Mass. Institute of Technology.

President's Report,

Dec. 8, 1886.

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To the Corporation of the Massachusetts Institute of Technology.

DURING the twelve months which have passed since I presented my last annual report, the school year 1885–86 has come to its close, and the school year 1886–87 has begun; the one with results altogether fortunate, the other under the fairest auspices.

The class of 1886 graduated on the 1st of June. Of the 62 students of the fourth year, who were candidates for the degree of Bachelor of Science, 59 were admitted to that grade by your authority, upon the recommendation of the Faculty of the School of Industrial Science.

The public exercises of the day were after the severe and simple form set by the first President of the Institute. The class thus graduating was one of exceptional strength of character and thoroughness of scholarship. There could be no higher example of what this school aims to effect than is afforded by the graduating theses of the class of 1886, taken in connection with the records of its members during the four years of their stay among us.

Those years had been spent in the work, not of decoration, but of construction; not in polishing the surface, but in building up the substance of mind and character. Little time or thought had been expended in memorizing facts previously ascertained, or in rehearsing the opinions of others; but from the first day's exercise in the laboratory of general chemistry, on through all their course, these young men had been taught to see with their own eyes, and think with their own minds, weighing, probing, analyzing, testing, for themselves, the substances and appearances which formed the subjects of their study, until through the development of their perceptive powers, through the formation of a habit of careful, discriminating, and minute observation, and through the exercise of the

faculty of judgment, the least gifted of them had become capable, as evidenced by the severe test of our thesis requirement, of selecting a field of investigation, isolating the subject-matter, eliminating for the time every thing alien or adventitious, providing all the conditions of a true experiment, and, through the application of approved tests, making an actual contribution to human knowledge. This is what we deem Education, in the best and fullest sense of that term.

THE NEW YEAR.

The total number of persons registered in all the departments and schools under the control of this corporation, for the school year 1886–87, is 738, against an aggregate, last year, of 730.

Omitting from consideration the students of the Lowell Free School of Practical Design, the number this year is 675 against 669 last year. Still further excluding the students of the School of Mechanic Arts, we find the number of students in the School of Industrial Science, the proper Institute of Technology, to be 637 against 609 last year, showing an increase of 28, or four and a-half per cent.

The following table exhibits the number of students in the School of Industrial Science each year from the opening of the Institute to the present time.

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1876–77	215
1866–67	137	1877–78	194
1867–68	167	1878–79	188
1868–69	172	1879–80	203
1869–70	206	1880–81	253
1870–71	224	1881–82	302
1871–72	261	1882–83	368
1872–73	348	1883–84	443
1873–74	276	1884–85	579
1874–75	248	1885–86	609
1875–76	255	1886–87	637

The aggregate for 1886–87 is divided among the several classes as follows: —

Graduate students, candidates for advanced degrees		2
Regular students,	Fourth Year	57
" "	Third "	87
" "	Second "	98
" "	First "	198
Special students		195

Approximately assigning the special students to classes according to the predominant studies pursued by them, we should reach the following statement of the division of the whole body among the several years.

Class.	Regular.	Special.	Total.
Graduates	2	–	2
Fourth year	57	25	82
Third year	87	48	135
Second year	98	64	162
First year	198	58	256
	442	195	637

STATISTICS OF EXAMINATIONS.

The results of the applications for admission to all classes of the School of Industrial Science thus far in the current school year, and of the examinations had thereupon, may be stated as follows: —

Forty-two were admitted without examination, either to the first year class, upon presenting certificates of clear admission to some college of reputable standing; or, upon the presentation of diplomas of graduation from some degree-conferring institution, classical or scientific, to our second or third year class as regular students, or to some department as special students; 158 were admitted upon examination, free of conditions; 80 were admitted with one

condition imposed, 25 with two conditions, 7 with three conditions; 40 applicants were rejected upon examination; 2 were admitted as special students, upon examination in the studies specially requisite to the partial courses which they proposed to follow.

The total number of applicants appears, therefore, to have been 354. Of those admitted upon examination, 61 have not thus far entered the school. In some instances, in the case of applicants heavily conditioned, this has been due to the advice of the Faculty that a longer period be taken for preparation; in some, to a change of plans, to sickness, or other causes.

There is reason for believing that not a few young men graduating from the high schools of Boston and vicinity, but not intending to pursue their studies further, pass our examinations as a sort of brevet. Thus to take our examinations shows a not discreditable ambition on the part of these young men. A certificate of clear admission to the Institute gives a very handsome finish to a high school course; and, as no great addition to the labor of examination is involved, it need not be made a matter of complaint on our part.

The figures which have been given regarding the entrance examinations of 1886, taken in connection with those of 1885 and 1884, show a progressive improvement in the preparation of candidates for admission. Of the total number submitting to examination this year, 76 per cent were admitted free of conditions, or with but one condition attached, as against 70 per cent last year. This result is due mainly to a better understanding of the requirements for entrance to the Institute, and to greater care and pains taken by teachers of high schools and academies in meeting those requirements.

EXAMINATIONS AT DISTANT POINTS.

In addition to the entrance examinations held in Boston in June and September, 1886, examinations were also con-

ducted in June at Atlanta, Chicago, Cincinnati, Denver, Nashville, New York, Philadelphia, Montreal, San Francisco, St. Louis, St. Paul, and Washington, generally with the assistance of the superintendents of the city schools who co-operated with the Faculty in the most cordial manner.

STATISTICS OF RESIDENCE.

Thirty-two States of the Union, besides the Territory of Dakota and the District of Columbia, are represented on our lists of students. Canada, Belgium, Peru, and Japan have also sent us students.

Of the total number of 637, including special students, 402 are from Massachusetts, or 63.3 per cent of the whole; 84 are from other New England States; 151 from outside New England.

The following table shows the number of students of each specified class, from each State or foreign country.

State.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regu'r Students.	Special Students.	Total.
Arkansas	..	..	..	..	1	1	1	2
California	..	..	1	2	3	6	2	8
Connecticut	..	..	3	1	5	9	7	16
Dakota	..	..	..	..	1	1	..	1
Delaware	..	..	..	..	..	..	1	1
Dist. Columbia,	..	..	..	..	..	..	4	4
Georgia	..	1	..	..	1	2	1	3
Illinois	..	..	1	3	10	14	5	19
Indiana	..	..	..	..	1	1	1	2
Iowa	..	2	..	1	1	4	2	6
Kansas	..	1	..	1	..	2	..	2
Kentucky	..	..	..	..	1	1	3	4
Maine	..	4	..	3	5	12	8	20
Maryland	..	..	1	..	1	2	..	2
Massachusetts	1	38	62	68	127	296	100	402
Michigan	..	..	1	1	1	3	2	5
Minnesota	..	..	1	..	1	2	2	4
Mississippi	..	..	..	..	..	..	1	1
Missouri	..	..	..	..	..	..	1	1
Nebraska	..	..	..	1	..	1	1	2
Nevada	..	..	..	..	..	..	1	1
N. Hampshire	..	4	3	2	7	16	10	26
New Jersey	..	..	..	..	1	1	6	7
New York	..	2	3	3	9	17	7	24
Ohio	..	1	2	2	6	11	10	21
Oregon	..	..	1	..	..	1	..	1
Pennsylvania	1	..	1	4	3	9	4	13
Rhode Island	..	1	4	4	6	15	2	17
South Carolina,	..	..	..	1	..	1	..	1
Tennessee	..	..	..	..	..	..	1	1
Vermont	..	..	..	..	3	3	2	5
Virginia	..	..	1	1	..	2	1	3
W. Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	..	1	..	2	3	..	3
Foreign Country.								
Belgium	..	..	..	..	..	..	1	1
Japan	..	..	1	..	..	1	..	1
Peru	..	..	..	..	1	1	1	2
Prov. of Quebec,	..	2	..	..	1	3	..	3
N. Brunswick	..	1	..	..	..	1	..	1

RESIDENCE OF MASSACHUSETTS STUDENTS.

It has been said that 63.3 per cent of all our students are from Massachusetts. All the counties of the State, except the small county of Dukes and Nantucket, send students to the Institute of Technology. Ninety-one cities and towns are reported on the lists. The first column of the following table shows the number of cities and towns in each county sending pupils to the Institute; the second column gives the aggregate number from each county. It appears that Suffolk furnishes us 144 pupils; Middlesex comes next, with 105; Essex, third, with 49; Norfolk, fourth, with 36.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	2	2	Middlesex	26	105
Berkshire	3	5	Norfolk	10	36
Bristol	5	16	Plymouth	10	19
Essex	17	49	Suffolk	3	144
Franklin	1	2	Worcester	9	14
Hampden	3	7		91	402
Hampshire	2	3			

The following is a list of the towns, twenty-one in number, which send four or more scholars to the Institute:—

Boston	140	Lynn	7	Fall River	4
Newton	26	Plymouth	6	Framingham	4
Cambridge	11	Salem	6	Malden	4
Somerville	10	Beverly	5	New Bedford	4
Brookline	8	Haverhill	5	Stoughton	4
Lowell	8	Melrose	5	Weymouth	4
Hyde Park	7	Newburyport	5	Winchester	4
Lawrence	7	Canton	4		

PROPORTION OF OLD AND OF NEW STUDENTS.

The following table exhibits, for each year of the school's history, the distribution of the total number of students

among two classes: first, those students whose names are found upon the catalogue of the year preceding; and, secondly, those students whose names appear as new names upon the catalogue of the year to which the statement relates: —

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number were regular first year Students.	(5) No. of New Students not of the regular first year class.
1866-67	137	34	103	58	45
1867-68	167	79	88	54	34
1868-69	172	82	90	50	40
1869-70	206	90	116	63	53
1870-71	224	109	115	71	44
1871-72	261	122	139	82	57
1872-73	348	173	175	112	63
1873-74	276	171	105	59	46
1874-75	248	159	89	35	54
1875-76	255	139	116	65	51
1876-77	215	130	85	31	54
1877-78	194	96	98	47	51
1878-79	188	99	89	34	55
1879-80	203	102	101	34	67
1880-81	253	121	132	62	70
1881-82	302	136	166	86	80
1882-83	368	173	195	114	81
1883-84	443	231	212	140	72
1884-85	579	311	268	186	82
1885-86	609	369	240	177	63
1886-87	637	379	258	190*	68

It appears from the foregoing, that the number of students remaining over has been increased by 10, while the number registered for the first time is larger by 18; making the net gain, as previously stated, 28.

AGES OF STUDENTS ON ENTRANCE.

Another class of facts, first presented in the report of last year, is given for the current year; those, namely,

* In addition, 8 students are repeating the first year.

which relate to the ages of our students upon entrance. The regular students of the first year class number 198. From these we should except three cases of students of unusual ages; viz., two of 22 and one of 23 years. These deductions leave 195 as the number of students whose ages have been made the subject of computation.

The results appear in the following table, in comparison with the corresponding results for 1885–86.

Period of Life.	1885–86.		1886–87.	
	Half-Year Groups.	Yearly Groups.	Half-Year Groups.	Yearly Groups.
16 to 16½ years	11		10	
16½ to 17 years	16	27	19	29
17 to 17½ years	24		16	
17½ to 18 years	20	44	33	49
18 to 18½ years	42		38	
18½ to 19 years	23	65	23	61
19 to 19½ years	21		21	
19½ to 20 years	11	32	15	36
20 to 20½ years	6		9	
20½ to 21 years	3	9	6	15
21 to 22 years	5	5	5	5
	* 182	182	† 195	195

From the foregoing tables it appears that the average age of the 195 students taken for this comparison, the present year, is 219.91 months, or 18 years, 3 months, and 27 days. This compares with the corresponding figures relating to the five previous entering classes, as follows: —

	Av. Age in Months.		Av. Age in Months.
Class of 1885	220.50	Class of 1888	220.66
Class of 1886	218.45	Class of 1889	218.53
Class of 1887	218.88	Class of 1890	219.91

* Five students being excepted from the computation, two being of unusual age, the ages of three not being recorded.

† Three being of unusual age, as stated.

PROPORTION OF REGULAR AND OF SPECIAL STUDENTS.

Another table which has been prepared exhibits both the absolute number of regular and of special students, as by the catalogue of each successive year, and also the proportion existing between these two classes: —

Year.	No. of Regular Students.	No. of Special Students.	Total No. of Students.	Percentage.	
				Regular.	Special.
				Per cent.	Per cent.
1865-66	64	8	72	89	11
1866-67	110	27	137	80	20
1867-68	124	43	167	74	26
1868-69	105	67	172	61	39
1869-70	125	81	206	71	29
1870-71	143	81	224	64	36
1871-72	180	81	261	69	31
1872-73	235	113	348	68	32
1873-74	182	94	276	66	34
1874-75	170	78	248	69	31
1875-76	182	73	255	71	29
1876-77	134	81	215	62	38
1877-78	117	77	194	60	40
1878-79	103	85	188	55	45
1879-80	110	93	203	54	46
1880-81	140	113	253	55	45
1881-82	164	138	302	54	46
1882-83	219	149	368	60	40
1883-84	272	171	443	61	39
1884-85	368	211	579	64	36
1885-86	415	194	609	68	32
1886-87	442	195	637	69	31

It will be seen that the tendency noted in the reports of the two last years, towards a progressive increase in the proportion of students taking the full regular course, still continues. The policy of the Institute regarding special students was very fully presented in the last annual report.

GRADUATES OF OTHER COLLEGES.

It has been stated that two students who have graduated from this school with the degree of Bachelor of Science are pursuing courses of study in the Institute as candidates for advanced degrees.

In addition, we have nineteen students, graduates of other institutions, pursuing courses of study with us, either as regular students, candidates for the Bachelor's degree, or as special students. Of these, nine are graduates of Harvard University, two of Brown University, while one comes from each of the following institutions: Baldwin University, the University of New Brunswick, the University of the Pacific, the University of Vermont, Belmont College, Columbian University, Yale College, and Ohio State University.

Of the nineteen, three are regular students of the fourth year in civil, in mechanical, or in electrical engineering; two are regular students in mechanical engineering, one in civil, and one in electrical engineering, in the third year. The remainder are registered as special students; six of them devoting themselves to chemistry and metallurgy, three to architecture, one to civil engineering, one to mechanical engineering, and one to physics.

In the earlier years of the Institute, the crowded condition of our laboratories, and the intense occupation of our teachers in undergraduate instruction, left little opportunity for work in advance of that demanded by our first degree, that of Bachelor of Science. The ampler space and more elaborate equipment of our present laboratories, the higher specialization of the services of the school, and the larger teaching staff have, within the past two or three years, encouraged the Faculty to offer facilities for study and research far beyond that of the required courses; and it is my earnest hope, that more and more the stronger men of our graduating classes will decide to remain for one or more years of advanced work, and become candidates for the advanced degrees, — those of Master of Science, Doctor of Philosophy, and Doctor of Science, — which the corporation has authorized to be conferred.

The presence of graduates of other institutions, as candidates for our degree of Bachelor of Science, or as special students in the various undergraduate departments, has ong been a feature on our lists.

Serious difficulties in classifying such students, and in arranging their desired courses of study, have always been encountered, from the great diversity existing in the undergraduate instruction of the institutions from which they came, and even more from the widely different significance to be attached to identical announcements on the schedules of study in such institutions. Especially has embarrassment been caused by the manner in which the mathematics are taught in many of the colleges of the country. With us the mathematics are taught, not for themselves, but for their uses: instructors employ methods directed to give the pupils command of algebra, geometry, analytics, or the calculus, as tools; the pupils, on their part, having early, perhaps immediate, occasion for such applications of their mathematics, give themselves to their work with greater earnestness and directness; while the constant reference to mathematical principles in the drawing-room or laboratory emphasizes these principles in the mind.

THE COURSES OF INSTRUCTION.

For the first time for several years, we have in the fourth year class one or more candidates for the Bachelor's degree in each department of the Institute.

The following table presents the number of students in each of the regular courses. It will be seen that this statement relates to the second, third, and fourth years; choice of courses being made only at the end of the first year.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Natural History.	Physics.	General Course.	Total.
4th year class,	8	19	8	1	7	9	1	1	3	57
3d " "	15	30	6	4	9	19	3	..	1	87
2d " "	22	26	5	8	8	24	..	1	4	98
Total. . .	45	75	19	13	24	52	4	2	8	242

The following table exhibits the number of persons who have graduated within each of the several courses, at each succeeding year since the first diplomas were conferred in 1868. In this table, the term "General Courses" will be understood to embrace alike the "Science and Literature" Course of the period 1868–1880, and the Elective and General Courses of the period subsequent.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History.	Physics.	General Courses.	Total.
1868 . .	6	1	6	..	..	..	..	..	..	1	14
1869 . .	2	2	..	..	1	..	..	..	..	..	5
1870 . .	4	2	2	..	1	..	..	..	..	1	10
1871 . .	8	2	5	..	2	..	..	..	..	..	17
1872 . .	3	1	5	..	3	..	..	..	..	..	12
1873 . .	13	1	3	1	7	..	..	..	..	1	26
1874 . .	10	4	1	1	..	..	..	..	..	2	18
1875 . .	10	6	6	1	1	..	..	..	1	2	27
1876 . .	12	9	7	..	5	1	..	1	4	4	43
1877 . .	12	6	8	4	2	..	..	..	..	..	32
1878 . .	8	2	2	3	3	..	..	..	..	1	19
1879 . .	6	8	3	1	3	..	..	1	1	..	23
1880 . .	3	..	3	..	1	..	..	..	..	1	8
1881 . .	3	5	6	3	8	..	..	1	..	2	28
1882 . .	2	5	5	3	6	..	..	1	1	1	24
1883 . .	3	7	4	1	3	..	..	..	..	..	18
1884 . .	5	6	13	..	12	..	..	..	..	..	36
1885 . .	4	6	8	2	4	..	2	..	..	1	27
1886 . .	9	23	7	1	7	..	10	1	..	1	59
Total .	123	96	94	21	69	1	12	5	7	18	446
Deduct names counted twice											2
											444

THE WORK OF SPECIAL STUDENTS.

The 195 special students in the School of Industrial Science cannot be classified systematically; but the following table exhibits the number of special students pursuing each particular branch of study, according to the attendance papers filed by them, and approved by the Faculty: —

NUMBER OF SPECIAL STUDENTS ATTENDING EXERCISES IN THE FOLLOWING DEPARTMENTS OF STUDY OR PRACTICE.

Architecture	51	German	81
Applied Mechanics	47	Mathematics	92
Chemistry	71	Mechanical Engineering	47
Civil Engineering	25	Military Drill	16
Mechanical Drawing	20	Mining and Metallurgy	23
Descriptive Geometry	21	Physics	93
English	68	Shop Work	44
French	46	Heating and Ventilation	10
Geology, etc.	36		

Total number of entries, by special students	791
Total number of special students	195
Average number of entries	4.1

It may be of interest to note the numbers of students either regular or special, pursuing certain leading branches of study, in each of the four years, which are as follows :—

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	211	134	105	17	467
Chemistry	227	26	29	20	302
English	209	117	69	..	395
French	210	13	..	..	223
Physics	..	141	106	22	269
German	..	131	113	10	254
Shopwork *	..	73	50	26	149

THE CORPS OF INSTRUCTORS.

A still further increase of the instructing staff has been required during the year.

The number of instructors of all grades, excluding those persons who are announced as lecturers for the year only, is 69, against 62 last year. This increase has been in part due to the increasing specialization of work in the departments of mechanical and electrical engineering, and of

* Exclusive of students in the School of Mechanic Arts.

drawing-room and laboratory practice in all departments; in part to the increase in the size of the classes, requiring a greater number of divisions for the purposes of recitation or field work.

The number of professors in the school is now 12; of associate professors, 7; of assistant professors, 6; of instructors, 27; of assistants, 17.

The following table shows the number of teachers of each recognized grade in each year since the foundation of the school.

Year.	Professors.	Associate Professors.	Assistant Professors.	Instructors.	Assistants.	Total.
1865-66 . .	10	..	..	..	..	10
1866-67 . .	12	..	..	2	..	14
1867-68 . .	12	..	1	2	2	17
1868-69 . .	13	..	..	6	1	20
1869-70 . .	16	..	1	6	2	25
1870-71 . .	18	..	2	7	5	32
1871-72 . .	21	..	2	11	1	35
1872-73 . .	23	..	2	9	1	35
1873-74 . .	20	..	3	10	4	37
1874-75 . .	20	..	3	7	3	33
1875-76 . .	23	..	..	6	8	37
1876-77 . .	21	..	..	4	10	35
1877-78 . .	20	..	..	3	14	37
1878-79 . .	18	..	..	7	12	37
1879-80 . .	16	..	..	7	8	31
1880-81 . .	15	..	2	6	7	30
1881-82 . .	17	..	3	6	11	37
1882-83 . .	16	..	3	10	11	40
1883-84 . .	15	..	8	15	10	48
1884-85 . .	14	3	11	15	14	57
1885-86 . .	14	6	7	17	18	62
1886-87 . .	12	7	6	27	17	69

The changes of the past year among our professors and other teachers have been many and important. For the first time in the twenty-one years of our history, an active member of the corps of instructors has died in service. Professor Nichols departed this life in Hamburg, on the

14th of July, from the effects of a critical surgical operation, undertaken, though with little expectation of a favorable result, for his relief from the distressing malady against which for many years he had fought with marvellous heroism.

William Ripley Nichols was born in Roxbury, on the 30th of April, 1847. After preparing himself for Harvard College, he entered the Institute of Technology in 1865. Graduating from the chemical course as one of the five members of the class of 1869, after a career in which he was not less remarked for scholarly grace than for scientific strength, he was at once selected as an assistant in chemistry, and in 1872 was made professor of general chemistry, which chair he held until his death. His own strong predilections, rather than any purpose of the government or Faculty, led him to add to his duties a gradually extending course of instruction in sanitary chemistry.

During the year 1881–82, Professor Nichols so far yielded to the entreaties of his colleagues as to relinquish temporarily his duties at the Institute, and to seek, through repose, the restoration of his health, long before deeply undermined by excessive labors. Resuming his work, with but slight improvement observable in his condition, he again took up his burden with an extraordinary power of will, bearing its increasing weight to the end with a serene courage rarely seen among men. If ever one of our race proved the utmost effects of resolution and fortitude in contesting the progress of fatal disease, that man was William Ripley Nichols.

As an investigator, Professor Nichols early attained eminence in that department known as sanitary chemistry, especially as related to the water-supply of cities. Here he had few equals; while his conservatism of temper and his sterling conscientiousness kept him from the errors and faults into which so many promising students in this field have fallen.

As a teacher, Professor Nichols was a clear expositor,

strong and terse in argument, apt in illustration, neat and effective in manipulation. To faithful and ambitious students he was, in his calm, steady, lofty way, a constant source of inspiration and encouragement.

As a disciplinarian, dealing with mixed classes of young men, often ill-trained in their previous studies and exercises, and not always duly attentive and diligent, he was, let it be said in that spirit of truthfulness of which his own character and career afford so shining an example, somewhat severe. Dealing heroically with his own life, health, hopes, pleasures; setting for himself a lofty standard, and holding himself unflinchingly up to its full height, he was, in a degree, deficient in toleration for faults and errors in half-formed or ambiguous characters.

As a member of the Faculty, his influence was, from first to last of his connection with it, altogether and highly useful. No man did more — doubtless all my colleagues of the Faculty would hasten to say, no man did so much — to create and maintain the peculiar character of this school. He was, beyond all others, master of its rules and methods of procedure. His moral courage and lofty principles of action not only kept him from faltering in difficult situations, in doubtful cases, but were a positive force to hold up the hands and the hearts of his colleagues. Here he was eminently a leader, — and that not by any desire to lead, or a disposition to manage or govern; not from any wilfulness of temper, or through any dialectical or rhetorical artfulness: but solely and always by the clearness of his reasons, the thoroughness of his convictions, the perfect consistency of his views and purposes.

In the middle of the year, Professor George L. Vose withdrew, on his own instance, from the chair of civil engineering, to which he was appointed in 1881. Although Professor Vose's resignation was due to a difference of views between himself and the Faculty of the school, as to the courses of instruction, his colleagues have not failed to do justice to his very high professional acquirements and

abilities, to his sincerity and moral earnestness, and to the great kindliness and generosity of his nature.

Still another loss which the Institute has sustained during the year has been in the violent death, through a distressing accident, of Mr. William Cook, instructor in the modern languages.

Mr. Cook was born in 1842. He entered Yale College in the class of 1861. After graduation, he entered the army, and served till the close of the war then in progress. He subsequently spent several years abroad, engaged in the study of modern languages. Upon his return, he became instructor and afterwards assistant professor of German in Harvard University, where he remained until 1881. On a wider field, he rendered valuable services to his profession as the English editor of several important French and German works.

In 1885 Mr. Cook was appointed instructor, to fill an original vacancy caused by the increase in the number of students in the department of modern languages. During his single year in the Institute he had achieved a marked success, commanding the respect and winning the regard of his pupils. He had been engaged to continue his work in the school the coming year, after a promotion which testified to the sense entertained of the value of his services, and was on the point of resuming his instruction, when cut off by the accidental discharge of a fowling-piece, at Chatham, Mass., on the 27th of August, 1886.

The vacancies caused by the casualties recited have been temporarily filled as follows: —

The instruction in general chemistry is given the present year by Assistant Professor Pope, of the department of analytical chemistry. Professor Pope also gives the instruction in the theoretical chemistry of the second year. Professor Drown assumes the responsible charge of the instruction in sanitary chemistry; Mrs. Richards remaining the instructor in that department, as under Professor Nichols, assisted by Mr. Frederick Fox, jun., M.S. Mr.

Clement W. Andrews, A.M., gives the instruction in the theoretical chemistry of the third year.

Assistant Professor George F. Swain has been appointed associate professor of civil engineering, and placed in charge of that department, pending an appointment to the Hayward professorship.

Professor Swain graduated from the Institute with high honors in 1877. From 1880 to 1882 he was engaged as a special agent of the census office in investigating the water-power employed in manufactories on the Atlantic slope. The results of these investigations, accompanied by most valuable discussions of the geographical and meteorological conditions controlling the flow of water in the streams of that region, and its utilization for the purposes of manufacture, have been published by the United-States Government in several extended reports. In 1881 he was appointed instructor in Civil Engineering in the Massachusetts Institute of Technology, and in 1883 was advanced to the grade of assistant professor.

Some important changes in the nature of extending and diversifying the instruction given in this department will be mentioned in another connection.

During the course of the past year, Mr. Charles D. Jameson was appointed instructor in railroad engineering. Mr. Jameson was graduated from Bowdoin College, in the Engineering Department, in 1876. After graduation, he was almost constantly engaged in railroad engineering in the field until his appointment here. Three years of the time were spent on the Memphis and Charleston Railroad, and four and a half years on the Mexican Central Railroad.

To fill the vacancy caused by Mr. Cook's death, Dr. G. Theodore Dippold has been appointed instructor in modern languages. Dr. Dippold is a native of Frankfort-on-the Main, where he completed his course at the Gymnasium. After attending lectures at Heidelberg, he came to America, and first occupied a position as tutor in German in Harvard University, 1870–73. After this he was in-

structor in French and Anglo-Saxon in Boston University, 1874–83, where he took the degree of Ph.D. He was subsequently instructor in German in Wellesley College, and in 1883 at the Johns Hopkins University.

The great increase which has taken place in the number of students, especially of the first and second years, appeared to the Faculty and to the Executive Committee to require an important addition to the instructing staff in the department of history and political science; and, at the close of the last school year, the position of instructor in that department was offered to Dr. Davis R. Dewey, and by him accepted. Dr. Dewey graduated, with the degree of Bachelor of Arts, at the University of Vermont in 1879. For four years thereafter he was engaged in teaching, the greater portion of that time as principal of the high school in Hyde Park, Ill. From 1883 to 1886, he was a student in advanced courses of historical and political science in the Johns Hopkins University, Baltimore, from which he received the present year the degree of Doctor of Philosophy. Dr. Dewey has already made himself a reputation for good work in economic statistics and industrial history.

The department of architecture has been materially strengthened, during the year, by the appointment of Mr. Thomas O'Grady, jun., as instructor. Mr. O'Grady was a special student in architecture, at the institute, during the years 1878–80, and has since been engaged in the active practice of his profession in the city of Boston.

The following gentlemen, formerly assistants, have this year been appointed instructors in their several departments: Mr. Charles A. French (mathematics), Mr. George H. Barton (mineralogy), Mr. George R. Underwood (industrial chemistry), Mr. Fred. L. Bardwell (general chemistry), Mr. Aug. H. Gill (general chemistry), Mr. Arthur J. Purinton (mechanical engineering), Mr. Harry W. Tyler (mathematics), and Mr. Alfred L. Fitch (mechanical engineering).

CHANGES IN COURSES OF STUDY AND IN LABORATORY ACCOMMODATIONS.

The most considerable modification which has taken place in any of the courses of instruction during the past year has been in the department of civil engineering.

The rapid development of the technical sciences and the specialization of the various branches of civil engineering have so enlarged the field of professional work, as to make it desirable, that, among a numerous body of students like ours, some choice should be allowed as to the subjects of study to be extensively and minutely pursued, so that those who feel a special aptitude for making themselves highly expert in some one line, or who have peculiar outside reasons for doing so, may have the desired opportunity.

At the same time, it is fully recognized to be expedient for the great majority of students to cover nearly the whole familiar field of civil engineering study, in the uncertainty which necessarily exists in the case of most regarding the particular line of work to which circumstances will ultimately direct them.

In this view, the studies of the civil engineering department remain essentially the same as heretofore, down to the completion of the second year. During the third year, a few options are introduced, causing a certain, though as yet not considerable, branching-out of the course. In the fourth year, three widely different lines of study and practice are offered the student. The first is a general course, substantially the same with that heretofore pursued. The second is known as the railroad course, and is especially adapted to allow those students who are sufficiently confident of their future field of work, to qualify themselves in a far higher degree than is attainable in the general course, for service in surveying and locating railroad lines, in constructing and maintaining roadways, tracks, bridges, and terminals, and in taking part, should they in time be called to do so, in operating and managing roads. In addi-

tion to the regular course in political economy, the students of this class receive special instruction in the economics of transportation and in railroad book-keeping. Particular pains are taken to impress it upon the students that the engineer should be the friend and not the enemy of the finances of the road on which he is employed; that it is his part, not to build engineering monuments to display his skill and ingenuity, but to meet the exigencies of transportation as simply and cheaply as is consistent with strength, permanence, and security; that all unnecessary expenditures in meeting the demands of traffic and travel become a perpetual tax.

The third branch of the civil engineering department is styled the course in geodesy and topography, and is designed to qualify any who may desire it for work of the highest class in geodesy, topography, and field astronomy. It is not anticipated that this branch will ever be taken by many students; but it is deemed appropriate that a school of applied science should be prepared to give such instruction, while the need of men thoroughly trained in this way has long been felt in connection with the government surveys.

A tentative scheme for the civil engineering studies, as thus proposed to be modified, has already been put forth in pamphlet form. Advantage will be carefully taken of experience in the further development of the new lines of study.

During the past year, the appliances of the chemical laboratory have been materially increased in extent and the older apparatus has been perfected. The crowded condition of the sanitary laboratory rendered an increase of facilities necessary. The large room 36, New Building, was taken for a laboratory of sanitary chemistry, and equipped in a most thorough manner, thereby giving ample accommodation for thirty students; the small rooms 33 and 34 being surrendered by the chemical department, to be used for recitations. The laboratory of indus-

trial chemistry has been rendered more effective by the addition of numerous pieces of apparatus, and the dyeing-room has been put in successful operation during the year. Increased attention has been paid to teaching this branch of chemistry by excursions to manufacturing establishments. The laboratory for organic chemistry has been crowded during the whole year; and, if the present demand for men with this special training continues, increased facilities must soon be given for the prosecution of work in this direction.

Rooms 32 and 33 in the Rogers Building have been thrown together, and together with room 31 have been made into a suite, for the better accommodation of the departments of English, history and political science. Laboratory methods are being, as far as possible, introduced into the instruction in these branches.

The changes in the department of physics, chiefly in connection with the instruction in electrical engineering, have been rather of the nature of steady and marked, though gradual, advance in all directions, than of radical alterations. Our collection of apparatus for precise measurement is large, as is necessarily the case with such advanced instruction and such large classes; and the past year has added materially to our resources in this direction. In addition to the valuable and delicate measuring instruments which have been purchased, we are also in possession of an experimental dynamo-machine, constructed by two of our students in connection with their thesis-work, and particularly adapted for the study of the theory of such machines. New and valuable courses of lectures have been instituted, on the Precision of Measurements by Professor Holman, and on Quaternions by Professor Osborne; and additional courses will be opened during the present year. In the matter of original research, the laboratory has been busy; and during the year 1885–86, five papers have been published in the Proceedings of the American Academy of Arts and Sciences, while several

others are nearly ready for publication. Allusion should also be made to the increased number of exercises in heating and ventilation, and to the largely increased number of students from the Architectural, Biological, Mechanical, and Civil Engineering courses.

The changes in the departments of applied mechanics and mechanical engineering since last year have been in the nature of a further development of the courses laid out, and a more thorough systematizing of the work. The options of the fourth year have been entered upon earlier, thus giving opportunity for further extension of the scope of these studies. In the laboratories some new apparatus has been added. That for testing injectors, and that for calibrating wires, has been added; and machinery is now being introduced for testing the transmission of power by ropes, which will also enable us to extend further the belting tests, which have formed a prominent feature of the instruction in this laboratory during the past two years. The department has received a new Mack injector, and five grooved pulleys for ropes from the manufacturers in Glasgow.

THE NEED OF FURTHER ENDOWMENTS.

More and more painfully, from year to year, we feel the need of large permanent endowments, to increase the present usefulness, and to secure the future, of the Institute. No school in the land is undertaking to do a work so large as ours, without twice, thrice, or four times our invested means. Few American institutions draw so much as one-half their income from students' fees; many derive not more than one-third or one-fourth from this source. The Massachusetts Institute of Technology is obliged to meet not less than three-fourths of its expenses through tuition bills. This is not only a dangerous situation for any institution to occupy, but it is unduly onerous upon our students.

It should be remembered, that, but eight years ago, the total number of students registered in the School of Indus-

trial Science was 188; to-day it is 637. No corresponding increase of endowments has taken place. Nearly all of the additions to our means which have been made in the interval have necessarily gone to meet the absolute exigencies created by the great increase in the attendance upon the school. These 450 additional students have had to be accommodated, buildings erected, laboratories furnished, costly scientific apparatus provided for them.

While thus the increasing numbers of scholars at the Institute has involved larger and larger expenditures, both the logic of events and the rightful ambition of the Faculty and Corporation, have created continually new occasions for the use of money. It was no more in our power to refuse to keep the Institute abreast of the age, in the matter of the fulness and variety of instruction, than it was to reject the hundreds of pupils applying for admission, in excess of our traditional numbers. It was morally necessary that we should at once enlarge the school, and improve it. During the past five or six years, a new and most important scientific profession, that of electrical engineering, has emerged into the field of industry; while, within the more familiar professions, the demand for a higher order of expert work has invited further and still further specialization, requiring the introduction of large groups of optional studies not known to the catalogues of former years.

In this effort to make the Massachusetts Institute of Technology second to none in the world, the Corporation have succeeded, — thanks, largely, to the zeal, learning, and sound judgment of a devoted and self-sacrificing body of professors and instructors; but the funds which are needed to secure that position beyond temporary disaster or business depression, to give the benefits of our instruction to the largest number of deserving pupils, and to yield an adequate remuneration to the instructing staff, have not been placed at the disposal of the Corporation.

I am speaking in no spirit of complaint or censure. The munificence of the citizens of Boston, of Massachusetts, of

New England, in endowing and supporting institutions of art and learning, has long been the admiration of the men of other regions and of other countries. Growing up under the shadow of a university not more honored by time than by fortune, rightfully wearing as her crown-jewels the affection and gratitude of the land to whose prosperity, order, and virtue she has so largely ministered through successive generations, with many another institution of beneficence claiming a share in the public thought, and in the special interest of the wealthy, — it is not surprising that this new school, representing the new education, should still be poor.

Nor is it a subject altogether of regret, that in the past we have been somewhat pinched for means. The early growth of the Institute may not inconceivably have been sounder and firmer, because slow and painful. But I think no one can know much of this school without having a strong conviction that the full time has now come, when it requires for its greatest usefulness, for the maintenance of its high character among the scientific institutions of the world, and for its security against disaster and business depression, large, very large, additions to its permanent investments.

We should have half a million of dollars for immediate, imperative needs; it would require a million to place us in as good a financial condition as the poorest school of our rank in the United States. This is not, it should be borne in mind, an appeal in behalf of an institution whose necessities arise from its failing to meet a public demand; which is to be supported because it was once brought into existence, and is to be kept alive, whether wanted or not, by pleas *ad misericordiam*. The urgent necessities of the Massachusetts Institute of Technology have arisen through the growing popular appreciation of the kind of education which is here given, through the very success of our graduates in dealing with the problems of practical life. The needs of the Institute are so great, because the Institute

is itself so much needed. It will not be like Massachusetts, if those wants are not, in a near future, fully and liberally supplied.

Gentlemen of the Corporation, — the same year which has witnessed, not only the first, but also the second death among the corps of instructors of the Massachusetts Institute of Technology, has seen the hand of the Destroyer laid more heavily than ever before upon our own body. Your minds have already recalled the names and faces of the four members of the Corporation who have passed away from earth since the December meeting of 1885.

In Mr. John C. Hoadley, we have lost one of the foremost engineers of this country of great engineers, — a scholar, also, in the higher walks of literature; in the Rev. Dr. Lothrop, a devoted friend of this institution, one who, to an unusual degree, mingled with the virtues of his sacred calling the shrewd wit and practical sense of a man of the world; in Dr. John D. Philbrick, a master of educational science; in Mr. Henry P. Kidder, one of Boston's noblest citizens, who, in his lofty career, did not more to promote the financial greatness of his city and his State, than to advance their intellectual and moral purity and prosperity, who won great wealth by honorable means that he might devote it to beneficent uses, who never saw the sun set upon a day in which he had not done good to others, and who, through all his life, unconsciously builded his own monument, compact of worthy deeds. In filling the places thus left vacant, we shall search widely and choose carefully; but we cannot hope altogether to make good these losses, for four such men will come to us, at the best, not in a year, but in a decade.

FRANCIS A. WALKER, *President.*