indiana and Illinois have produced men of decidedly higher average standing than New Jersey, Wisconsin, Iowa and Missouri. Those born in Germany are considerably above and those born in Canada are below the average, and the figures may here represent a real difference in the classes drawn to this country.

The fact that there is not a significant difference in the average standing of scientific men born in different regions of the country tends to support the conclusion that scientific performance is mainly due to environment rather than to innate aptitude. If the fact that Massachusetts has produced relatively to its population four times as many scientific men as Pennsylvania and fifty times as many as the southern states were due to a superior stock, then we should expect that the average standing of its scientific men would be higher than elsewhere; but this is not the case. Like most arguments intended to disentangle the complex factors of 'nature and nurture,' this, however, is not conclusive. If scientific ability were innate, each tending to reach his level in spite of environment, then a potentially great man of science would become such wherever born, and we might expect a favorable environment to produce mediocre men, but not great men. But this argument is answered by the small number of scientific men from certain regions of the country. Differences in stock can scarcely be great enough to account for this; it seems to be due to circumstance. A further analysis of the curves of distribution might throw light on the problem. Thus it might be that the men of greatest genius were independent of the environment, while men of fair average performance were produced by it. Examples might be given in favor of this view, but I can not see that it is supported by the forms of the curves of distribution. I hope at some time to take up the question from a study of individual cases, but I have not as yet the data at hand. My general impression is that certain aptitudes, as for mathematics and music, are mainly innate, and that kinds of character and degrees of ability are mainly innate, but that the direction of performance is mainly due to circumstances, and that the environment imposes a veto on any performance not congenial to it.

The present distribution of the 1,000 men of science is somewhat the same as their origin. The population of the country has more than doubled since 1860, and the number of these scientific men per million population is consequently less than half the number per million at the period of their birth. There are in Massachusetts 144 of the 1,000, which is 51.3 per million of the population, according to the census of 1900. The numbers then decrease to 26.4 per million in New York, 10.3 in Pennsylvania, 13.1 in Illinois, 8.2 in Ohio, 3.1 in Iowa, 1.1 in Alabama, 0.7 in Louisiana and 0 in Mississippi. The most striking development has been the attraction to Washington of a large group of scientific men, 119 of the thousand, nearly all in the service of the government. This number has been almost exactly supplied to the country by the excess of scientific men born abroad—120. This leaves an equal balance between the gains and losses of other parts of the country. The greatest gain has been made by California, which has drawn 42 of the scientific men from other states; Illinois and Maryland have each gained 21. Other states have gained consider-

ably in proportion to their total scientific population—New Jersey, 7, Minnesota 9, Missouri 7, Nebraska 7 and Colorado 5. These gains appear to be significant, attributable to the establishment and growth of universities.

Massachusetts, New York and Pennsylvania have remained nearly stationary. Massachusetts has gained ten of the scientific men and New York nine, while Pennsylvania has lost one. The conditions in New York are by no means creditable to that state, in view of its great increase in wealth. Outside New York City, the state has lost 31 men of science, nearly one third of those it has produced, and half the others are concentrated at Ithaca. The conditions are somewhat similar in Massachusetts and Pennsylvania, outside Boston, Cambridge and Philadelphia.

The rural New England states, Maine, New Hampshire and Vermont, have lost 48 of the 62 scientific men whom they have produced. This is a loss that they can ill afford; it signifies a distinct decadence. Had each of these states provided an income of $50,000 to retain these men in their service, they would have been repaid manyfold, commercially as well as intellectually. The conditions in some of the north central states are also ominous, though more likely to improve. Thus Ohio has lost forty-one of its scientific men, more than half of those whom it has produced; Indiana has also lost more than half and Iowa just half. The south remains in its lamentable condition of scientific stagnation, but we may hope that material progress will be followed by an intellectual awakening. All these figures become more impressive when we remember that they indicate performance in scholarship, in literature and in art, as well as in science. It would be well if they were widely known, as they would tend to awaken civic pride and to improve the conditions of intellectual activity.

The average standing of the scientific men residing in different parts of the country varies a little more than the standing of those produced in different regions and is perhaps less likely to be due to chance variations. This appears to be somewhat paradoxical from the point of view of the theory of probabilities. The fact that of the 75 scientific men born in Ohio, 42 belong to the first group and 33 to the second is a natural result of chance distribution, and the fact that of the 34 scientific men remaining in the state, 13 belong to the first group and 21 to the second might equally well be the result of chance distribution. But apparently it is not. Ohio has lost more than half the scientific men it has produced; it has lost two thirds of its better men and one third of its more mediocre men. The state has not provided for its scientific men, and has provided less adequately for the better men than for those who are not so good. Indiana has lost three fourths of its men of the first class and one fourth of those of the second class. The three rural New England states have lost seventeen eighteenths of their men of the first class and one half of those of the second class. These conditions are significant and serious.

Other states have improved their positions. Thus, thanks to its great university, Michigan has 22 men in the first group as compared with five in the second. Thanks again to its universities, Illinois has increased its number of scientific men from 42 to 63, of whom 36 are in the first class. California, Missouri and Minnesota have, on the other hand, called men who are below the average.

The large centers of scientific population in Massachusetts and New York have about maintained their positions, having produced men of about average standing and their resident men of science being of about average standing. Massachusetts has, however, gained a little and New York has lost a little. Of the 119 scientific men in Washington, 69 are in the first group and 50 in the second. This appears to me to be a fact of very great importance. It is commonly said that less able scientific men are attracted to the government service, that those who are able leave it for university positions and that those who stay are not encouraged to do their best work. Such statements are refuted by these statistics. The average performance of the scientific men at Washington is higher than in Massachusetts or in New York. This conclusion is most gratifying to those of us who believe that the future of scientific research depends large-

ly on its support by the nation, the states and the municipalities.

The writer has on various occasions called attention to the economic conditions which limit scientific research. As one of the objects of the present work is to improve these conditions, it may be well to repeat here the argument. Our economic system rests on the free exchange of services. A state of society may some day be reached in which each will aim to give as much as he can and to take as little, but at present it appeals to our sense of fairness that each should ask for his services what someone else is willing to pay. In the increasing complexity of our society this method is working two serious injustices. One of these is the formation of monopolies. Thanks chiefly to the applications of science, many services can now be supplied at a cost less than people would be willing to pay. When free competition is excluded, either by the conditions of the case or by ingenious combination, people may be made to pay more than a fair return for certain services. The problems of monopoly are being discussed on all sides, and remedies are being sought in all directions; but the injustice which in a way is the converse of monopoly has scarcely been noticed. This is the case in which an individual gives services without an adequate return, owing to the fact that they are not rendered to a single individual or group who will pay for them, but to society as a whole. A surgeon may ask for an operation for appendicitis as large a fee as his patient is willing to pay, but should he after years of research discover a method of preventing appendicitis altogether, he would receive no payment at all, but would, on the contrary, give up all future fees for the operation. The surgeons who by risking and sacrificing their lives discovered how to suppress yellow fever have received no return for their great work.

The two most important services for society —the bearing and rearing of children and creation in science and art—are exactly those for which society gives no economic returns, leaving them dependent on instincts which are in danger of atrophy. This state of affairs not only does injustice to the unrewarded individual, but works immeasurable harm to society—a greater injury probably than all existing monopolies. There are more than a hundred thousand physicians in the United States who are practising on their patients for fees, while there are scarcely two hundred who are studying seriously the causes of disease and the methods of preventing it. The conditions are similar in law and in all professions and trades. The scientific investigator is usually an amateur. He has wealth or earns his living by some profession, and incidentally does what he can to advance science for love of the work. This has its good side in producing a small group of men who are not subject to purely commercial standards. But this is after all a minor factor, and the scientific man is likely to look for fame, which is scarcely more ideal than money and can be supplied to but few. Satisfaction in the work itself is the best reward for work; but no one can know that his work is of value except by the reflected appreciation of others, and in the existing social order the simplest and probably the most adequate expression of this appreciation is direct payment for the service rendered.

The methods that society has devised to meet this situation, apart from the conferring of honors and fame, are recent and inadequate. Copyrights and patents are the most direct acknowledgment of property in ideas. They have accomplished a good deal, and their scope should be extended. At present only a small part of discovery is covered by the patent office, and this perhaps not the part requiring the greatest genius. It is, however, leading, especially in Germany, to the development of discovery on a sound commercial basis. It is said that one chemical firm employs three hundred doctors of philosophy to carry on scientific investigations. Research has hitherto been forwarded mainly by the universities, where again Germany has led the way. The professorship is given as a reward for successful investigations, and the holder of a chair is expected to devote himself to investigation as well as to teaching. There is a tendency to permit certain professors to engage almost exclusively in research. Thus the astronom-

ical observatories of Harvard, Chicago and California universities are purely research institutions. A further step has been taken in the endowment of institutions, such as the Carnegie Institution and the Rockefeller Institute, explicitly for research. The most logical and important advance, however, consists in the direct conduct of research by the government. As the government should control monopolies, so it should conduct the work which is not for the benefit of a single individual, but for the people as a whole. There are, of course, no end of difficulties in the control of monopolies or the conduct of research by a municipality, state or nation; but it is exactly these difficulties that it is our business to overcome. We may congratulate ourselves that our national government is at present accomplishing more for research and the applications of science than the government of any other nation, and that the men of science working under the government are doing their full share for the advancement of science.

Table II. gives the cities in which five or more of the thousand scientific men were born, and the cities in which five or more of them now reside. The tendency towards concentration which we know to exist is here measured. Two hundred and twenty-seven of the scientific men were born in places producing five or more, and 782 of them live in places where there are five or more. This is, of course, natural, and probably desirable; scientific work is accomplished where men gather together. Still the fact that three fourths of our scientific men live in 39 places—with a good many more in the suburbs—leaves rather a scanty number for the rest of the country. We have, however, more separate scientific centers than foreign countries, and by this circumstance we both gain and lose. The lack of men of distinction in whole regions and large cities is a serious indictment of our civilization. The existence of cities such as Brooklyn and Buffalo is an intellectual scandal.

Of the 866 men native to the United States, 224 were born in the cities which in 1900 had a population of more than 25,000. These

Table II. Distribution in Different Places.

	According to Birthplace.			Per Million 1860.
	I.-V.	VI.-X.	Total.	
New York, N. Y.	33	25	**58**	*71.2*
Boston, Mass.	24	19	**43**	*241.8*
Philadelphia, Pa.	12	16	**28**	*49.5*
Baltimore, Md.	9	11	**20**	*94.1*
Cincinnati, O.	6	6	**12**	*74.5*
Brooklyn, N. Y.	3	8	**11**	*39.4*
Chicago, Ills.	5	3	**8**	*73.2*
Buffalo, N. Y.	3	4	**7**	*86.2*
St. Louis, Mo.	2	5	**7**	*43.5*
Cambridge, Mass.	4	2	**6**	*230.2*
Cleveland, O.	4	2	**6**	*140.5*
Salem, Mass.	1	5	**6**	*269.6*
Milwaukee, Wis.	1	4	**5**	*110.5*
Newark, N. J.	3	2	**5**	*69.5*
San Francisco, Cal.	2	3	**5**	*88.0*
Total.	**112**	**115**	**227**	

	According to Residence.			Per Million 1900.
	I.-V.	VI.-X.	Total.	
Washington, D. C.	69	50	**119**	*426.9*
New York, N. Y. }	61	54	**115**	*56.1*
Brooklyn, N. Y. }	1	3	**4**	*3.4*
Cambridge, Mass.	30	22	**52**	*576.8*
Chicago, Ills.	29	16	**45**	*26.5*
Baltimore, Md.	22	16	**38**	*74.6*
New Haven, Conn.	24	10	**34**	*314.7*
Philadelphia, Pa.	14	20	**34**	*26.3*
Boston, Mass.	14	19	**33**	*58.8*
Ithaca, N. Y.	17	15	**32**	*2436.1*
Ann Arbor, Mich.	20	5	**25**	*1723.1*
Madison, Wis.	7	11	**18**	*939.2*
Berkeley, Cal.	8	9	**17**	*1286.5*
Palo Alto, Cal.	9	7	**16**	*9650.2*
Princeton, N. J.	8	6	**14**	*3590.6*
Minneapolis, Minn.	3	8	**11**	*54.3*
St. Louis, Mo.	6	5	**11**	*19.1*
Worcester, Mass.	7	4	**11**	*229.6*
Cleveland, O.	6	4	**10**	*26.2*
Columbus, O.	3	7	**10**	*79.6*
San Francisco, Cal.	1	9	**10**	*29.1*
Columbia, Mo.	1	8	**9**	*1592.6*
Lincoln, Nebr.	4	5	**9**	*224.0*
Syracuse, N. Y.	0	9	**9**	*83.0*
Cincinnati, O.	2	6	**8**	*24.5*
Bryn Mawr, Pa.	2	5	**7**	*?*
Evanston, Ills.	5	2	**7**	*363.4*
Middleton, Conn.	2	5	**7**	*730.0*
Bloomington, Ind.	3	3	**6**	*928.8*
Brookline, Mass.	4	2	**6**	*300.9*
Charlottesville, Va.	5	1	**6**	*930.7*
Iowa City, Ia.	4	2	**6**	*751.2*
Mt. Hamilton, Cal.	4	2	**6**	*?*
Northampton, Mass.	2	4	**6**	*321.8*
Providence, R. I.	5	1	**6**	*34.2*
Albany, N. Y.	3	2	**5**	*53.1*
Amherst, Mass.	3	2	**5**	*994.9*
Chapel Hill, N. C.	3	2	**5**	*4549.6*
Lawrence, Kans.	2	3	**5**	*460.3*
New Brunswick, N. J.	2	3	**5**	*249.9*
Total.	**415**	**367**	**782**	

places had in 1860 a population of about 4,500,000 as compared with a rural population of about 27,000,000. The urban population was about one sixth of the rural population and produced more than a quarter of the scientific men. The urban birth rate was 50 and the rural birth rate was 23.8. The superior position of the towns is doubtless due to a more favorable environment, but it may also be in part due to the fact that the parents of these scientific men were the abler clergymen and others of their generation who were drawn to the cities.

Table III. gives the institutions with which three or more of the scientific men are connected, and in the case of institutions in which there are more than fifteen the details of their rank are shown, I., II., etc., representing the first hundred, the second hundred, etc. I give this table with some hesitation, but it appears that in the end it will be for the advantage of scientific research if it is known which institutions obtain and retain the best men. Harvard has 66.5 of the scientific men, the half (0.5) being used when a professor is emeritus or gives only part of his time to an institution. Columbia follows with 60, and Chicago comes next with 39. In both the U. S. Geological Survey and the Department of Agriculture there are 32. About half of the scientific men are connected with 18 institutions. Harvard has not only the largest number of scientific men, but they are also of the highest rank, 19 being in the first hundred and 8.5 in the second hundred. Johns Hopkins has nine in the first hundred and Columbia and Chicago each has seven. A table such as this might have some practical influence if the data were made public at intervals of ten years.

Table IV. gives the institutions at which the 1,000 men of science pursued their studies. A man is credited for his degree to the first institution at which he took it, but in the case of graduate study, he may have attended several institutions. He is not, however, credited

TABLE III.—DISTRIBUTION ACCORDING TO PRESENT POSITION OF THE THOUSAND MEN OF SCIENCE.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	Total.
Harvard	19	8.5	3	6.5	3.5	6	4.5	5.5	3.5	6.5	**66.5**
Columbia	7	6	6.5	4.5	5	4.5	5.5	6	4	11	**60**
Chicago	7	10	3	6	2	2.5	3	2	1.5	2	**39**
Cornell	3	6	3	2	3	1.5	3	3.5	4	4.5	**33.5**
U. S. Geological Survey	6	3	4	4	4	1	3	3	2	2	**32**
U. S. Department Agriculture	3	4	2	4	3	2	3	3	3	5	**32**
Johns Hopkins	9	2	5.5	0	1.5	2	4.5	0.5	1	4.5	**30.5**
California	1	2	2	4	3	4	1	5	1	4	**27**
Yale	2	5.5	3	3.5	5.5	2	1	0	2	2	**26.5**
Smithsonian Institution	3	2	4	4	2	0	1	3	1	2	**22**
Michigan	1	3	6	3	3	0	0	1	1	2	**20**
Mass. Inst. Tech.	1	2	2.5	4	2	3	2	0	0	3	**19.5**
Wisconsin	1	3	1	2	0	3	2	4	2	0	**18**
Pennsylvania	2	1	1	3.5	2.5	1.5	1	2	0.5	2	**17**
Leland Stanford, Jr.	3	1	1	1	3	2	2	1	1	1	**16**
Total											**459.5**
Princeton											**14.5**
Minnesota, Ohio State											**10**
New York University											**9.5**
Missouri, Nebraska, Northwestern											**9**
National Bureau of Standards, U. S. Navy, Am. Mus. Nat. History											**8**
Carnegie Institution, Clark, Iowa, Syracuse, Virginia, Wesleyan											**7**
Bryn Mawr, Cincinnati, Dartmouth, Illinois, Indiana, N. Y. Botanical Garden, Smith											**6**
Brown, Kansas, North Carolina, Texas, Washington (St. Louis)											**5**
Field Columbian Museum, General Electric Co., St. Louis, Western Reserve, Pennsylvania State, Rutgers											**4**
Lehigh											**3.5**
Philadelphia, Acad. Nat. Sciences Amherst, Case, College of City of New York, Colorado College, Colorado University, Haverford, Purdue, Rockefeller Institute, Simmons, Tufts, Vassar, Worcester											**3**
Grand Total											**730**

TABLE IV. ATTENDANCE OF THE THOUSAND MEN OF SCIENCE AT DIFFERENT INSTITUTIONS.

	Bachelor's Degree.			Graduate Study.			Ph.D.			Grand Total.
	I.–V.	VI.–X.	Total.	I.–V.	VI.–X.	Total.	I.–V.	VI.–X.	Total.	
Harvard	55	51	*106*	38	36	*74*	30	27	*57*	**237**
Johns Hopkins	12	15	*27*	27	15	*42*	50	52	*102*	**171**
Yale	35	17	*52*	9	4	*13*	14	14	*28*	**93**
Columbia	12	16	*28*	9	3	*12*	11	27	*38*	**78**
Cornell	19	12	*31*	4	13	*17*	10	16	*26*	**74**
Michigan	23	12	*35*	4	4	*8*	8	2	*10*	**53**
Princeton	11	12	*23*	5	7	*12*	4	4	*8*	**43**
Chicago	0	2	*2*	3	11	*14*	12	11	*23*	**39**
Mass. Inst. Tech.	13	13	*26*	3	6	*9*	0	0	*0*	**35**
Amherst	12	11	*23*	2	3	*5*	0	1	*1*	**29**
Clark	0	0	*0*	5	11	*16*	4	8	*12*	**28**
Pennsylvania	5	10	*15*	2	2	*4*	3	6	*9*	**28**
Wisconsin	4	10	*14*	1	4	*5*	2	2	*4*	**23**
California	5	7	*12*	3	3	*6*	3	1	*4*	**22**
Wesleyan	9	7	*16*	2	3	*5*	0	0	*0*	**21**
Indiana	4	4	*8*	2	4	*6*	4	0	*4*	**18**
Nebraska	5	5	*10*	4	2	*6*	1	1	*2*	**18**
Williams	6	8	*14*	0	2	*2*	0	1	*1*	**17**
Dartmouth	5	5	*10*	2	1	*3*	0	1	*1*	**14**
Oberlin	6	4	*10*	2	2	*4*	0	0	*0*	**14**
College City N. Y.	7	4	*11*	1	1	*2*	0	0	*0*	**13**
Geo. Washington	3	2	*5*	2	0	*2*	3	3	*6*	**13**
Brown	4	4	*8*	1	2	*3*	0	0	*0*	**11**
Iowa	2	4	*6*	1	2	*3*	1	0	*1*	**10**
Toronto	5	13	*18*	3	3	*6*	0	0	*0*	**24**
Edinburgh	2	1	*3*	0	3	*3*	2	3	*5*	**11**
Cambridge	2	0	*2*	3	5	*8*	0	0	*0*	**10**
Berlin				53	42	*95*	11	11	*22*	**117**
Leipzig				30	15	*45*	27	12	*39*	**84**
Göttingen				18	18	*36*	19	14	*33*	**69**
Heidelberg				27	14	*41*	7	8	*15*	**56**
Munich				13	5	*18*	6	7	*13*	**31**
Strasburg				13	4	*17*	3	3	*6*	**23**
Freiburg				10	5	*15*	3	1	*4*	**19**
Bonn				10	4	*14*	2	2	*4*	**18**
Zürich				5	6	*11*	1	2	*3*	**14**
Vienna				9	3	*12*	0	0	*0*	**12**
Würzburg				4	3	*7*	3	2	*5*	**12**
Paris				21	7	*28*	0	1	*1*	**29**
Total	**266**	**249**	**515**	**351**	**278**	**629**	**244**	**243**	**487**	**1631**

as a graduate student to the institutions from which he received the doctorate.[2] The total influence of Harvard is 237, of the Johns Hopkins 171, of Yale 93, of Columbia 78 and of Cornell 74. About one tenth of the men of science received their bachelor's degree from Harvard and about the same number their doctor's degree from the Johns Hopkins. It is not certain that a preponderance of scientific men has been produced at any institution as compared with the total number of students, and it appears that those who attend the larger universities are not of higher average performance than others. Thus of the 106 who have taken the bachelor's degree at Harvard, 55 are in the first rank and 51 in the second. Yale, Cornell and Michigan have produced men above the average rank, and the excess is such that it is probably significant, though the departures fall within the limits of possible chance variation. On the whole,

[2] The doctorates include the comparatively few cases in which the degree of doctor of science has been conferred in course.

however, there is no significant difference in rank between the 515 men who attended the larger institutions and those who attended smaller colleges or none. It might be supposed that abler students would be attracted to a university such as Harvard, and that they would have greater opportunities there, but this appears not to be the case. So far as it goes, this favors the theory that men of science are born such and are not dependent on the environment for the quality of their performance. It may, however, be that relatively more men of mediocre ability are led to take up scientific work at an institution such as Harvard, whereas only those of genius are likely to break through the barrier of an unfavorable environment.

The conditions are similar in the case of the doctor's degree. Of the 487 men who have received it from the larger institutions, 244 are of the first rank and 243 of the second; nor do any institutions excel, unless it be Leipzig and Göttingen. Those who pursue graduate studies at institutions from which they do not take the degree are of distinctly higher standing than the average A.B. or Ph.D. This is probably because the abler and more energetic men have attended several institutions, more especially abroad, many of them having worked in foreign universities even after having obtained scientific distinction.

The thousand men of science under consideration pursued their graduate studies on the average from fifteen to twenty years ago. Since that time a considerable change has occurred in the relative numbers of students attracted to different institutions. Owing to the improvement of our universities relatively fewer students now frequent foreign institu-

TABLE V. SUBJECTS OF THE THOUSAND MEN OF SCIENCE WHO HAVE PURSUED GRADUATE STUDIES OR TAKEN THE DOCTOR'S DEGREE AT DIFFERENT INSTITUTIONS.

	Graduate Study.													Ph.D.												Grand Total.
	Chemistry	Physics.	Zoology.	Geology.	Botany.	Mathematics.	Pathology.	Psychology.	Astronomy.	Physiology.	Anatomy.	Anthropology.	Total.	Chemistry.	Physics.	Zoology.	Geology.	Botany.	Mathematics.	Pathology.	Psychology.	Astronomy.	Physiology.	Anatomy.	Anthropology.	Total.	
Johns Hopkins	3	8	5	4	3	5	7	2		3	2		*42*	18	24	22	9	1	8	1	6	2	10	1	*102*	**144**
Harvard	10	8	13	8	12	10	1	7	1	3	1		*74*	9	2	20	7	10	3		4			2	*57*	**131**
Columbia	3	4		2		1		1		1			*12*	5	5	9	1	5	6		2	2	2	1	*38*	**50**
Cornell	1	4	3	2	3	2				1	1		*17*	1	14	2		5	1		3				*26*	**43**
Yale	3	2	2	4		1		1					*13*	8	2	2	5	1	5		2	1	2		*28*	**41**
Chicago	2	4	1		3		1		2	1			*14*	1	1	11	3	2	3				1	1	*23*	**37**
Clark	1	2	6			5				1	1		*16*		1	2			1	1	5		1		1	*12*	**28**
Princeton		1	6			1		2	1		1		*12*	1	3	2			1		1				*8*	**20**
Michigan		4	2			1		1					*8*		2	1		4		3					*10*	**18**
Pennsylvania			1				2	1					*4*	3	1	3		1			1				*9*	**13**
California	1	1	1					1	2				*6*	1			1	2							*4*	**10**
Indiana		2	1		1			2					*6*			2	1	1							*4*	**10**
Berlin	18	24	5	3	5	5	10	14	3	4	3	1	*95*	3	12	1			2		1	3			*22*	**117**
Leipzig	10	2	7	3	2	4	2	8		5	1	1	*45*	11	2	8	1	3	4		9		1		*39*	**84**
Göttingen	10	5	1	3		9	3	5					*36*	17	2		2		12						*33*	**69**
Heidelberg	18	2	2	8		3	2	4		1		1	*41*	12			3								*15*	**56**
Munich	10		2	2			1	1		1	1		*18*	5		1	3	2				1	1		*13*	**31**
Strasburg	4	1	4		2	1	2		2		1		*17*		2	1		1	1				1			*6*	**23**
Freiburg	3	1	5	1			2	2		1			*15*	1		2					1				*4*	**19**
Bonn	2				7			1	1	2		1	*14*		1			2	1						*4*	**18**
Zürich	6	3	1			1							*11*	2				1							*3*	**14**
Vienna	1	1					10						*12*												*0*	**12**
Würzburg	2		3				1				1		*7*		4	1									*5*	**12**
Paris	5	4	3	3		4	3	6					*28*						1						*1*	**29**
Total	**113**	**83**	**74**	**43**	**38**	**53**	**47**	**59**	**12**	**24**	**13**	**4**	**563**	**98**	**78**	**90**	**36**	**41**	**49**	**5**	**35**	**10**	**18**	**2**	**4**	**466**	**1029**

tions. The number of doctorates conferred in the natural and exact sciences during the past nine years is as follows: Johns Hopkins, 147; Chicago, 145; Columbia, 137; Harvard, 129; Yale, 120; Cornell, 94; Pennsylvania, 85; Clark, 75. There is then a drop to universities that have conferred fewer than 25 degrees in the sciences during this period. Relatively more work is done in the sciences in some institutions than in others. Thus the percentage of degrees in the sciences in these universities is as follows: Clark, 95; Cornell, 58; Johns Hopkins, 54; Columbia, 49; Chicago, 48; Pennsylvania, 43; Harvard, 42, and Yale, 41.

Table V. shows the institutional origin of men who have pursued different sciences. The Johns Hopkins University has excelled relatively in chemistry, physics, zoology and physiology; Harvard in zoology and botany; Columbia in zoology, botany and mathematics; Cornell in physics and botany; Clark in psychology, and Michigan in botany and pathology. Of the foreign universities, Berlin has excelled in physics, Leipzig in psychology and Göttingen in chemistry and mathematics.

The table also shows that men are more likely to pursue graduate studies and to take the doctor's degree in some sciences than in others. Of the fifty psychologists, 35 have received the doctor's degree from the institutions given in the table, and of the 150 zoologists 90 have received it, whereas only two of the 25 anatomists and only five of the 60 pathologists have received a non-technical higher degree from these universities. While important improvements in the practise of surgery and medicine have been made in this country, it must be admitted that we are not doing our share for the advancement of pathology, anatomy and physiology.

It would be desirable to compare the scientific men and the scientific work of the United States with those of other nations, and I hope to collect data on this subject. It is my impression from such information as is on hand that we produce from one seventh to one tenth of the world's scientific research, but that we have not produced one tenth of its recent great discoveries or of its contemporary great men. With our vast population and unlimited resources, it would be shameful and intolerable to let the future be no better than the present. It is obvious that we should collect without delay the information that would tell us where we stand among the nations.

It is not altogether without interest to find that it is possible to reduce to order facts which might be supposed to be outside the range of the natural and exact sciences. The present articles are, however, only a beginning of a study of scientific men as a group and of the conditions on which scientific performance depends. We have in a large measure explored the material world and subdued it to our uses; it is now our business to secure an equal increase in our knowledge of human nature and to apply it for our welfare. If he is a benefactor to mankind who makes two blades of grass grow where one grew before, his services would be immeasurably greater who could enable two men of science to flourish where there had been but one.

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Brachiopod Nomenclature.

The following is an epitome of the results of some recent investigations; a fuller account of them has been handed to the editor of the *Annals and Magazine of Natural History* (England).

The genera *Epithyris, Hypothyris* and *Cleiothyris* can not be used, as they are now, on King's authority: they must stand or fall by what Phillips did. From what Phillips says of the first two (Pal. Foss. Devon., etc., 1841, pp. 54, 55) the types are as follows:

Genus *Epithyris,* Phillips.

Type *Terebratula maxillata,* Sowerby.

This will be the generic name for the *Terebratula maxillata* group of the Jurassic.

Genus *Hypothyris,* Phillips.

Type *Terebratula concinna,* Sowerby.

This would be the name for a series of Jurassic Rhynchonellæ, but it is preoccupied, and so must drop altogether. However, the terms epithyrid and hypothyrid will be found extremely useful to describe the beak-characters which Phillips noted.