many industries, founded upon many elemental scientific pursuits. Science in reality can not be divided and subdivided, but is intricately and firmly bound together so closely that one branch can not develop fully without the other. Accordingly, to grasp a truthful and comprehensive notion, the industrial and scientific growth in agriculture should be measured only through all branches of science concerned, all practises involved, and the various industries included. It is this sort of concept of science in agriculture I ask you, in my closing sentence, to seek; and not simply a view which results from a study of a component of the whole.

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AN ANALYSIS OF THE MEDICAL GROUP IN CATTELL'S THOUSAND LEADING MEN OF SCIENCE

THE basis of the present study is the list of starred names in the 1906 and 1910 editions of Cattell's "American Men of Science" representing individuals who are engaged in teaching or research in medicine or who, though occupying other fields, are directly or indirectly advancing knowledge in the medical sciences.

The analyses, presented for the most part in tabular form, have been made with the object of determining

1. The principal field of activity of each individual.
2. The overlapping of different fields of activity.
3. Nativity.
4. Age.
5. Sex.
6. Education as represented by degrees.
7. Education as represented by institutions.
8. Post-graduate study.
9. Service in one or more institutions.
10. Present distribution with rank.
11. Lapse of time between degree and full professorship.
12. Change of field of activity.
13. The clinician's position as an investigator.

It is true that the entire number of individuals is too small to allow far-reaching conclusions to be drawn. Medicine in this country is, however, undergoing so many changes—changes which began about twenty-five years ago and will doubtless continue—that it seemed advisable to analyze, for future students of medical education and medical progress, the conditions as represented in Cattell's editions of 1906 and 1910. The trend of these changes and the influence of the development of the medical sciences can be traced even in the first edition and markedly in the second, by separating the older group of men, limited to chemistry, anatomy, physiology and pathology from the younger group representing, in addition to these, bacteriology, physiological chemistry and pharmacology. In the absence, however, of definite tables of earlier periods, it is difficult to draw comparison from the first edition, except such as are possible on the basis of age. If one had tables for, say 1890 to 1895, the period representing the beginning of the rapid development of the laboratory side of medicine in this country, the analysis of 1906 and 1910 would be of greater value. Still, it is hoped that the present study will preclude such regrets on the part of some student of medical education who wishes in 1930 to analyze the advances during the period of twenty years preceding his study.

The basis upon which Cattell selected the names for "American Men of Science," as well as his method of selecting the thousand leading men, are too well known for repetition. It must suffice to state that in the first edition are the records of 4,000 men and women and that the second edition was enlarged to include 5,536. The directory is essentially a list, with short records, of individuals working in the natural and exact sciences, and it is presented as "a fairly complete survey of the scientific activity of a country at a given period." Cattell's object in preparing the special list of a thousand leading men was to secure a group for the scientific study of the "conditions on which scientific research depends and so far as

may be to improve these conditions." One other point is of importance: although the first edition was published in 1906, the record apparently was completed before January 1, 1903,[1] and the first edition therefore refers to conditions as of the latter year. For this reason the list prepared from the first edition will hereafter be referred to as the "1903 list" and that of the second edition as the "1910 list."

To my use of Cattell's list of a thousand leading men as a basis for the selection of a medical group, there can be, I think, no objection. The group of medical names is all inclusive and represents medical men of every degree of scientific effort. Moreover, as a result of my studies of the special group of 238 names, I consider the selection well made; I have found only two names without stars, that in my opinion should have been starred and, on the other hand, only three starred that perhaps did not deserve a star.

METHODS OF SELECTING THE MEDICAL GROUP

In Cattell's "thousand men" those representing the medical sciences doubtless fall in the four groups: chemistry, 175; pathology, 60; physiology, 40; and anatomy, 20.[2] The three last groups are probably almost entirely composed of men working in the medical sciences, while of the first group relatively few are interested in medicine. In my classification which gives 179 names in the 1903 list and 59 new names in the 1910 list, I have disregarded Cattell's groupings for the reason that I desired to obtain a list representing men who are advancing a knowledge of the medical sciences without regard to their relation to medical schools. Thus embryologists, comparative anatomists, chemists and biologists, whose researches bear on medical problems or contribute to the methods of the medical sciences, have been included. The list is one of men working in the sciences bearing directly upon medicine rather than of medical men concerned with science.

[1] See second edition, pp. 531 and 538.

[2] The other divisions are: physics, 150; zoology, 150; botany, 100; geology, 100; mathematics, 80; astronomy, 50; psychology, 50; anthropology, 20.

Some of the criteria upon which the selection of names was made follow: A person engaged in teaching and research in medicine, whether or not possessing the M.D. degree is, of course, included. The possession of the M.D. degree by a person not concerned with medical teaching or research is not sufficient reason for inclusion unless this person's work has some bearing on medicine; thus a zoologist or biologist with the M.D. degree is not included unless he has been concerned with studies in neurology, embryology or comparative anatomy. On the other hand, a biologist without the degree of M.D., but contributing to the knowledge of the anatomy or embryology of mammals is always included as one concerned in advancing the knowledge of the medical sciences. Despite these rules, the decision as regards zoologists and biologists has sometimes been difficult, but has always rested on the relation of research work to medicine. A like difficulty arises in regard to chemistry, especially among the older group representing chemistry before the rise of physiological chemistry. Naturally a chemist whose life work has been the teaching of medical students is included irrespective of work in other fields; on the other hand, an individual holding a chair in general chemistry and teaching medical students only incidentally, and whose investigations have nothing to do with physiological chemistry is not included. So also are judged a few workers in industrial or agricultural chemistry; if their work has a direct bearing on normal physiology or the problems of disease, they are included; otherwise not. Thus chemists concerned with the study of metabolism in man or animals, but without medical degree or affiliation with medical schools, are included, as are also chemists whose problems are those of sanitation and public health closely related to the problems of the acute infectious diseases; on the other hand, sanitary engineers, concerned with water filters, sewage problems, etc., are not. The same holds for bacteriologists; a bacteriologist of non-medical training or affiliation, studying diseases of animals is accepted; one engaged only in the systematic study of lower plant

forms, or the diseases of plants is not. Psychology offers some difficulties. All workers in psychology may be indirectly contributing to the knowledge of normal and abnormal mental conditions, but the line has been drawn so as to include only those who use the material afforded by the insane and feeble-minded; that is, those who have entered or are closely in touch with the field of psychiatry; or, on the other hand, are responsible for the teaching of medical students. Pharmacists, pharmaceutical chemists and botanists interested in materia medica, although the group is very small, have caused some difficulty. They have been classified, in part, on the basis of the character of their researches, and in part on their medical affiliations, as either chemists or pharmacologists.

Under physiologists, plant physiologists have not been included, unless their work has a bearing on pharmacology; all, however, who work on lower animal forms and offer knowledge of importance to the understanding of mammalian physiology have been included.

In two small groups another factor enters; a few individuals have reached a position of importance, in fields distantly related to medicine, but owe their success in part, at least, to early efforts in clinical medicine or the medical sciences; on the other hand, a few men occupy fields which a few years ago had no relation to medicine but which now are of importance in the border-line problems of the medical sciences. In each group the decision has been laid upon the individual's influence upon medical teaching and research.

CLASSIFICATION

My classification of the medical group is made according to the predominant interest of the individual. In Cattell's classification all medical effort is distributed under the four important headings of anatomy, physiology, chemistry and pathology, with a possible scattering of medical effort under zoology, psychology, etc. To bring in the various distinct subdivisions of medicine and its allied sciences, and to give a true picture of the activities of the starred men of the medical or near-medical group, it has been necessary for me to classify under eleven headings (see Table I.). This has been necessary because a considerable number of individuals classified in Table I. as anatomists (including histologists and embryologists) are classified in "American Men of Science" as zoologists, biologists, etc. As, however, they are from the medical point of view, and for the purpose of this study, anatomists, they are so grouped. So also in the case of physiologists, pharmacologists and chemists, who may have interests in two or three fields, each individual is grouped in the field in which he has shown the greatest activity, despite the fact that according to this rule a professor of physiology may be classed as a physiological chemist. The same rule holds for those grouped by Cattell under bacteriology and hygiene, or under pathology and medicine, etc. Another difficulty arises in the group engaged in the practise of clinical medicine; an individual may be classed in "American Men of Science" under "Medicine, Neurology," or "Pathology, Medicine," though in each case neurology or medicine is the principal field of effort of the individual. Under such circumstances, provided the individual is actually engaged in clinical work, he is given a clinical classification. In some instances this robs the laboratory branches of one or two men, but, as a rule, it is merely a matter of transferring a name from "Medicine" to Surgery, Pediatrics or Psychiatry, as the case may be, and takes out of the group "Pathology," a number of clinicians who are pathologists only in the sense that they are diagnosticians of disease. Likewise the free use, by Cattell, of the single designation "Medicine" in the case of a surgeon or a psychiatrist, has necessitated the addition of other fields, as surgery, psychiatry, pediatrics, etc. In all this revision of classification the personal opinion of the writer, based on a knowledge of the work of the individuals concerned, is the chief factor. That this personal element may have led to occasional errors is possible; but for the purpose of distinguishing between the different types of activity, it is believed to be without essential error.

Whenever possible the analysis of the lists

of 1903 and 1910 is shown as a distinct part of one table. When, however, this would entail a large awkward table, and when there is no particular advantage to be gained, a composite table is given. Occasionally where differences are striking the two lists are presented in separate tables.

In interpreting these tables it should be borne in mind that although with each new edition Cattell prepares a new list of one thousand leading scientists, the names starred in an earlier list are still retained unless dropped by reason of death or removal to a foreign country. Thus in the 1910 edition of "American Men of Science" more than a thousand names are starred. The exact number over a thousand is the difference between the new names added and those dropped on account of death or departure from the United States. Therefore, my list of 59 names, taken from the second edition, includes names not starred in the 1906 edition and, naturally, none of the names which at that time were starred, with one exception, a person who changed from work in general biology to distinctly medical research. The losses of starred names in 1910, as compared with 1906, were six in number: by death, Wilbur Olin Atwater (physiological chemistry); James Carroll (bacteriology and pathology); Gaylord Parsons Clark (physiology), and John Bruce MacCallum (anatomy and physiology); by removal from the country, Arthur Robertson Cushny (pharmacology), and William Osler (medicine). (The name of Ira van Giesen appears in the first edition but not in the second and is not noted among deaths or removals.)

It should also be explained that although the directory includes many Canadian scientists, these are not considered by Cattell in making up the lists of 1,000 leading men.

A classification, according to principal field of activity, is shown in Table I.

Despite the attention given to classification, as described above, certain liberties have been taken with this table; under pathology (comparative) has been included an individual classified by Cattell as a medical zoologist; under bacteriology are included three individuals whose chief work is in hygiene; and under pharmacology are included two men who are essentially medical botanists. These inclusions are made here for the sake of shortening the table; in later tables, however, due allowance has been made so that statistics concerning pharmacologists, for example, are not confused by including botanists. It should also be stated that under neurologists are included only men working in clinical neurology or neuropathology. Neurologists, in the sense of anatomists studying the anatomy of the nervous system, and not in clinical work, are included under anatomists.

TABLE I

Classification According to Principal Field of Effort

Field	1903 List: Number		1910 List: Number
Anatomy	45	Including histology, embryology and comparative anatomy	12
Physiology	31	Including comparative physiology	11
Pathology	21	Including comparative and experimental pathology	6
Bacteriology	15	Including protozoology and hygiene	7
Chemistry	29	Inorganic, organic, physiological pharmaceutical and micro-chemistry and toxicology	9
Pharmacology	7	Including materia medica, therapeutics and medical botany	4
Medicine	20	Refers to internal medicine	2
Psychiatry	3	Including psychology	3
Neurology	3		2
Surgery	2		3
Pediatrics	3		0
	179		59

Total of both lists, 238.

The chief points of interest brought out by this table are: (1) the large number of individuals in the older laboratory sciences—anatomy, physiology and chemistry—as compared with the number in those, pathology, bacteriology and pharmacology, of more recent development, and (2) the relatively small number of clinicians who have attained scientific distinction. These differences hold in both lists.

TABLE II

Laboratory Group, Showing Overlapping of Fields of Activity

	1903 List	1910 List
Anatomy and zoology	9	1
Anatomy and biology	5	2
Anatomy and physiology	5	0
Anatomy and neurology[3]	3	0
Anatomy, neurology[3] and biology	1	0
Anatomy, biology and physiology	2	0
Anatomy, biology, zoology, neurology[3] and physiology	4	0
Anatomy, anthropology and neurology[3]	1	0
Anatomy, biology and zoology	2	0
Anatomy, pathology and bacteriology	2	0
Physiology and hygiene	1	0
Physiology and history of medicine	1	0
Physiology and psychology	2	0
Physiology and biology	3	1
Physiology and neurology[3]	1	0
Physiology and pharmacology	4	1
Physiology and physiological chemistry	8	0
Physiology and pharmacology and physiological chemistry	2	2
Pharmacology and physiological chemistry	2	2
Pathology and physiological chemistry	0	2
Pathology and bacteriology	13	4
Pathology and bacteriology and hygiene	2	0
Pathology, physiology and experimental surgery	0	1
Bacteriology and hygiene	4	4
Bacteriology and biology	1	0
Bacteriology and zoology	1	0
Bacteriology, hygiene, biology and physiological chemistry	2	0
Bacteriology, hygiene and physiological chemistry	1	1
Chemistry and hygiene	1	0
Chemistry and toxicology	3	0
Chemistry and pharmacy	2	1
Chemistry and hygiene	2	0
Chemistry and physics	1	0
Botany, pharmacy and materia medica.	2	0
	93	22

In connection with the clinical branches, the striking fact is shown that in the 1903 list more men have gained scientific distinction in

[3] Refers here to anatomy or physiology of the nervous system; not to clinical neurology.

TABLE III

Clinical Group—Variety of Interests

	1903 List	1910 List
Medicine and anatomy	1	0
Surgery, anatomy, physiology and materia medica	1	0
Medicine and physiology	1	0
Surgery, neurology[4] and physiology	1	0
Surgery and physiology	0	1
Neurology and physiology	1	0
Medicine, pathology, pharmacology and physiological chemistry	1	0
Medicine, pathology and therapeutics	0	1
Medicine, pathology and physiology	1	0
Medicine, neurology, physiology and toxicology	1	0
Medicine, neurology and psychiatry	0	1
Medicine, pharmacy and materia medica.	1	0
Medicine and physiology	1	0
Medicine and pathology	6	1
Medicine and hygiene	0	1
Medicine, pathology and bacteriology.	2	0
Medicine, pathology, bacteriology and hygiene	1	0
Medicine, pathology and physiological chemistry	1	0
Medicine and physiological chemistry	0	1
Obstetrics, pathology and bacteriology.	1	0
Neurology, psychiatry and pathology	1	1
Medicine, bacteriology, hygiene and bibliography	1	0
Botany, physiology, materia medica, pharmacology, medicine and neurology.	1	0
Psychiatry and hospital organization	1	0
	25	7

internal medicine than in all the other fields of clinical effort combined. On the other hand, in the 1910 list, the distribution is more even. The preponderance of internists in the earlier list is due, as will be shown later, to the large number of teachers of medicine, who before the period of laboratory expansion combined with their teaching, investigations in pathology, pharmacology, hygiene, etc.

Although Table I. shows the general distribution by important groups, it does not give a complete picture of the variety of effort represented by some of the members of these

[4] In this table neurology refers to clinical neurology.

groups. In Tables II. and III. this variety of effort is shown. Incidental effort in a neighboring field is not indicated, only more serious effort in teaching or research. Table II. represents laboratory effort only, while Table III. shows the activities of those persons engaged in the several fields of clinical medicine.

Thus it is seen that of the 179 individuals in the 1903 list 118 or 65 per cent. were interested in more than one field of activity; while in the 1910 list only 49 per cent. were working in more than one field. These figures would appear to indicate, among the latter group, a tendency to specialize.

NATIVITY

Table IV.[5] shows distribution according to birth. For the purpose of condensing the table no state is given alone unless it is represented by more than two names; states with one or two names are grouped under the words "other states" appearing in each division. For the sake of record these may be given as follows: Vermont 1 (1903); New Hampshire 1 (1910); District of Columbia 1 (1903); North and South Carolina each 2 in 1903; Tennessee 2, Alabama and Mississippi each 1 in 1910; Minnesota 1, in 1903; Colorado and California each 1 in 1903, and California 1 in 1910.

If this table is contrasted with a similar table by Cattell in which is analyzed the larger group of one thousand scientists, the following points of similarity or difference appear:

1. Of the larger group (1,000) 126 were foreign born; of the medical group (238), 37; 12.6 per cent. as compared to 15.5 per cent. Of the 37 foreign born, 14 were natives of Canada, and if these are set in a separate group, the members of the medical group of non-American birth are but 9.6 per cent. Another point is of interest in this connection: In our 1903 list, 13 medical men are shown to be of Canadian birth, while Cattell's corresponding list shows for the entire 1,000, a total of 34 of Canadian birth. This shows that more than one third of the individuals of Canadian birth have achieved their prominence through the medical sciences. As far as any one influence is concerned in this it would appear to be connected with the University of Toronto. Of the 13 individuals of the medical group, resident in the United States in 1903, eight were graduates in arts or medicine of this university. No other Canadian institution is represented by more than one individual. On the other hand, as five of the Canadians went to Hopkins for post-graduate study, this institution would appear to be a secondary important factor in that it drew the

TABLE IV

Nativity: Born in United States, 200. Foreign Born 37[6]

	North Atlantic Division							South Atlantic Division			South Central Division		North Central Division								Western Division	Foreign Born							
Lists	Maine	Massachusetts	Connecticut	New York	New Jersey	Pennsylvania	Other States	Maryland	Virginia	Other States	Kentucky	Other States	Ohio	Indiana	Illinois	Michigan	Wisconsin	Iowa	Missouri	Other States	All States	Canada	British Isles	Germany, Austria	Sweden	Switzerland	Russia	India	Japan
1903	5	22	9	31	5	17	1	9	5	5	3	0	10	4	5	5	8	3	1	1	2	13	6	5	0	1	2	1	0
1910	1	6	1	9	2	2	1	1	3	0	2	4	5	3	1	1	1	1	4	0	1	1	2	2	2	0	1	0	1
Totals	6	28	10	40	7	19	2	10	8	5	5	4	15	7	6	6	9	4	5	1	3	14	8	7	2		3	1	1

[5] In this and all other tables in which totals do not agree with those of Table I., it is to be understood that the records, as given in "American Men of Science," were, in some instances, incomplete or difficult of interpretation.

[6] Birth place of one individual in 1903 list not given.

men from Canada. Only two other institutions, Clark and Chicago, attracted two men each. This Canadian influence is lost, however, in the 1910 group, which contains only one individual born in Canada.

In connection with the group of 37 foreign born, it is of interest that nearly one half received part or all of their education in the United States, thus five received the Ph.D., eight the M.D., and four the bachelor, and later degrees from American schools. On the other hand, twenty appear to have finished their professional education in other countries. On the basis of this analysis it would appear, therefore, that only 8.4 per cent. of the entire medical group of 238 individuals represents entirely foreign educational influences.

It is of interest that the distribution by birth in this country of the medical group is in general in proportion to Cattell's figures for the larger group of one thousand men of science. This is shown in the following table in which only those states are given which have 20 or more men in the 1,000 list.

TABLE V

Nativity: Comparison of 1,000 with Medical Group

	N. Y.	Mass.	Ohio	Penna.	Ill.	Conn.	Wis.	Maine	N. J.	Ind.	Mich.	Md.	Iowa
Cattell's 1,000.	183	134	75	66	42	40	35	29	28	28	27	26	20
Medical 238...	40	28	15	19	6	10	9	6	7	7	6	10	4

AGE

Table VI. gives the age by decades of the individuals composing the various subdivisions of the medical group, as prepared from the 1903 list. To this is added the analysis, by age only, of members of the 1910 group. This table presents several points of interest. In each list the decade represented by the largest number of individuals is the fourth; in the 1910 list, the majority of all names falls in this decade, while in the 1903 list it is shared by the fourth and the fifth decades. As, however, we have no lists before 1903, for comparison it is impossible to say how many of the men in the fifth decade, in 1903, might have been starred in a list prepared in 1893, when they were between 30 and 40. All evidence points to the fourth decade as the period when the majority of men in the medical sciences reach an unusual degree of prominence. From the 1910 list it is certain that the chance for prominence diminishes rapidly after the 40th year. This may not be true in clinical medicine, for, as shown in the 1903 list, the largest number appear in the fifth and seventh decades. The various laboratory specialties show little difference except in the case of anatomy and pathology, each of which has an unusual proportion of individuals reaching prominence in the fourth decade. In these two branches half the total number in each group fall in the fourth decade. The probable explanation lies in the changes in medical education which began in the early nineties. Until that time pathology was in most schools taught by a clinician and the teaching of anatomy was frequently relegated to a surgeon. The divorcing of anatomy and pathology from medicine and surgery and the increase of laboratory teaching in these two subjects opened many opportunities for scientific work, previously closed. These changes, in all probability, explain the large number of prominent men in these two fields who in 1903 fell in the fourth decade.

TABLE VI

Age

1903 List	20–30	30–40	40–50	50–60	60–70	70–80	Age Not Given
Anatomy	3	22	13	5	2		
Physiology	4	10	11	5	1		
Chemistry		10	9	7	2	1	
Pathology	1	10	7	2			1
Bacteriology and hygiene	1	4	6	1	2		1
Pharmacology, therapeutics		2	5				
Medicine		4	6	3	6	1	
Surgery, neurology, psychiatry, pediatrics		3	2	3	2	1	
Totals	9	65	59	26	15	3	2
1910 list—totals	1	34	14	9	1	0	
Combined totals	10	99	73	35	16	3	2

SEX

In the 1903 list of 179 names, 4 women find a place, three representing anatomy and one

hygiene; in the 1910 list, three are added, two representing anatomy and one bacteriology and chemistry; a total of 7 or almost 3 per cent. of the combined lists.

EDUCATION AS REPRESENTED BY DEGREES

In connection with Table VII., which presents the educational qualifications of the members of the medical group, as shown by their degrees, a few words of explanation are necessary. Honorary degrees are not included. M.B. is given the same value as M.D. The omissions tabulated under "insufficient data" refer to an anatomist who is described merely as a "licentiate," one chemist with the single degree of E.M.; and to a third individual whose record gives no information concerning degrees. Otherwise degrees are accurately given, except that the chemist with bachelor's degree only should be credited also with a degree in pharmacy (Ph.G.). In the column headed "M.D. only" the figures in brackets refer to the number in this class who took some academic work but did not receive the bachelor's degree.

TABLE VII

Education as Represented by Degrees—238 individuals

1903 List	Bachelor's and M.D.	Master's and M.D.	Bachelor's Sc.D. and M.D.	Ph.D. and M.D.	M.D. Only	Bachelor's Only	Bachelor's and Master's	Bachelor's and Sc.D.	Ph.D.	Bachelor's Sc.D. and D.V.M.	Sc.D. and M.D.	Insufficient Data	Totals
Anatomy	9	6	1	1	10 (3)	1	1	1	14			1	45
Physiology	4	6		3	6 (3)				11	1			31
Chemistry	2	1		3	2	1	1	1	15		1	1	29
Pathology	7	4		2	7 (5)				1			1	21
Bacteriology and hygiene	1		1	1	6 (2)		1		5				15
Pharmacology	2	1		2	2 (1)								7
Medicine	8	2		1	9 (1)								20
Surgery, neurology, psychiatry, pediatrics	4	4			2 (2)				1				11
Totals	37	24	2	13	44 (17)	2	3	2	47	1	1	3	179
1910 list	19	11	1	6	5	1	0	1	15	0	0	0	59
Combined totals	56	35	3	19	49	3	3	3	62	1	1	3	238

The figures for the 1910 list are given at the bottom of the table without division into scientific groups.

The figures presented in Table VII. bring out some interesting facts. The most striking of these is the small number of men in the 1910 list with the degree M.D. only, 8.5 per cent. as compared with 24.5 per cent. in the 1903 list. That this is not due to a larger number of men with the Ph.D. degree only, is shown by the fact that in the two lists the percentage of individuals[7] with the latter degree only, is practically the same, 26.2 per cent. for 1903 and 25.4 per cent. for 1910. On the other hand, the number of individuals with M.D. degree equals 68 per cent. in the 1903 lists and 71 per cent. in the 1910 list, again practically no change. The conclusion is unavoidable that about two thirds of the prominent men in each list were developed through the training represented by the M.D. degree and about one quarter through that represented by the Ph.D. degree, but that in the period represented by the 1910 list, there was a greater tendency on the part of the M.D. group to anticipate the present educational prerequisite in medicine—a collegiate education. In the 1903 list individuals with the bachelor's or master's degree antedating their M.D. degree constitute only 34 per cent. of the total; in 1910 this percentage increased to 51. On the other hand, it is worthy of note that in the entire list of 238 individuals only 9 achieved distinction on the basis of the bachelor's or master's degree or the degree Sc.D.

[7] In this calculation individuals with both M.D. and Ph.D. degrees (13 in 1903 and 6 in 1910) are classed in the M.D. group, as is also one individual with ScD. and D.V.M. degrees.

With the exception of the Ph.D. degree, the various degrees are distributed about equally among the several medical sciences. Anatomy, physiology and chemistry, the older and more exact of the group, claim, as would be expected, nearly all the Ph.D. men.

EDUCATION AS REPRESENTED BY INSTITUTIONS

In Table VIII. is presented the group of institutions which have given five or more degrees to individuals in 1903 and 1910 lists. In this table degrees are tabulated, not individuals, that is, a man receiving the degrees A.B., A.M. and M.D. is tabulated three times; if, in addition, he received a Ph.D. degree, he receives four places.[8] The object of the table is to show in a general way the institutions concerned in training the larger number of the group. To limit the tabulation to institutions granting five or more degrees is not entirely satisfactory, but the list of institutions

TABLE VIII

Institutions Represented by Five or More Degrees; 1903 and 1910 Lists Combined

	A.B.	B.S.	Ph.B.	A.M.	M.S.	Sc.D.	Ph.D.	M.D.[9]	D.V.M.	E.M.	Ph.G.	Totals
Harvard	22	7		15		3	5	24				76
Johns Hopkins	13	1			1		18	14				47
Columbia	4		2	4			7	18		1		36
Yale	8	5	3				8	3				27
Pennsylvania	4	2	1				2	18				27
Michigan		5	1	1	3	1	2	8				21
Chicago (including Rush Med. School)		2			1		13	5				21
Cornell	1	3	3	1		1	1		1			11
Toronto	7			1				2				10
Princeton	4			4								8
New York University and Bellevue								6				6
Leipzig							4	2				6
Wisconsin		3			1						1	5
Missouri		2						3				5
Northwestern		1			1			3				5
Amherst	4			1								5

credited with four, three, two and one degree is so lengthy that tabulation is impossible. Thus three institutions are credited with four degrees; six with three; seventeen with two and one hundred and sixteen with one. The tabulation of these in detail serves no good purpose. If we compare Table VIII. with Table VII. we find in regard to the M.D. degree that 106 of the 163 medical degrees were given by 12 institutions; the remaining 57 being scattered among 35 institutions. Also 60 of the 81 Ph.D. degrees were granted by 9 institutions; the remainder representing 13 institutions. 21[10] of the M.D. and 15 of the Ph.D. degrees were granted by foreign universities. Foreign universities giving more than one M.D. degree are Toronto, Strassburg, Bonn, Leipzig, Aberdeen and Edinburgh. The only foreign universities which find a place in the table are Toronto and Leipzig.

Some objection might be raised to the insertion in this table of Amherst and Princeton, which do not have medical departments. However, the table is intended to represent general educational preparation and brings out prominently the important rôle played by Harvard, Hopkins, Columbia, Yale, Pennsylvania, Michigan and Chicago—the universities represented by more than twenty degrees—in the development of the medical sciences.

One or two minor points noted in the preparation of this table are:

1. The women's colleges represented are Smith, Radcliffe, Vassar and Bryn Mawr.

2. The figures for Toronto, Amherst and Northwestern are based on the 1903 list; no new names occurred in the 1910 list.

3. Homeopathic schools are represented by two individuals, one working in botany and materia medica and the other in anatomy and anthropology.

One purpose in preparing Table VIII. was to determine how many men took all their work in one university and whether workers in any one scientific group favored certain universities. The analysis on this point yields the following information: Of 62 individuals with the Ph.D. degree (in 1903 and 1910 lists) 24 took all work leading to this degree in one institution, as follows; Johns Hopkins: anato-

[8] There is in this table a slight error due to the fact that Ph.D. men do not always give data concerning the bachelor and master's degree.

[9] Including M.B.

[10] Of these 5 were conferred by Canadian; 4 by English, and 12 by German schools.

mists, 2; physiologists, 4; physiological chemists, 2; pharmacologist, 1; Columbia: physiologist, 1; physiological chemist, 1; psychologist, 1; Yale: physiological chemists, 4; physiologists, 2; Harvard: pharmacologist, 1; psychologist, 1; Cornell: physiological chemist, 1; Chicago: physiologist, 1; George Washington University: anatomist, 1; and Pennsylvania: chemist and bacteriologist, 1.

A similar study of men (1903 and 1910 lists combined) with the medical degree shows that of 80 receiving their bachelor degree in a university with a medical department, 40 remained for their medical education while an equal number went elsewhere. Of the first group Harvard claims 16, Pennsylvania 5, Michigan 4, and John Hopkins, Yale and Edinburgh, each 2.

POST-GRADUATE STUDY

As a supplement to Table VIII. is presented an analysis (see Table IX.) of post-graduate study after the winning of the M.D. or Ph.D. degree or in the absence of these, the bachelor's or master's degree. As post-graduate work is included (1) work as a fellow, (2) residence in a teaching or research institution with or without appointment and (3) foreign study. Also where an individual holds both the M.D. and Ph.D. degrees work for the later of these is counted as post-graduate work. When an individual has not held a fellowship and no special course of study is given, the first appointment (as assistant, instructor, lecturer, etc.) after graduation is considered as post-graduate work. Some objection might be raised to including the first appointment as post-graduate study, but as it frequently offers the best criterion of conditions determining future work and of crystallizing the tendencies of the individual, it seems justifiable. On the other hand, if this first position was presumably devoid of opportunities for training, as, for example, a position in a secondary school, it has not been included. In this table, unlike the others, in order to bring out general tendencies, the compiler has freely used his discretion as to omissions at the expense, perhaps, of some of the smaller institutions. Despite all these liberties, the table has been prepared with great difficulty. This has been due in part to the complete absence of all data in connection with some names, and in part to the difficulty of defining graduate work, that is, determining what should and what should not be included. One other difficulty must be mentioned. Although the majority of individuals are credited with postgraduate work in only one or two institutions, some studied in four or more. As a result, in Table IX. the latter have been counted four or more times; thus the same individual may be credited to Columbia, Hopkins, Germany and France, though the total time spent in these four places may not have been greater than that given by another individual credited only to Columbia. To indicate the time element, an attempt was made early in the compilation to indicate length of time of post-graduate study, but this was beset with so many difficulties that it was abandoned. The table, therefore, indicates diversity of post-graduate study by a number of individuals, without regard to the time element, or the sequence of study. For convenience of tabulation foreign universities are grouped under the name of the country in which they are located. So also work in federal, state and city laboratories and in the army and navy are grouped under the head of *Government Work.*

TABLE IX

Post-graduate Instruction; 1903 List Only

	Anat.	Phys.	Chem.	Path.	Bact. and Hyg.	Pharm. and Therap.	Clin. Med.	Surgery, Neurology, Psychiatry, Pediatrics	Totals
Hopkins	13	10	2	8	6	2	3	1	45
Harvard	7	7	1	2	1		2	3	23
Columbia	5	4	2	3	1		1	1	17
Government work	2	1	2	4	4		1		14
Pennsylvania	3	1		1	1	1	5		12
Michigan	5	1		1	2	1			10
Chicago	4	2				1		1	8
Clark	4	1			2				7
Yale		1	4		1				6
Cornell	1	1	1			1			4
Germany	11	13	14	12	5	4	7	1	67
France	1	1	2	2	4		1	2	13
England	1	5	2	1			1	1	11
Austria	1			2	2		1	2	8
Scotland	1	3						1	5
Italy	2	1			1				4

In this table, based on the 1903 list only, institutions or countries credited with less than four post-graduates are not given. The 1910 list, because of the small number of names, can not be conveniently given in tabular form. It shows however that institutions represented by more than one post-graduate are as follows: Harvard, 11; Government Work, 8; Johns Hopkins, 6; Yale and Pennsylvania, each 4; Chicago and Cornell, each 3; and Columbia, 2. Foreign countries are represented as follows: Germany, 13; Great Britain, 5; Austria, 3; France and Canada, each 2.

These figures from the 1903 list indicate clearly the prominent part which Johns Hopkins University has played in stimulating the development of the medical sciences in this country and also the predominant influence of Germany upon American medicine. Germany's lead holds in both lists, but Hopkins and Harvard change places in the 1910 list, while Yale improves its standing at the expense of Columbia, and Michigan and Clark drop out of the list. Just how important these changes are, it is impossible to say on account of the smaller number of names in the 1910 list as compared with that of 1903.

CONSIDERATIONS OF PROFESSIONAL ADVANCEMENT

In preceding tables (VII., VIII. and IX.) have been presented academic and professional education and post-graduate work up to or including the first appointment held. It is now of interest to consider the progress of these various individuals in their later professional life. To this end are presented (*a*) the number of individuals remaining continuously in one, working in two only, or in three or more institutions; (*b*) residence and position of individuals in both groups at the time (1903 and 1910) of Cattell's classifications; (*c*) the length of time between receipt of last degree and appointment as full professor; and (*d*) changes in field of work.

Table X. presents those institutions in which two or more men have labored continuously from time of first appointment. In preparing this table, which includes both 1903 and 1910 lists, scholarships and fellowships have not been considered (these are included in Table IX). Likewise, incidental teaching, research or administrative positions held simultaneously in other institutions, usually of the same city, have also been disregarded.

TABLE X

Continuous Residence in One Institution—85 Names from 1903 and 1910 Lists

	Anatomy	Physiology	Chemistry	Pathology	Bacteriology and Hygiene	Clinical[11]
Cornell	1		1			
Michigan	2			1	2	
Columbia	3	1		1	1	1
Pennsylvania	3	1	1		1	6
Johns Hopkins	2	2		1	1	2
Harvard	2	4[12]		4	1	6
Government	1	1	1	1	3	
Chicago (including Rush Med. College)				3		
Yale		1	3			
Wisconsin	1		1		1	
Western Reserve		1[12]	1	2		
Buffalo				1		1
Bellevue						2
Missouri	2					

In addition to the data presented in the table, the following institutions are to be credited with one man each: Anatomy: Minnesota, Princeton, Smith, Washington and Iowa; physiology: Syracuse, Nebraska, Medico-Chirurgical College and the Rockefeller Institute; bacteriology and hygiene: Wesleyan and Massachusetts Institute of Technology; clinical medicine: Albany Medical College.

In Table XI. is shown the number of men who have worked in only two institutions.

Institutions having one individual in first column only are Toronto, Smith, Edinburgh, Clark, Dartmouth, Virginia, Manitoba, Haverford, St. Louis Medical College, Miami, Georgetown, and Massachusetts, New York and Cincinnati Colleges of Pharmacy; in second column only, Bowdoin, Texas, Minnesota, Western Reserve, Buffalo, Jefferson, Vanderbilt and Simmons.

[11] Medicine, surgery, neurology, psychiatry, pediatrics.

[12] Including one pharmacologist.

TABLE XI

Service in Two Institutions Only—56 Names—from 1903 and 1910 Lists

	First Position	Second Position
Hopkins	10	5
Michigan	4	1
Chicago (including Rush Medical College)	1	5
Columbia	5	6
University and Bellevue	4	4
Missouri	0	2
Cornell	0	5
Harvard	2	5
Rockefeller Institute	0	2
Yale	3	0
Government work	4	2
New York Polyclinic	2	0
Wisconsin	0	4
Albany Medical College	1	1
California	1	2
Wesleyan	1	1
Northwestern	1	2
Pennsylvania	2	2
Bryn Mawr	2	0
Stanford	2	0
Massachusetts Institute of Technology	0	2

A comparison of Tables X. and XI. shows that of the total of 238 individuals, definite scientific prominence was attained by 85 who remained in one institution and by 56 who had worked in two institutions; of the remaining 97, about three quarters are definitely credited with residence in three or more institutions.[13] On the basis of such a classification it would appear that greater opportunity for successful effort, and therefore greater scientific prominence, attends continuous residence in one institution. On the other hand, if the second and third group are added together, the figures favor migration. The first group, which includes a large proportion of the older men in anatomy, physiology, chemistry and the clinical subjects, is in striking contrast to the condition under the German system; on the other hand, the second and third groups contain a large number of the younger men representing prominence in pathology, bacteriology, hygiene and physiological chemistry, and is suggestive of the principle of migration so characteristic of the German system. Another important point brought out is that a relatively small number of institutions have fostered this selected group, or at least have given them opportunity for attaining prominence. This is shown in Table XII., which is based upon the total number of positions held by 158[14] individuals of the 1903 list only. Only institutions represented by four or more positions are given.

[13] The data concerning twenty-one is either incomplete or too indefinite for tabulation in this regard.

TABLE XII

Institutions and Positions Represented by 158 Individuals of 1903 List.

Institutions	Position					Totals
	Permanent	I.	II.	III.	IV. or Later	
Johns Hopkins	7	19	6	5	3	40
Harvard	12	7	5	1	–	25
Columbia	6	8	7	3	–	24
Michigan	5	6	4	4	1	20
Pennsylvania	10	4	4	–	1	19
Chicago	1	1	8	7	1	18
University and Bellevue	2	4	6	–	–	12
Northwestern	–	1	4	1	1	7
Cornell	2	2	3	–	–	7
Yale	2	3	1	–	–	6
Western Reserve	3	–	3	–	–	6
Missouri	1	–	3	–	1	5
California	–	1	2	1	1	5
Clark	–	1	3	1	–	5
Minnesota	1	–	1	2	–	4
Rockefeller Institute	1	–	2	1	–	4
Foreign Universities	–	7	1	1	1	10
Federal, State, City and Hospital	6	3	2	6	5	22
Grand total						239[15]

Table XII. shows 239 positions divided in 18 ways. If foreign universities, federal, state and city and hospital positions and the Rockefeller Institute are removed, we have 203 positions divided among only 15 universities. As the total number of positions occupied by the 158 individuals was 314 it is evident that

[14] Twenty-one names are omitted because of unsatisfactory or indefinite data.

[15] Institutions represented by less than 4 men total 75 positions, making a final total of 314 positions.

these fifteen universities were responsible for two thirds of the opportunities offered for advancement in the sciences of medicine in this country up to the year 1903. The institutions offering more than ten positions are seven in number, Hopkins, Harvard, Columbia, Michigan, Pennsylvania, Chicago and New York University,[16] in the order named, with a total of 158 positions or almost exactly half of the positions (314) represented by the total number of individuals.

PRESENT DISTRIBUTION WITH RANK

Table XIII. presents the distribution of the entire 238 individuals and their rank as given in the 1906 and 1910 editions of "American Men of Science." Persons characterized as "emeritus" or "retired" are credited according to their last appointment. Nine men in active service in 1906 are not included in the table; these represent two men called to foreign universities, a medical clinician, a specialist in tuberculosis—the last two without university affiliation—a librarian, and four men whose later records are incomplete. The table thus really includes only 229 individuals.[17]

TABLE XIII

Distribution and Rank; 1903 and 1910 Lists; 229 Names

	Professor	Adj. or Associate Professor	Assistant or Junior Professor	Instructor, Lecturer, Associate or Assistant	Director, Chief or Curator	Emeritus or Retired	Totals	Gains in 1910
Harvard	15	3	3	4			25	8
Hopkins	9	8		1			18	3
Columbia	10	3		3		2	18	4
Pennsylvania	12			1	3		16	5
Chicago (incl. Rush)	5	6	2	1			14	4
Cornell	9	1	2		1		13	4
Federal and state depts.					11		11	4
Michigan	8			1			9	1
Wisconsin	5			2			7	3
California	2		2	2			6	0
N. Y. University and Bellevue	5					1	6	1
Rockefeller Institute					6		6	2
U. S. Army and Navy and P. H. Service	1				2	2	5	1
Western Reserve	4					1	5	3
Minnesota	2		1	1			4	0
Northwestern	3	1					4	0
Missouri	2	1	1				4	1
Yale	2		2				4	2
Hospitals					4		4	2
Wesleyan	2	1					3	0
Illinois	3						3	1
Mass. Institute of Technology	1			2			3	1
St. Louis Medical School	1				1		2	0
Buffalo	2						2	0
Philippine Med. School	2						2	2
Stanford	2						2	1
Indiana	1	1					2	1
Other Institutions	24	3	1	1	2	1	31	5
Not classified							9	0
Totals							238	59

It is of interest also that this very definite support of scientific medicine concerns almost entirely the university schools; independent medical schools play little or no part in this table.

[16] Including the old New York University and Bellevue Hospital Medical Schools.

[17] Only institutions represented by two or more places are given in the table. Other institutions represented by one professor are: Bowdoin, Texas,

In Table XIV., based on the 1903 list only, is shown the lapse of time, in the several broad groups representing medicine, between the receipt of last degree and attainment of full professorship, and also the number in each group who have reached prominence without the grade of full professor. The number of individuals in this table is only about two thirds (140) of the total number (179) studied. The names omitted represent those who do not fall readily into the groups given, who are without academic affiliation, or whose records are incomplete. Those who taught two subjects, as anatomy and physiology, and those who held two chairs in succession, as, for example, a clinician, temporarily the occupant of a chair of pathology, are classified more or less arbitrarily according to their greater prominence in one or the other of the subjects named, but each is counted only once.

TABLE XIV

Lapse of Time between Degree and Full Professorship. 1903 List, 140 Names

	Totals	1-2 Years	3-5 Years	6-10 Years	11-20 Years	20-27 Years	Average No. of Yrs.	Lower Grades
Anatomy	41	7	4	9	4	2	8	15
Physiology	27	1	4	6	5	1	9	10
Physiol. chem. and pharmacology	19	5	5	6	0	0	4	3
Pathology, bacteriology and hygiene	30	1	7	8	6	1	$8\frac{1}{2}$	7
Clinical	23	0	0	8	6	6	$14\frac{1}{2}$	3
Totals	140	14	20	37	21	10		38

It is seen that in anatomy, physiology, pathology and bacteriology the average wait is about the same, eight to nine years; in physiological chemistry and pharmacology it is low —four years—all full professors in these subjects having been appointed within ten years of their graduation; in clinical medicine the average is nearly double that of the other branches. The early average in physiological chemistry and pharmacology is, in all probability, due to the rapid development of these subjects as a part of the curriculum of the modern medical school; the high average in medicine is doubtless to be explained by the old custom of appointing only prominent consultants to chairs of medicine. An analysis of the appointments in anatomy indicates that the large number of early appointments is to be explained by the comparatively recent policy of divorcing the teaching of anatomy from that of physiology and surgery, which has thrown open many chairs to the younger men specializing in anatomy. Only in the clinical branches apparently has there been, in the past, much chance for a man to be called to a chair after twenty years. Considering all branches the largest number of individuals reached professorial rank during the second five-year period after graduation.

The individuals who have attained prominence without becoming full professors present great variation in lapse of time after graduation; in anatomy the extremes are one and twenty-five; in physiology, two and thirteen; in physiological chemistry, two and ten; in pathology and allied subjects, one and eleven; in clinical medicine, nine and twelve. It is noteworthy, however, that of the entire group of thirty-eight individuals representing grades lower than professor, only six had been graduated more than ten years.

CHANGE OF FIELD OF WORK

That success or prominence in a given field is necessarily the result of continuous single-minded effort in that field is supported by an analysis of the 1903 list. Excluding concurrent appointments, the interacting interests of the group representing physiology, physiological chemistry and pharmacology and the very natural communion of interests shared by pathologist and clinician, there is very little tendency to change in field of effort. Two

Clark, Iowa, Princeton, Knox, Smith, Syracuse, Tufts, Medico-Chirurgical of Philadelphia, Vanderbilt, Woman's Medical College of Philadelphia, Chicago Homeopathic Medical College, Eclectic Medical Institute of Cincinnati, Virginia, Pittsburg, Ohio, Washington and Lee, Washington University, George Washington University, the Jefferson, Denver and Albany Medical Schools and New York College of Pharmacy; by lower grades of title, Simmons, Dartmouth, Bryn Mawr, Nebraska and Georgetown; by a director, Pennsylvania State College and a commercial laboratory.

anatomists had an early brief experience in pathology and one in physiology. Three physiologists started as anatomists, but changed their interest early in their career. Some of the physiologists and chemists entered the field of pharmacology, and some of the latter that of pharmacy also, but in no instance have they been interested in other branches.

Three pathologists had initial appointments in anatomy or histology, and one in clinical medicine. One bacteriologist had an early appointment in chemistry.

THE CLINICIAN AS AN INVESTIGATOR

Of the clinical group, five individuals had been professors of pathology, while two had held chairs of materia medica, one a chair of botany and therapeutics and one a chair of anatomy. Three others had been, respectively, professor of hygiene, physiology and the institutes of medicine. Of those who had not held chairs, three had done notable work in pathology, one in physiology and toxicology and one in clinical hematology (microscopy). These activities are naturally those closely related to diagnosis and treatment, respectively, and it is probably these activities in the science of medicine, and not the actual practise of medicine, which gave the individuals in question their prominence as men of science. The history of medicine in this country shows that the first medical laboratories, presided over by men who did not practise medicine, were those of chemistry. Anatomy and physiology, at first in the hands of the clinicians, were the subjects next to acquire laboratory facilities and full-time men. Still later, pathology was divorced from clinical teaching and became a laboratory subject. But until about twenty to twenty-five years ago, the advancement of the medical sciences, aside from chemistry, was largely in the hands of clinicians, and it was men of the type represented in this list—as Mitchell, Delafield, Fitz and Janeway—who kept the scientific side of medicine alive in the period preceding the development of our present manifold laboratory activities. That twenty men in internal medicine and thirteen men in surgery and the specialties—men busily engaged in the actual practise of medicine—should constitute almost one fifth of a list of 179 prominent medical men of science, the majority of whom are laboratory men, is a matter for sincere congratulation. It will be interesting to see whether or not the new conditions in medicine, the full-time chairs in clinical medicine and the better equipped clinical and research laboratories, yield as large a number of prominent scientists in clinical medicine. The 1910 list with its 59 new names is too small and too near the 1903 period to be of value. It shows only two new names in internal medicine, three in psychiatry, two in neurology, three in surgery and none in pediatrics, as contrasted with twenty, three, three, two and three in 1903. For psychiatry, neurology and surgery this is an excellent showing; for internal medicine and pediatrics, opinion must be deferred.

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THE NATIONAL FORESTS

THE first-hand impressions and experiences gained on his thirty-day tour of the National Forests are described as "invaluable" by Secretary of Agriculture Houston in a letter which he sent on his return to Washington to the chief forester, expressing his approval of the administrative work and methods of the forest service.

Starting out with the expressed intention of seeing the work with his own eyes and studying on the ground the principal problems involved in managing and developing the forest resources of the country, Secretary Houston visited typical forests in each of the six great forest districts of the west, penetrating into the wilds on logging locomotives, automobiles, horseback, and at times on foot, and getting into personal touch, not only with the rangers and guards, but with homesteaders, cattlemen, lumberjacks and others among whom the forest officers do their work. Secretary Houston in his letter to the forester says:

I especially desired to familarize myself with the administrative machinery and business methods, to acquaint myself with the grazing condi-