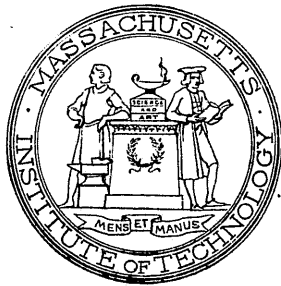


ANNUAL REPORT  
OF THE  
PRESIDENT AND TREASURER  
OF THE  
MASSACHUSETTS  
INSTITUTE OF TECHNOLOGY,

DEC. 10, 1890.



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*To the Corporation of the Massachusetts Institute of Technology:*

Since my last annual report, one school year has ended happily, and another has opened with the fairest prospects. On the 3d of June, the degree of Bachelor of Science was conferred upon one hundred and two members of the class of 1890, and upon one member of a preceding class who had supplied certain requirements previously lacking. The degree of Master of Science was conferred upon a member of the class of 1889, after the completion of a year of additional study.

Inasmuch as Graduation Day of 1890 marked the close of the first quarter-century in the life of the Institute, it was made the occasion of a commemorative address by Augustus Lowell, Esq., of the Corporation and of the Executive Committee, in which the work of twenty-five years was reviewed, and the contributions of the school to the cause of scientific and technical education were set forth, both for the encouragement of the governors, teachers, alumni, and other friends of the Institute, and as an historical record of interest.

Of the 102 graduating members of the class of 1890, 25 graduated in civil engineering, 27 in mechanical engineering, 3 in mining engineering, 5 in architecture, 13 in chemistry, 18 in electrical engineering, 3 in biology, 2 in physics; 6 graduated from the department of general studies. All courses of the school were thus represented in the award of diplomas. The fourth-year students of the year now current comprise candidates for the degree of the Institute, in each of the nine courses named, and also,

for the first time, in chemical engineering, that course (X.) having been opened to students at the beginning of the school year 1888-89. The course in sanitary engineering (XI.) will not present candidates for a degree until the school year next following,

The new year has witnessed an increase, though not a large increase, in the number of students in the school. The total registration this year, as by the catalogue now in press, amounts to 937 against 909 last year, a gain of 28. The following table exhibits the number of students in the school each year, from the opening of the Institute to the present time :—

Year.	No. of Students.	Year.	No. of Students.
1865-66	72	1878-79	188
1866-67	137	1879-80	203
1867-68	167	1880-81	253
1868-69	172	1881-82	302
1869-70	206	1882-83	368
1870-71	224	1883-84	443
1871-72	261	1884-85	579
1872-73	348	1885-86	609
1873-74	276	1886-87	637
1874-75	248	1887-88	720
1875-76	255	1888-89	827
1876-77	215	1889-90	909
1877-78	194	1890-91	937

#### STUDENTS BY CLASSES.

The aggregate number of students for 1890-91 is divided among the several classes as follows :—

Graduate student, candidate for advanced degree	1
Regular students, Fourth Year	115
“ “ Third Year	138
“ “ Second Year	154
“ “ First Year	250
Special students	279
Total	937

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following statement of the division of the whole body among the several years : —

CLASS.	Regular.	Special.	Total.
Graduate of the M. I. T., candidate for an advanced degree . . . . .	1	..	1
Fourth Year . . . . .	115	32	147
Third Year . . . . .	138	71	209
Second Year . . . . .	154	84	238
First Year . . . . .	250	92	342
	658	279	937

STATISTICS OF EXAMINATIONS.

Of the 937 students of the present year, 365 were not connected with the school in 1889-90.

Fourteen had been connected with the Institute at some previous time, and returned to resume their places in the school; 26 were admitted provisionally, without examination; 60 were admitted on the presentation of diplomas or certificates from other institutions.

Excluding from consideration those who were admitted but have not, in fact, entered the school, 36 in number, the following was the result of the examinations held : —

Admitted clear . . . . .	165
“ on one condition . . . . .	51
“ “ two conditions . . . . .	28
“ “ three “ . . . . .	13
“ “ more than three conditions . . . . .	8
Rejected . . . . .	64
	329

EXAMINATIONS AT DISTANT POINTS.

In addition to the entrance examinations held in Boston in June and September, 1890, examinations were also con-





## RESIDENCE OF MASSACHUSETTS STUDENTS.

It has been said that 55.2 per cent of our students are from Massachusetts. All the counties of the State, except the small counties of Dukes and Nantucket, send students to the Institute. One hundred and six 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 Middlesex sends us 164 pupils; Suffolk comes next, with 156; Essex third, with 60; Norfolk fourth, with 51. Last year Suffolk County led the list.

COUNTY.	No. of Towns.	No. of Students.	COUNTY.	No. of Towns.	No. of Students.
Barnstable . . .	4	5	Hampden . . .	4	8
Berkshire . . .	3	4	Middlesex . . .	32	164
Bristol . . .	5	21	Norfolk . . .	17	51
Essex . . .	15	60	Plymouth . . .	12	24
Franklin . . .	1	1	Suffolk . . .	3	156
Hampshire . . .	2	4	Worcester . . .	8	19
	30	95	Total . . .	106	517

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

Boston . . . . . 143	Fall River . . . . . 8	Dedham . . . . . 4
Newton . . . . . 29	Lawrence . . . . . 7	Gloucester . . . . . 4
Cambridge . . . . . 21	Framingham . . . . . 6	Hingham . . . . . 4
Brookline . . . . . 18	Melrose . . . . . 6	Hyde Park . . . . . 4
Lynn . . . . . 14	New Bedford . . . . . 6	Kingston . . . . . 4
Lowell . . . . . 13	Salem . . . . . 6	Milton . . . . . 4
Newburyport . . . . . 13	Watertown . . . . . 6	Stoneham . . . . . 4
Chelsea . . . . . 12	Arlington . . . . . 5	Wellesley . . . . . 4
Waltham . . . . . 11	Fitchburg . . . . . 5	Weymouth . . . . . 4
Malden . . . . . 10	Medford . . . . . 5	Winchester . . . . . 4
Somerville . . . . . 10	Taunton . . . . . 5	Worcester . . . . . 4

## PROPORTION OF OLD AND OF NEW STUDENTS.

The following table exhibits, for each year since 1883, 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 Cata- logue 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 num- ber are reg- ular first-year Students.	(5) No. of New Students not of the regular first- year class.
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
1887-88	720	396	324	229	95
1888-89	827	465	362	245	117
1889-90	909	557	352	255	97
1890-91	937	572	365	234*	131

It appears from the foregoing that the number of students remaining over has been increased by 15, while the number registered for the first time is larger by 13, making the net gain, as previously stated, 28.

## AGES OF STUDENTS ON ENTRANCE.

The next table exhibits the ages of our students upon entrance. The regular students of the first-year class number 250. From these we should except 4 cases of students of unusual ages. These deductions leave 246 as the number of students whose ages have been made the subject of computation.

\* In addition, 16 students are repeating the first year.

The results appear in the following table, in comparison with the corresponding results for 1889-90:—

PERIOD OF LIFE.	1889-90.		1890-91.	
	Half-Year Groups.	Yearly Groups.	Half-Year Groups.	Yearly Groups.
16 to 16½ years . . . . .	1	.	1	..
16½ to 17 years . . . . .	9	10	10	11
17 to 17½ years . . . . .	26	..	11	..
17½ to 18 years . . . . .	49	75	32	43
18 to 18½ years . . . . .	58	..	48	..
18½ to 19 years . . . . .	43	101	53	101
19 to 19½ years . . . . .	30	..	38	..
19½ to 20 years . . . . .	10	40	24	62
20 to 20½ years . . . . .	12	..	10	..
20½ to 21 years . . . . .	10	22	9	19
21 to 22 years . . . . .	7	7	10	10
	255	255	246	246

From the foregoing tables it appears that the average age of the 246 students taken for this comparison, the present year, is 225.66 months, or 18 years 8 months and 15 days. This compares with the corresponding figures relating to previous entering classes as follows:—

	Av. Age in Months.
Class of 1890 . . . . .	219.91
Class of 1891 . . . . .	221.55
Class of 1892 . . . . .	223.50
Class of 1893 . . . . .	222.40
Class of 1894 . . . . .	225.66

We have here the most marked increase in the age of our entering students which has taken place since these statistics were first compiled.

In this connection it may be interesting to note the ages at graduation of the class leaving us in June. The 102

members of the class were distributed among the several periods of life, as follows:—

Under 20 . . . . .	8	Between 22 and 23 . . . . .	22
Between 20 and 20½ . . . . .	4	"    23 and 24 . . . . .	10
"    20½ and 21 . . . . .	10	24 and over . . . . .	18
"    21 and 21½ . . . . .	11		—
"    21½ and 22 . . . . .	19		102

Here, again, we note a gain, in the age of graduation, over the class leaving the Institute in 1889.

#### PROPORTION OF REGULAR AND OF SPECIAL STUDENTS.

The following table exhibits both the absolute number of regular and of special students, as by the Catalogue of each successive year since 1882, and the proportion existing between these two classes:—

YEAR.	No. of Regular Students.	No. of Special Students.	Total No. of Students.	PERCENTAGE.	
				Regular.	Special.
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
1887-88	520	200	720	72	28
1888-89	590	237	827	71	29
1889-90	652	257	909	72	28
1890-91	658	279	937	70	30

#### WOMEN AS STUDENTS IN THE INSTITUTE.

The number of women pursuing courses with us last year was 33; this year it is only 23. Of this number, 2 are graduates of colleges. Of the total number, 4 are regular students of the fourth year; 4 of the third year; 1 of the second year; 3 of the first year. Eleven are

special students. Of the 9 regular students of the upper classes, 2 take Course V., chemistry; 5 Course VII., natural history; 1 Course VIII., physics; 1 Course XII., geology. Of the special students, 4 devote themselves to chemistry and physics; 5 chiefly to biology, and allied subjects; 1 to mathematics, and 1 to geology.

#### GRADUATES OF OTHER COLLEGES.

Forty-eight graduates of institutions conferring degrees are included in our list of students for the present year. Of these, 6 are our own graduates, of whom 1 is pursuing studies as a candidate for an advanced degree. Forty-two are graduates of other institutions pursuing courses of study with us, either as regular or as special students. Of these, 10 are graduates of Harvard University, 4 each of Brown and Yale Universities, two each of Boston University, Amherst College, and the Michigan Mining School; while one comes from each of the following institutions: Oregon State University, Oberlin College, Hobart, Swarthmore, Hamilton, Kenyon, Trinity, Robert College, Georgetown College, Smith College, Iowa State College, Alleghany College, Haverford College, Spring Hill College, Rose Polytechnic Institute, Cornell University, Denison University, and University of the City of New York.

Of the 47, not candidates for advanced degrees here, 8 are regular students of the fourth year, — 3 in civil engineering, 1 in architecture, 3 in electrical engineering, and 1 in physics; 10 are regular students in the third year, — 2 in civil engineering, 6 in electrical engineering, 1 in chemical engineering, 1 in mechanical engineering; 3 are regular students in the second year, — 1 in civil engineering, and 2 in electrical engineering; 1 is a regular student in the first year; the remaining 25 are special students.

## THE COURSES OF INSTRUCTION.

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.	Chemical Engineering.	Sanitary Engineering.	Geology.	Total.
4th Year Class . . .	24	31	4	6	13	21	4	3	1	8	..	..	115
3d " " . . .	29	28	5	13	6	35	5	1	5	3	7	1	138
2d " " . . .	26	36	9	8	8	49	2	..	7	7	..	2	154
Total . . .	79	95	18	27	27	105	11	4	13	18	7	3	407

The following table shows the figures of the total line, in the foregoing table, in comparison with the corresponding figures for the seven next preceding years:—

	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Natural History.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Total.
1883 . .	21	33	27	5	21	18	1	..	1	..	..	..	127
1884 . .	29	54	28	9	20	30	1	1	3	..	..	..	175
1885 . .	44	74	26	10	23	41	4	1	5	..	..	..	228
1886 . .	45	75	19	13	24	52	4	2	8	..	..	..	242
1887 . .	50	89	16	18	23	61	5	6	14	..	..	..	282
1888 . .	71	100	12	21	28	74	4	5	12	11	..	..	338
1889 . .	79	99	14	30	29	91	9	5	12	14	6	..	388
1890 . .	79	95	18	27	27	105	11	4	13	18	7	3	407
Total . .	418	619	160	133	195	472	39	24	68	43	13	3	2,187

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:—

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History.	Physics.	General Course.	Total.
1868	6	1	6	..	..	..	..	..	..	1	14
1869	2	2	..	..	1	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	10
1871	8	2	2	..	2	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	26
1874	10	4	1	1	..	..	..	..	..	2	18
1875	10	6	6	1	1	..	..	..	..	2	27
1876	12	9	7	..	5	1	..	2	1	4	43
1877	12	6	8	4	2	..	..	..	3	..	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	3	3	8	..	..	..	..	2	28
1882	2	7	6	3	6	..	..	1	1	1	24
1883*	3	5	5	3	3	..	..	1	1	1	19
1884	5	7	5	1	3	..	..	..	..	..	36
1885	4	6	8	2	4	..	2	..	..	1	27
1886	9	23	7	1	7	..	10	1	1	1	59
1887	10	17	8	1	9	..	8	1	1	3	58
1888	11	25	4	5	10	..	17	3	1	1	77
1889	15	23	5	3	8	..	17	1	1	2	75
1890	25	27	3	5	13	..	18	3	2	6	102
Total,	183	189	* 115	35	109	1	72	14	11	30	759
Deduct names counted twice . . . . .											2
Net total . . . . .											757

Our special students, of course, cannot be classified systematically; but the following table exhibits the number of such students pursuing each particular branch of study:—

\* The degree of the Institute was this year conferred upon a member of the class of 1883, in the department of mining engineering.

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

Acoustics . . . . .	11	Literature . . . . .	33
Anthropology . . . . .	4	Mathematics . . . . .	138
Applied Mechanics . . . . .	54	Mechanism . . . . .	31
Architecture . . . . .	84	Mechanical Engineering . . . . .	26
Astronomy . . . . .	8	Metallurgy . . . . .	16
Biology . . . . .	10	Military Drill . . . . .	19
Blowpipe Analysis . . . . .	1	Mining . . . . .	5
Chemistry . . . . .	73	Organic Chemistry . . . . .	12
Civil Engineering . . . . .	23	Physics . . . . .	108
Climatology . . . . .	1	Physical Laboratory . . . . .	4
Drawing . . . . .	51	Political Economy . . . . .	34
Descriptive Geometry . . . . .	53	Political Science . . . . .	2
Economics . . . . .	4	Railroad Management . . . . .	1
Electricity . . . . .	18	Sanitary Chemistry . . . . .	1
English . . . . .	26	Sanitary Engineering . . . . .	4
French . . . . .	47	Spanish . . . . .	2
Geology, etc. . . . .	33	Shop-work . . . . .	77
German . . . . .	93	Surveying . . . . .	11
Heating and Ventilation . . . . .	11	Textile Coloring . . . . .	6
History . . . . .	6	Theoretical Chemistry . . . . .	2
Industrial Chemistry . . . . .	11	Zoölogy . . . . .	4

Total number of entries, by special students . . . . .	1,158
Total number of special students . . . . .	279
Average number of entries . . . . .	4.1

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

STUDIES.	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . . . . .	320	211	158	38	727
Chemistry . . . . .	308	37	29	29	403
English . . . . .	270	182	133	3	588
French . . . . .	273	15	7	11	306
Physics . . . . .	..	209	189	48	446
German . . . . .	57	179	155	10	401
Shop-work . . . . .	..	143	54	48	245



## CHANGES IN BUILDINGS AND ROOMS.

The erection of the Engineering Building properly belongs to the history of 1889, although the delay in putting up the great engine actually brought that work by a few weeks within the present year. Naturally enough, there is as yet little to be added to the story of the material development of the Institute. After such an effort as was involved in the erection of the building of 1889, a school as poor as ours may well look forward to resting for a little while. What has since been done is mainly in the nature of changes in the old buildings consequent upon the departure of the civil and mechanical engineers to their new and grander abode.

In the Rogers Building, Prof. Richards has annexed to his domain all parts of the basement formerly occupied by Prof. Lanza. These acquisitions nearly double the space devoted to mining and metallurgy, allowing not only a considerable extension of the assaying department, but also the equipment of an ample and safe blowpipe-room and the establishment of a small but pleasant library and reading-room. It is not merely in the way of an increase of space that the assaying department has profited by these structural changes. The ventilation of both the assaying-room and the furnace-room has been vastly improved by throwing down the old partition walls. Indeed, the change in this respect amounts to a revolution. If the teachers and students of mining and metallurgy are not happy now, it will be useless to try to please them. Prof. Richards retains the two rooms on the third floor hitherto occupied by him, the one as a lecture-room, the other as a model-room and museum. Another change, not less welcome to others than to the miners, has been the removal of the eighty horse-power Porter-Allen engine, which, for seven years, has kept pounding away in the basement,

shaking the whole building and greatly disturbing the occupants of the first floor, at times rendering the Society of Arts room almost unfit for lectures. Prof. Richards now has his own separate engine, of fifteen horse-power, while the power required for ventilation and other purposes in the Clarendon Street Building is furnished by another engine, of equal power, situated in that building itself.

Another change, which will, it is hoped, bring both pleasure and advantage to the students of the Institute, has been wrought on the fourth floor of Rogers, by which the whole front of that story has been converted into a large, light reading-room for students in English, history, and political science. For this purpose, three rooms, viz., the old and most unsafe blowpipe-room, Prof. Schwamb's dark and gloomy model-room, and the mathematical recitation-room on the southeast corner of the building, were thrown into one; book-cases and reading-desks were brought up from below or newly constructed; the lighting and ventilating of the room were improved as far as possible; and the virtue of paint was tried to its utmost, with a very agreeable result. The graduates of the past few years, who in their time were obliged to use the small, ill-ventilated "English" reading-room in the third story, cannot fail to rejoice at learning under how much pleasanter conditions their successors in the school now read the reviews, look up the professors' references, or write out their notes. Prof. Dewey has his own office in immediate connection with the new reading-room; the other teachers in this department keep their desks in rooms 31 and 33, on the floor below, using these at times for small classes.

The first-year mechanical drawing classes, under Prof. Faunce, so long cooped up in the "lantern" story, now occupy the large room (No. 43) on the Newbury Street side of the fourth floor. This room has desks for 199 students working at a time, while the lockers and drawers provided give accommodation for 102 more. Here, also,

are found chairs and reading-tables for thirty to fifty students of the first year, in the intervals between recitations and lectures. The room left vacant by this better provision for mechanical drawing has been taken up by the classes in freehand drawing, and has been liberally provided with special apparatus and appliances.

On the main floor, the lecture-room (No. 15) so long known as the Society of Arts room has been invaded by a much-needed extension of the Secretary's office, the remainder of the room being turned into a students' reading-room, with a small lobby for the Librarian and his assistant. The rising floor and chairs of room 15 have been carried across the hall-way into room 11, which has been fitted up in all respects like the old Society of Arts room, with the added advantage of greatly improved ventilation, as all who attend the meetings of that society will be glad to learn.

I cannot leave the Rogers Building, even in this brief survey, without alluding to the wonderful change which two coats of paint and some carpenters' and glaziers' work have wrought in the aspect of the main hall and the grand stairways. It was only when the building was seen in its new dress that any one of us came to realize how greatly it had, for twenty years, been disfigured by stained and battered walls. It is much to be hoped that the students in their goings out and comings in will respect what has been done.

In the Clarendon Street Building there has been but little change. In speaking of the chemical department, further on in this report, I shall allude to the occupation of certain rooms on the third floor of this building for the first time, for the purposes of that department. On the second floor, the architectural students have taken possession of the large drawing-room left vacant by the departure of the civil engineers; a door has been cut through from the architectural library; and this department, with

more than one hundred students, now enjoys a beautiful and commodious suite of rooms, in every way adapted to its always advancing work.

#### LIBRARIES.

The work of cataloguing the important departmental libraries as well as the small general library of the Institute, noted in my last report, has gone on as rapidly as Mr. Andrews' duties would permit. Mr. Andrews gave up his summer vacation to this work. The number of cards added to the catalogue during the year has been 5,161, making a total of 11,282 now written, covering 12,061 volumes and 2,636 pamphlets.

The following departmental libraries are now completely catalogued: Mining, Chemistry, Biology, Political Science, English. In regard to these libraries, the statements as to the number of volumes are exact; in respect to the remaining libraries, such statements must necessarily be approximate only.

The following is the Librarian's statement and estimate of date Sept. 30, 1890:—

LIBRARY.	NO. OF VOLUMES.
General . . . . .	1,475*
Engineering . . . . .	2,100*
Mining . . . . .	897
Architectural . . . . .	750*
Chemical . . . . .	4,231
Biological . . . . .	939
Political Science . . . . .	3,432
Physical . . . . .	2,500*
English . . . . .	671
Geological . . . . .	1,000*
Total . . . . .	<u>17,990</u>

It is impossible to state or even closely to estimate the number of pamphlets in the several libraries of the Institute; but they certainly exceed eight thousand.

\* Approximately.

The accessions to the libraries of the school, considered as a whole, during the year, by gift or by purchase, have been 2,455. Of these, 42 replace old editions or books bound with others, leaving 2,413 as the number of net accessions. Of these, 1,867 are bound volumes, and 546 pamphlets. Their cost and their distribution among the several libraries appear in the following table:—

LIBRARY.	Volumes.	Pamphlets.	Total Cost.
General . . . . .	115	160	\$78 71
Engineering . . . . .	233	47	481 12
Mining . . . . .	136	7	81 20
Architectural . . . . .	61	1	229 32
Chemical . . . . .	476	166	490 13
Biological . . . . .	89	17	99 60
Political Science . . . . .	463	87	462 23
Physical . . . . .	99	42	196 94
English . . . . .	173	2	130 58
Geological . . . . .	22	17	. . .
Totals . . . . .	1,867	546	\$2,249 83

Neither the subscriptions to periodicals nor the expense of binding is included in the foregoing table. The number of periodicals at present subscribed for is 196. There are received by gift or through exchange, 101; making the total number of periodicals on our files, 297. Of these, 36 are received in duplicate for the necessary purposes of different departments, making the number of periodicals actually arriving, 333.

The Institute has received a number of gifts of single books, during the year, and in addition, the following more considerable gifts:—

From the late Prof. Atkinson, 62 volumes, mostly on Political Economy.

From Hon. David P. Klemptner, a set of the reports of the Massachusetts State Board of Health.

From Messrs. Longmans, Green & Co., 11 volumes of their publications.

From the Class of 1890, architectural department, a copy of l'Art Arabe, by Prisse d'Avennes.

#### THE CORPS OF INSTRUCTORS.

The Catalogue of 1890-91 shows the number of instructors of all grades to be 95, inclusive of those concerned with the Mechanic Arts, but exclusive of those who are announced as lecturers for the year only. The addition of these would raise the total to 109, made up as follows:—

Professors . . . . .	10
Associate Professors . . . . .	14
Assistant Professors . . . . .	7
Instructors . . . . .	38
Assistants . . . . .	26
Lecturers for the year . . . . .	14

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	Civil Engineering.	Mechanical Eng. and App. Mechanics.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Physics and Elect. Engineering.	Biology, Zoology, etc.	Mineralogy, Geology, and Geography.	English and Political Science.	Language.	Mathematics.	Drawing and Descriptive Geometry.	Mechanic Arts.	Military Tactics.
Professors.....(10)	1	1	1	1	1	1	..	1	..	1	2	..	..	..
Associate Professors(14)	3	2	..	1	1	1	1	..	3	1	1	..	..	..
Assistant Professors.(7)	..	1	1	1	1	..	..	1	..	..	1	1	..	..
Instructors.....(38)	2	5	1	2	8	5	1	1	2	2	3	2	3	1
Assistants.....(26)	4	6	..	..	4	4	1	..	..	..	1	3	3	..
Total.....(95)	10	15	3	5	15	11	3	3	5	4	8	6	6	1
Lecturers.....(14)	1	..	1	3	2	3	3	..	1	..	..	..	..	..
Total.....(109)	11	15	4	8	17	14	6	3	6	4	8	6	6	1

CHANGES IN THE FACULTY AND THE CORPS OF  
INSTRUCTORS.

In my report of a year ago, I announced the retirement of Prof. Wm. P. Atkinson from the chair of English and History, and his acceptance of the position of Professor Emeritus. To the deep regret of all his former associates and pupils, Prof. Atkinson died on the 10th of March, from an attack of apoplexy. The sentiments of the Corporation on the death of Prof. Atkinson have been expressed by a minute entered upon the records. I desire to add my personal tribute to Prof. Atkinson's devotion to the school, and his deep and tender interest in all his students.

Mr. George R. Carpenter has been appointed Associate Professor of English, entering upon his duties at the beginning of the school year.

Prof. Carpenter graduated from Harvard College in 1886, and was appointed Rogers Fellow for two years, 1886-88. The first of these years he spent in Paris, the second in Berlin, studying Comparative Literature. During the school year 1888-89 he was a member of the graduate department at Cambridge, continuing his studies and acting as assistant to Prof. Wendell. In 1889 he was appointed Instructor in English at Harvard, and served the University in that capacity throughout the year.

Prof. Carpenter is, as I have stated, especially a student of Comparative Literature; but with us he undertakes the difficult and delicate duty of giving to the students of a school of industrial science that instruction and practice in the use of language and in the art of composition which shall be most for their benefit, professionally and socially. The problem is a difficult one by reason of the limited amount of time and strength which, in an institution of high scientific and technical aims, can fairly be devoted to this object; but Prof. Carpenter takes it up with a zealous

interest which furnishes almost an assurance of success. His plan is to enter into such relations with the instructors in charge of the "professional" work of the school as will enable him intelligently to assign to each student themes having reference to his own studies, securing thus the great advantage of having the pupil write, simply, with direct intention, and out of a full mind, on subjects with which he is familiar and in which he is interested, instead of writing vaguely, affectedly, and ambitiously about subjects of which he knows little, and in which he perhaps takes but a slight interest. In the course of this work, lists will be made of students who display unusual aptitude and pleasure in composition; and these will be offered an opportunity for advanced study and practice in this line, so far as they may find time to undertake it. More important still, lists will be made of those students, beginning with the very first year, who, from lack of natural aptitude for such studies, or from defects of training, are found to be at a special disadvantage in English composition; and these students will be followed up with an unremitting but friendly importunity, to induce and enable them to correct their faults and supply their deficiencies on this side.

The problem of giving instruction in English, to the best effect, to students of scientific and technical schools, is a very interesting one. The teacher who shall solve it, will make a contribution to the philosophy of education which will be of great value, inasmuch as the number of these schools is large, and is rapidly increasing. The instruction given in English in the classical colleges is, by general admission, very unsatisfactory; but it, at least, stands related to the fact that the pupils have a comparatively large vocabulary, derived from long-continued work in language; that they have made a special study of etymology; that they have become familiar with the figures of rhetoric through the Latin and the Greek, and that they have for years been exercised upon subtle distinctions, alike in



language-study and in philosophy. Directly to introduce the methods of English instruction, as practised in our colleges, into a scientific school, would be to invite failure. Here the pupils have had little language-study; they are generally unfamiliar with the etymology of the words they use; they have little ingenuity in expression, and, indeed, but slight disposition to make much of expression, anyway. For pupils of this class, the methods that would be proper and useful in a college must be modified in no inconsiderable degree, if the highest success is to be obtained.

I have spoken of the deficiencies of the student of science, as compared with the student of the classics, of metaphysics, and of rhetoric, so far as the familiar college work in English is concerned. But it must not be thought that the account is all on one side. The scientific student has, to compensate for these deficiencies, certain mental qualities which may be made use of to good effect in training him to use his own language in statement, in narrative, in argument, or in the writing of personal letters and professional reports. The problem in pedagogy which I spoke of has reference to the best means of making use of those qualities in the teaching of English.

The student of natural and physical science has certain deficiencies in language which have been fairly acknowledged; but he has an immense advantage in a far greater clearness and vividness in the formation of mental images, and a much stronger grasp upon his conceptions. Trained, day by day and year by year, in the objective study of concrete things, he sees nothing vaguely; the images he forms are definite and distinct; what he knows, he knows perfectly. If fine writing be the end in view, these mental characteristics may or may not be advantageous; but for the purposes of simple, straightforward, manly expression, whether in description, in exposition, in narrative, in argument, or in business correspondence, they are a source of great power. Such a student will

still need much study and practice in the use of language to save him from committing numberless solecisms and to give him the completest use of his own powers of expression ; but he is, taken altogether, not a whit less promising a student of English than his fellow in the classical college. Nay, the advantage indicated extends from the thinking to the speaking or the writing, since every word which is seen to contain a physical image, as so many words do, and indeed as nearly all words in their beginning did, means more to a student of science than to a student of language, literature, and philosophy.

It is my hope that Prof. Carpenter, taking up his work with enthusiasm tempered by good judgment, may be able so to organize the instruction in English at the Institute as at no distant period to solve the problem how to use, to the best advantage of the student, the limited amount of time which can be devoted to these studies and exercises in such a school as this.

Prof. Carpenter is assisted by Mr. Fred. P. Emery, who, in the past few years, has done so much to keep up and carry forward the instruction in English at the Institute, and who has shown a continual gain in power, both as a scholar and as a teacher ; and also by Mr. R. W. Herrick, a recent graduate of Harvard, a young gentleman of excellent promise in literary work.

After a year's absence, Prof. Létang has returned, with renewed strength and zeal, to his duties in the department of architecture, cordially welcomed by all his former students.

The Corporation will learn, with deep regret, that Associate Profs. Holman and Schwamb have so far failed in health as to be obliged to give up their work for the current year. It is earnestly hoped that both these admirable teachers and highly accomplished scholars may be restored to us another year, in the full enjoyment of health. Each in his own line of work, Prof. Holman in physics and

especially in heat, Prof. Schwamb in mechanics and especially in machine design, has achieved a distinguished success, and has added much to the reputation of the Institute. Each is capable, granted only life and strength, of accomplishing still larger results.

In recognition of the increasing importance of the instruction in hydraulics, as well as of his own merits, Mr. Dwight Porter, Assistant Professor of Civil Engineering, has been appointed to be Associate Professor of Hydraulic Engineering.

Mr. Jerome Sondericker, for five years Instructor in Applied Mechanics, has been promoted to be Assistant Professor in that department. Prof. Sondericker graduated in 1880 at the University of Illinois, from the department of civil engineering. For three years he held the position of Instructor in Engineering and Mathematics in that institution, pursuing a course of graduate studies meanwhile. In 1883 he received the degree of C. E. from the University of Illinois, and was appointed Assistant Professor of Engineering and Mathematics. In 1885 he came to the Institute of Technology.

Mr. Eleazer B. Homer, for three years Instructor in the architectural department, has been appointed Associate Professor of Architecture. Prof. Homer graduated from the Institute of Technology in the department of architecture, with the class of 1885; and immediately entered the office of Messrs. Hartwell & Richardson, of Boston, where he remained until recalled to the Institute in 1887.

An important addition to the Faculty has been through the appointment of Dr. Harry W. Tyler as Assistant Professor of Mathematics. Dr. Tyler graduated from the Institute of Technology in the class of 1884, from the department of chemistry. He remained at the school two years as Assistant in Mathematics, and one year as Instructor. In 1887 he went abroad to carry on his studies at the University of Göttingen, and of Erlangen, at the

latter of which, in 1889, he received the degree of Doctor of Philosophy in mathematics, physics, and chemistry. He returned to the United States last year, anticipating an appointment in the mathematical department of the Institute; but was induced, by the urgent wishes of the Faculty and of the Executive Committee, to assume the duties of Secretary to the Faculty, then unexpectedly relinquished by Mr. Munroe. After a year's service in that capacity, Dr. Tyler received the appointment that has been mentioned. His accession greatly strengthens the mathematical staff, which now consists of two Professors, one Associate Professor, one Assistant Professor, three Instructors, and one Assistant. A brief survey of the work in mathematics done at the Institute may be of interest in this connection.

Our work in pure mathematics consists, on the one hand, of a limited range of subjects regarded as essential preparation for later technical work; on the other hand, of more advanced special subjects, open to students duly qualified.

In the former group, the ground to be covered is comparatively small, thus rendering possible a considerable degree of thoroughness and facility in operation. In view of the large number of students to be dealt with, the necessary drill requires a subdivision of each class into a considerable number of sections. Thus, in the first year, the class in mathematics numbers about three hundred and twenty, and is divided into twelve sections; while any material increase in the size of the class would render a still greater number of sections necessary. These sections require together forty-eight to sixty hours of instruction per week.

The second-year class in plane analytic geometry and differential calculus numbers about two hundred and forty students, grouped in ten sections, by courses: for these, thirty hours of instruction are required per week.

The series of required mathematical subjects terminates, in general, with integral calculus, for which a class of one hundred and sixty is divided into eight sections, receiving a weekly average of twenty-one and one-third hours of instruction during half of the third year.

Each student in an engineering course is thus expected to attend, during two and one-half years, 260 mathematical exercises, as follows: algebra, 32; solid geometry, 28; plane and spherical trigonometry, 70; plane analytic geometry, 45; differential calculus, 45; integral calculus, 40. With the present preponderance of the engineering courses, about 90 per cent of the graduates in any year will have completed the above series. Of students in the Institute at a given time, about 80 per cent in the first term, 60 per cent in the second term, are pursuing some one of these subjects.

The mathematical subjects of the second group, although they claim naturally a relatively small number of students, are of vital importance for the course in physics, and exert, as an admixture of pure science, a highly salutary influence on the technical work of the Institute. Besides the subjects now offered in the Catalogue, viz., General Theory of Equations, Determinants, Advanced Algebra and Trigonometry, Analytic Geometry of Three Dimensions, Advanced Calculus, Differential Equations, Theory of Probability and Method of Least Squares, and Quaternions, still more advanced courses may in time be arranged for graduate students in physics. For work of this character, a working-library is indispensable. The nucleus of such a library already exists in the general library of the Institute. By the courtesy of Prof. Richards, space for a needed mathematical reading-room has been placed temporarily at the disposal of the mathematical staff.

An addition to the corps of Instructors not of Faculty rank, upon which we may greatly felicitate ourselves, is found in the appointment of Dr. Augustus H. Gill, of the

class of 1884, Dr. Henry P. Talbot, of the class of 1885, and Dr. Arthur A. Noyes, of the class of 1886, as Instructors: Dr. Gill, in gas analysis, Drs. Talbot and Noyes, in analytical chemistry. These young men were among the strongest scholars of their respective classes while students at the Institute, and remained with us, as Assistants or Instructors, until their departure to pursue advanced studies in Germany. Returning with well-won honors, they have resumed work in the chemical department under the most favorable auspices.

Mr. James H. Stanwood, of the class of 1887, who for two years has been an Assistant in Civil Engineering, has been appointed Instructor. Mr. Collier Cobb, of the class of 1889, in Harvard University, and last year Assistant in Geology there, has been appointed Instructor in Geology. After the school year had been in progress two months, the sickness of Prof. Schwamb suddenly required the services of an additional Instructor. The Executive Committee were fortunately able to obtain the assistance of Mr. Edward V. French, of the class of 1889, who was appointed Instructor. This re-enforcement, together with the appointment of an additional Assistant during the second term, will, it is hoped, enable Profs. Lanza and Peabody to carry the heavy load so suddenly thrown upon them.

#### SUMMER SCHOOLS.

*Summer School in Geodesy and Topography.*—This school was held during the past summer at South Deerfield, Mass., and was attended with marked success. The instructors were Prof. Porter, Mr. Robbins, and Mr. C. C. Babb, of the class of 1890. The school covered a period of three weeks. Owing to the necessary absence of Prof. Niles, geology was omitted from the course this year, and the time thus left vacant was devoted to work in topography, geodesy, and hydraulic measurements. Several complete gaugings were

made of the flow of the Connecticut River, and the work thus done served as a valuable relief in the regular work, belonging to the fall term, of gauging the Charles River. Indeed, had not a portion of the class already had this experience in their summer course, it would have been impossible to carry on the hydraulic measurements during the present term without additional assistance. Ten students were in attendance on the summer school, most of them members of the present graduating class. All manifested a gratifying degree of interest and enthusiasm. The summer course has now been carried on for three successive years, with constantly increasing success.

*The Summer Mining School.* — During the month of June, twelve students attended the summer school of mining, which was held at the mines of the Lake Superior Iron Company, Ishpeming, Mich., under the direction of two professors. The study had special reference to practical mining work.

The class was divided into three parties, each working for a week in one special line, thus alternating during three weeks in three departments, viz., practical work underground, survey underground, geology and survey above-ground.

The practical work underground consisted of drilling, blasting, timbering, hauling, and prospecting with the diamond drill.

The underground workings are so extensive that the successive surveying parties were able to start from different levels, passing through different winzes or stopes downward, and to come back each another way and connect with the starting-point, thus closing the survey.

Aboveground the work consisted in mapping the surface with the plane table, studying at the same time the geology. By comparing the surface-map, obtained with the company's maps of underground workings, and adding the data from the diamond-drill records, which were kindly

furnished, a very satisfactory geological section was made across the entire basin.

The party was much indebted to Mr. J. S. Fay, Jr., the treasurer of the company, to Mr. C. H. Hall, the general manager, to Messrs. Chipman and Sturtevant and other officers of the company.

In addition to the regular work at the Lake Superior mines, three excursions were made, on as many days, to the Barnum mine at Ishpeming, the Jackson mine, charcoal-kilns and charcoal-furnace at Negaunee, and the Ropes gold mine and mill, about six miles from Ishpeming.

The party was everywhere warmly received, and thanks are due also to other mine managers, whose kind invitations to visit them could not be accepted, owing to lack of time. One section of the party made an excursion to Marquette, to visit the great shipping docks there.

**Course I. *Civil Engineering.*** — The course of study in this department has been somewhat modified this year. The time devoted to railroad management has been increased, and the course is now taken only by students choosing the railroad option; while the course in hydraulic measurements is now taken only by students choosing the general-engineering option.

Some additions have been made to the stock of surveying instruments; but, with the increasing number of students, further expenditures in this direction will soon be imperative. The new hydraulic tank described in my last report has within the past year been fully connected with the stand-pipe and with the pumps, and the entire apparatus is now complete in its main features. A great deal remains to be done, however, in providing accessory apparatus for carrying on the experiments and investigations with which the hydraulic laboratory was designed to deal. A brass casting, fitted with several orifices of various shapes and sizes, has been made by the Hancock Inspirator Company, and was in use last term, so that we are



now prepared to carry on experiments upon the flow through simple orifices. At the present time some gates and rigging for closing the orifices are under construction, and plans are being prepared for apparatus designed to serve in carrying out the various lines of experiment specified in my last report, such as the flow through mouth-pieces, over weirs, and through pipes, experiments touching the losses of head under various conditions, the distribution of velocity in pipes and jets, the siphonage of traps, and many other problems.

The development of these lines of research and experiment will necessitate the construction of various pieces of apparatus, accurately made of brass, which are somewhat expensive. As much as is possible with the means at command will be done this year; but without largely increased resources, the department can not hope to extend and diversify its instruction as far as would be desirable. Several thousand dollars should be expended during the next few years in building up this laboratory. We have now a system of tank and stand-pipes, forming a basis for hydraulic experiments, which is unapproached. None of the great technical schools, of Germany, so far as is known, have anything to compare with this; and the technical attaché of the German Legation in Washington, in visiting our laboratory last year, was so impressed that he requested drawings of the entire hydraulic apparatus to send to his government. It is to be hoped that the development of this laboratory, on the grand foundation already laid, will be pushed as rapidly as is practicable.

Progress has been made in the printing and lithographing of lecture notes, by the addition of Prof. Allen's notes on railroad engineering, Prof. Porter's notes on stereotomy, and some additional notes and detail drawings of bridges. The engineering library has been materially enriched during the past year by the addition of a number of valuable works, and by several complete files of period-

icals. It is rapidly becoming a valuable working collection. Upwards of sixty technical periodicals are now regularly received in this library.

Mention should be made of the fact that the Messrs. Parker & Parker, of Boston, have kindly loaned to the department, for an indefinite time, one of their four-inch Berrenberg rotary pumps, for use in the hydraulic laboratory; also that the Tuerk Motor Company have loaned one of their motors for experimental purposes. The department has also received from the Westinghouse Air Brake Company a triple valve of the newest type, showing its internal construction.

*Highway Engineering.* — Special progress is being made in the development and extension of the instruction in highway engineering. Through means furnished by Col. Albert A. Pope, of Boston, the regular instruction in this branch will be considerably extended; additional lectures will be given by outside engineers specially engaged in this class of work; the outfit of the department in the way of books, models, drawings, specifications, etc., will be at once largely increased; apparatus will be provided for tests of all kinds of road materials; and every effort will be made to carry the instruction in this branch as far as is consistent with its necessary relations to the other studies in the course. That development must take place slowly, and for a time, tentatively, in the directions which experience shall show to be most profitable. This year the amount of time given to the regular instruction will be doubled; some outside lectures will be given, charts and drawings will be prepared on a considerable scale, and means will be taken during the summer for gathering a large amount of additional material and information at home and abroad.

The demand for graduates in civil engineering has this year been greater than ever before, the number of graduates in the last class being much smaller than the number of positions offered. One of the graduates, Mr. C.

W. Sherman, has returned this year, to pursue advanced courses of study.

**Course II.** *Mechanical Engineering.*— In my report of December, 1889, the new Engineering Building and its equipment were fully described ; but at that time the laboratories and drawing-rooms of the mechanical engineering department were still in the Rogers Building. The removal took place just before the beginning of the second term in February, 1890. Notwithstanding the difficulties incident to transferring so large an amount of machinery and other apparatus during term time, and putting it in order for use, both in the regular laboratory practice and in the work of research pursued in connection with the theses of the fourth year's class, and notwithstanding a very annoying delay in the transportation from Milwaukee of the new triple-expansion engine, the exercises in this department were resumed promptly at the beginning of February, and were carried on without interruption through the remainder of the school year. But for the new building, it would have been impossible for the department to perform its regular laboratory work of the second term, owing to the increase in the number of students.

By way of addition to the present equipment, the most important thing of which these laboratories stand in need is an Emery testing machine of at least 200,000, better still of 300,000, pounds capacity, such as are now made by Wm. Sellers & Co., of Philadelphia. This machine would enable the applied-mechanics laboratory to perform work of great importance, which it cannot now undertake.

In addition to the natural development in all parts of the course, it should be mentioned that the work in naval architecture has already increased to such an extent that, instead of devoting to it a portion of time allotted to marine engineering, there is to be given the present year a course of two exercises per week on this subject, extending throughout the second term of the fourth year ; and those students

who take the marine-engineering option are to be given a choice, in addition, of taking either this course on naval architecture or the course on hydraulic motors.

The work in naval architecture is to be carried on by Prof. Peabody, with such additional assistance as it is hoped to obtain from Naval Constructor J. J. Woodward, or Naval Constructor Armistead.

The publication of the new and enlarged edition of Prof. Lanza's "Applied Mechanics" will afford a great help in carrying forward the instruction in this important branch of study, which so largely underlies nearly all the professional work of the school. For several years, now, the amount of cyclostyled notes and tables with which the students of applied mechanics have been furnished, in addition to what was contained in the text-books, has constituted an increasing burden. All this material has been incorporated in the revised edition, to the great relief of our classes.

**Course III. *Mining Engineering and Metallurgy.***—

This course has been wholly recast in form and not a little altered in substance during the present year. For reasons which will appear in speaking of the new Course XII., the department of mining engineering and metallurgy has been disconnected from all relations to the geological instruction of the Institute, except such as are for the benefit of its own students; and geology has been provided for in a separate course. The mining department, thus relieved from much that has been a burden to it, has been enriched by the addition of a great deal in the way of mechanical and civil engineering, which the present demands of practice made it important that the mining engineer should possess. Course III. thus, on the one hand, relieved from a burden it has carried in the past, and enriched and strengthened by more of properly engineering work, has been recast into four lines, which, for the further purposes of this paragraph, I may call "courses." Of these, the first

course prepares a student to take hold of work in line for promotion in any mining industry, — coal, iron, gold, silver, copper, or lead, — as a miner, a foreman, assistant manager, or manager of a mine. It fits him in geology, mining, milling, and in mechanical engineering adapted to mining. The second course prepares a student to take hold of work in line for promotion in a surveyor's office in a mining district as assistant surveyor, as surveyor of mines, as consulting mining engineer, as mine superintendent. It fits him in geology, mining, milling, and in civil engineering adapted to mining, construction of railroads, electric railroads, canals, roads, buildings, bridges, etc. The third course fits a student to take position in line for promotion in an iron, lead, copper, zinc, gold, or silver works as a hand, as foreman, assistant superintendent, or superintendent, or he may enter the works by the chemical laboratory. It fits him in analytical chemistry, metallurgy, mathematics, and in mechanical engineering adapted to metallurgical machinery, blowing engines, rolling mills, etc. The fourth course fits a student to take position in line for promotion in an iron, lead, copper, or zinc works as assistant chemist, as chemist, as furnace manager, as superintendent. It fits him in analytical and theoretical chemistry, in metallurgy, in electro-metallurgy.

The equipment of the milling-room has been increased during the year by adding an independent engine for running the machinery. There has been received from Messrs. Frazer & Chalmers, and Joshua Hendy Manufacturing Company, and from F. A. Huntington, the following machinery, a new Vanner, a new stamp battery, a new Hendy feeder, and a Huntington mill, at figures so low as to be practically a gift.

The amalgamating plant has been extended by the addition of four iron and three copper amalgamating pans, suitable for a great variety of tests, adding greatly to the capacity of the laboratory for teaching this subject.

The changes in the furnace-room include the reconstruction of the cupellation furnace, so that it can now be also used for smelting and refining small batches of copper, giving the students excellent facilities for becoming familiar with the higher heats necessary for copper smelting, and the placing of a hood in front of the blast furnace, which removes nearly all the fumes. A Brückner roasting cylinder is contemplated, and a place has been provided for it.

**Course IV. Architecture.**—In the architectural department the most important fact of the year has been the notice given of the suppression of the Two Years' Partial Course, to take effect in 1891, placing this department, at last, upon precisely the same basis as to regular and special students, with all the others. This will not keep away the class of pupils who at present constitute the main strength of the partial course, since it is intended to allow students to enter the departments as special students who have had two years' regular office experience, or who are graduates of colleges, or are over twenty-four years of age, to pursue such studies as they may be fitted for, these candidates being required only to pass a thorough examination in mechanical and freehand drawing, for entrance.

The regular course of studies has been rearranged and strengthened to meet this improvement. Graphical statics, at present only taught in theory, is to be applied to actual construction; and this very important application will be carried through an entire term. In the fourth year there have been added courses in sanitary science, history of construction, history of the Renaissance, and history of painting and sculpture. The library is now in first-rate working order, and, with a small yearly outlay, can be kept up very satisfactorily.

During the year there has been presented to the department a valuable set of working plumbing models by Messrs. William Lumb & Co., of this city; by Mrs. Edward M. Cary, a rare architectural work, *Monuments of Art*, by

Lubke & Caspar; and by Mrs. Emma L. Metcalf, a very interesting collection of drawings of the stained-glass windows of the Cathedrale d'Auch.

A very gratifying expression of the good-will of the class graduating from the architectural department in 1890 took the form of a sum of money, \$102.25, subscribed by them as a token of their interest in the "assured welfare and progress of the department, to make some slight addition to the resources of the school for the benefit of those who shall come after." With this money was bought the splendid work of Prisse d'Avennes, *d'Art Arabe*, making a most notable addition to the library.

The greatly increased number of students in this department will speedily render necessary an increase in the instructing staff. Considerable appropriations are also required for the construction of diagrams illustrative of the various courses of lectures, so that the instructors may be released from the loss of time now involved in putting their designs upon the black-board afresh each time a lecture is repeated.

**Course V. Chemistry.** — By a vote of the Executive Committee, Prof. Thomas M. Drown, Perkins Professor of Analytical Chemistry, has been placed in charge of the entire chemical department of the Institute. The work of the year in general chemistry and in analytical chemistry has gone on fortunately, without any notable change. The appointment of Dr. Gill, already spoken of, puts it in the power of the department to carry instruction in gas analysis much further than it has ever before been sought to do. At present, this service occupies, with a fair supply of apparatus, a small part of room 33, New Building; but it is in contemplation to enlarge the space devoted to this work, and to add a considerable amount of new apparatus. It is not alone the students of the chemical department proper who derive benefit from this branch of analysis, but also the chemical, mechanical, and mining

engineers, who have here the opportunity of becoming familiar with the methods of analysis of furnace gases.

The analysis of the waters of Massachusetts for the State Board of Health still continues to be carried on in the department of sanitary chemistry. The volume covering the results of two years of this work, together with a discussion of their significance regarding the public health, is now in press, and will shortly be issued by the Board. It is safe to say that this will be the most valuable contribution to our knowledge of natural waters that has ever been made in this country.

The crowded condition of the laboratory of organic chemistry made it absolutely necessary to find more room somewhere, somehow; and room 33, New Building, was fitted up as a supplementary laboratory for organic analysis and research.

The work in industrial chemistry has been steadily carried forward during the year. It is here that the Institute most needs powerful re-enforcement to enable it to do its largest service to the industries of the Commonwealth. With our present means, we can only make progress slowly in this all-important department. Twenty thousand dollars a year might advantageously be spent in these laboratories alone, above all which the present means of the Institute can provide; and if this were judiciously done, the industries of the State and the country would reap the proper fruit of such expenditures an hundred-fold.

In one respect, the laboratories of industrial chemistry have undergone a notable development during the year. Inasmuch as the space given to textile coloring was insufficient, and the light in the basement where the instruction was given was less than satisfactory, the Executive Committee decided to use room 31, on the third floor of the New Building, for a laboratory for textile coloring. The necessary changes were made during the summer, and the laboratory was opened to the students, Oct. 1. The



room is fitted with appliances for experimental dyeing, and can accommodate a class of ten at a time. The laboratory is equipped with sixty jacketed pots, heated by high-pressure steam. The pots are constructed according to plans prepared by the Instructor, Mr. J. W. Smith, are novel in form, and furnish most excellent results. All the apparatus used in textile coloring, including the printing machine, steam-box, and dye-baths, has been removed to this room.

The course in textile coloring has been still further developed during the year, and it is believed that it is now one of the most complete laboratory courses given upon this topic. In connection with the laboratory work, lectures are given and excursions made to textile works. The course is taken by seventeen students, and is to be regarded as a valuable adjunct in a general chemical training. It is further specially adapted to the needs of those students who intend hereafter to follow textile coloring, and to furnish them with a suitable scientific basis for their subsequent work, and even to fit them for subordinate positions in dye works, where they can then obtain intelligently the practical experience indispensable to the dyer and colorist.

It is much to be desired that still another room on this (the third) floor of the Clarendon Street Building should be devoted to special chemical investigations; but, with the many urgent demands from several different quarters for increased accommodations, it does not now seem possible to do more for the department of chemistry.

**Course VI. *Electrical Engineering*;** and **Course VIII. *Physics*.** — There is little to record with reference to these courses beyond a continuance of the steady growth in efficiency and in number of students, which has been recorded in previous years. Most of the graduating theses embodied results of really original work, and several have been published, or will be shortly.

There has been a gradual extension of the work in the

physical laboratory, especially in electrical measurements ; and during the present year, with the co-operation of the department of mechanical engineering, it is expected that much more will be done than heretofore in connection with the testing of dynamo-electric machinery, for which the facilities of the engineering laboratory are fully available. The general outfit of the physical laboratory is excellent, and has kept pace with the improvement in apparatus for physical measurement.

The most important change in the general scheme of instruction is one whereby the professional work in electricity of the students in Courses VI. and VIII. begins earlier than heretofore in the second year, which will, it is hoped, give more time in the latter part of the course for considering some of the newer developments of technical electricity. It is also proposed to give a brief course of lectures on physical measuring instruments to students of Courses VI. and VIII. in the second year, before entering the physical laboratory, the course to be in charge of Mr. Goodwin, Assistant in Physics.

The increasing number of courses which the department gives, both to its own professional students and to others, and especially the development of the courses in heat measurements, and electro-metallurgy, mentioned in the President's last annual report, will necessitate additional assistance during the coming year.

Owing to the much-regretted absence of Prof. Holman, on account of illness, two additional Assistants, Messrs. Swanton and Smith, have been specially appointed to aid in the work of the laboratory, in addition to Mr. Goodwin, previously appointed Assistant. These, with Messrs. Puffer and Collins, Instructors in Physics, and Mr. Laws, Assistant, are working very faithfully to maintain the excellence of the instruction in the laboratory, while Mr. Clifford has successfully completed the course of lectures on heat to the third-year students, usually given by Prof. Holman.

The extensive calls made upon this department for electricity to be used for general electric lighting within the Institute, and for furnishing power to various departments, will, if these continue to increase, require a larger supply of driving force than we have at our command; and, indeed, our engine of seventy-five horse-power is already at times taxed nearly to its maximum. During a considerable period, this term, the ventilating fan for the New Building has been driven by electricity, an electric motor replacing the steam-engine when this was temporarily disabled.

A growing difficulty has been met with on account of serious jarring of the building. This, always considerable, has materially increased of late with the increased use of the neighboring streets, by cars and teams. Some of our thesis work, involving the use of delicate measuring instruments, has had to be done in the night, in order to obtain satisfactory results; and it is very questionable whether certain experiments must not be omitted from the regular course of instruction, for the same reason. This difficulty cannot be removed; but it may perhaps be possible to mitigate it by the use of piers and supports of special construction.

There is also a pressing need of more room for laboratory and class instruction. For several years past it has often been found impossible to obtain a room which would comfortably seat our professional classes, and much inconvenience has been caused thereby. There is, furthermore, a need of several small rooms, which can be allotted to optional advanced laboratory work, the character of which renders it very difficult to carry it on among the distractions which are necessarily felt in a large room occupied by other students.

**Course VII. *Biology.***—The number of regular students in this department, as well as of those turning to this department from the chemical, architectural, engi-

neering, and general courses, for instruction in special subjects, steadily increases. With the beginning of the present year the staff was strengthened by the appointment of Mr. George V. McLauthlin, a graduate of the Institute in the chemical department in the class of 1888, as Assistant in Biology. This addition to the force has resulted in an extension and improvement of the courses in comparative zoölogy, anatomy, and embryology, by enabling Dr. Gardiner to devote his whole time to these subjects. This portion of the work of the department is now in a satisfactory condition.

Prof. Sedgwick continues to give the instruction in general biology, microscopy, botany, and physiology. But the relations of biology to sanitary science are manifestly so fundamental and far-reaching in their practical bearings that sanitary biology and bacteriology also claim a large portion of his time and energy. The recent remarkable extension of our knowledge of the ætiology of the infectious diseases has already made bacteriology one of the most important as well as one of the most practical of the biological sciences. Already the biologist has taken his place side by side with the chemist and the engineer in the study of the science and art of public sanitation. During the past year the biological work of the Lawrence Experiment Station of the State Board of Health has been done in the biological laboratory of the Institute, under the personal superintendence of Prof. Sedgwick, who has been ably assisted by Mr. Edwin O. Jordan, a graduate of the biological department in the class of 1888. Their reports to the Board, which are believed to constitute contributions of the first importance to sanitary biology, are already in the press.

The acknowledged importance of normal bacteriology, not merely in sanitary science, but in engineering, chemistry, and agricultural science, makes it imperative that this school shall not lag behind in the discoveries and their

applications already opening before us. The activity of soils, the fixation of nitrogen, the preservation of foods, the preservation of timber, the purity of public supplies, such as air, water, milk, and ice, as well as the more urgent and difficult problems of drainage, sewerage, and the public health, are obviously questions of immediate practical importance. To meet these new demands, the biological department should be strengthened by ampler accommodations, and the freeing of the professor in charge from much of his present elementary instruction.

Of the three persons graduated in biology in 1890, one submitted as his thesis important original results of an investigation of the bacteriological condition of the milk supply of Boston, soon to be published; the second, a young woman, was appointed, before graduation, teacher of science in a collegiate preparatory school; the third, after spending the intermediate time in the further study of bacteriology in Berlin, has been appointed to an important position in the service of the State Board of Health. The department this year has been unable to meet one-third of the demands made upon it for its graduates.

**Course IX. *General Studies.*** — I have already, in connection with the appointment of Prof. Carpenter, spoken of the plans that have been formed for extending the study of English at the Institute. The department of history has shared in the general prosperity that has attended Course IX. during the past year. The increased accommodations and the very convenient rearrangement of the departmental library and reading-room have enabled students to use their tools of labor, viz., books, papers, and magazines, with much better effect and understanding than ever before. The system of historical and political studies by means of class reference-libraries is now applied here under unusual advantages. The undergraduate student enjoys a daily use of all the necessary works of reference and literature on his subject, — a use which is rarely both con-

venient and possible to any but graduate students. Some considerable additions to the resources of the department have been made, including wall-maps, books of reference, and sets of reviews for political and library study.

During the last year a paper from this department, on the history of the Northeastern Fisheries, was published in the "Technology Quarterly." A graduate student from Course IX., Mr. Wm. B. Thurber, obtained last spring the degree of Master of Science, as the result of one year's advanced study, mainly under the direction of the department of history.

The accession of Prof. Carpenter to the chair of English has not only enabled Course IX. to extend and strengthen the literary side of its curriculum, but has also permitted the department of history to increase the time devoted to the history of philosophic thought, a field of study which is at present intrusted to the care of that department. The increase in the number of students in Course IX., and the very gratifying interest in history study shown by members of other courses in the Institute, will undoubtedly compel the department, at no distant day, to ask for additional assistance. The instruction in economics and statistics heretofore given has been continued with marked success during the year.

The instructors in the department of modern languages would gladly join with those of English, history, and economics in promoting the success of Course IX.; but no more can be done on this side without an increase of the instructing staff. All the teachers of modern languages are now fully occupied with their classes; and still those classes are larger than we could wish. For the best effect, it would be desirable to reduce the sections in French and German to the same size as the mathematical sections. This reduction could be effected by the assistance of two additional instructors, making the modern-language staff six, instead of four, as at present. That

increase would also allow of considerably more advanced work in French and German, for the benefit of graduate students, of students in Course IX., and also of students of other courses who should be ambitious to perfect themselves in these lines. It is clearly for the interest of the school as a whole, and of the professional courses as well, that modern-language study should be encouraged to the full extent of our means. The teachers in German are this year making a special effort to promote the readier reading of scientific and technical works in that language. Prof. Luquiens has undertaken the class in Spanish which last year was taught by Mr. Machado.

**Course X. *Chemical Engineering.*** — The first students in this course will be graduated in 1891. During the present year, instruction is being given for the first time to students of the fourth year. During the first term the instruction is mainly in mechanical engineering and in applied mechanics. The time devoted to chemistry is given to gas analysis and to laboratory work in applied chemistry, and to a new course in which various engineering problems are discussed from a chemical point of view. The leading topics considered in this course are fuels, their composition and consumption, boiler waters and incrustations, corrosion of boilers, lubricants, and other similar questions. This course will be followed in the second term by a course of lectures in which chemical machinery will be considered from an engineering point of view.

During the year a course in gas analysis, including the analysis of furnace gases and illuminating gas, has been instituted, mainly for the benefit of the students of chemical engineering, under the direction of Dr. A. H. Gill. The apparatus used for this purpose has been increased, and the course will be further developed during the coming year. An optional course in hydraulics, including the consideration of hydraulic motors and field measurements, has also been introduced during the past year.

**Course XI. Sanitary Engineering.** — No changes of importance have this year been made.

There are now seven regular students in the third year of this course, who next year will be candidates for the degree of the Institute.

**Course XII. Geology.** — Heretofore the teaching of geology and mineralogy has been made subsidiary to some of the established courses. During the past year a distinctly geological course has been added, with features worthy of special mention.

A notable departure from the usual courses in this science is the prominence given to topographical studies in connection with geology. The advance of improvements, wealth, and population is increasing the need of more detailed and careful surveys, even of the best known portions of our country. Too frequently, topographic maps are unsatisfactory to the working geologist, partly from their having been constructed by men who have not understood the significance and relative values of the features they have attempted to represent. There has accordingly arisen a demand for men qualified to perform superior work, both in topography and in geology. In recognition of this need, there has this year been inaugurated at the Institute a geological course, with much stronger topographical requirements than is usual.

The Institute of Technology has peculiar advantages for carrying on such a course. It already possesses a strong department of civil engineering, prepared by its equipment and corps of Instructors, including a special Professor of Topographical Engineering, to give to the instruction in topographic, geodetic, and hydrographic surveying that practical and thorough character which is desired.

That the institution presided over during its early days by Prof. Rogers should conspicuously cultivate the study of topographical geology seems highly appropriate, when we remember the eminence its founder and first Professor



of Geology attained, by unfolding the elaborate structure of the Appalachian Mountains and their resulting topography.

The new geological course contains a substantial amount of work in the construction of geological maps and sections, in physiographic geology, including orography, and in hydrography, besides large additions to the field-work heretofore provided for, together with the requirement that the students shall attend the summer course of topography and geology in the field.

Another important feature of the course provides for the application of geological knowledge to the discovery and development of mineral resources. Following the general chemistry of the first year, the student has analytical chemistry through his second and third years, qualifying him for assaying, and for work in mining and metallurgy, which he may elect in his fourth year. To the general courses in dynamical, structural, and historical geology and in mineralogy, there are now added advanced mineralogy, micro-lithology, and ore deposits. One of the most important additions is a course in economic geology, extending through the fourth year. These branches, with the study of geological maps and sections, already mentioned, and a liberal amount of field-work prepare the student to further specialize upon either chemical, lithological, or economic geology.

The Institute occasionally receives students who desire a thorough course in geological study without reference to any technical profession. Sometimes these students are well-qualified women, studying with well-defined purposes. When such students present good reasons for desiring more paleontology, zoölogy, and biology, arrangements may be made, by vote of the Faculty, for substituting such studies for certain others.

## FINANCIAL.

The additions made since my last report to the funds of the Institute, as appears by the report of the Treasurer, are as follows : —

By bequest of the late George Bucknam Dorr, applied to the general purposes of the Institute . . . . .	\$49,573 47
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By bequest of our late lamented colleague on the Corporation of the Institute, Hon. Charles Lewis Flint : —

As a Scholarship Fund . . . . .	5,000 00
As a Library Fund . . . . .	5,000 00

By bequest of the late Elisha Thacher Loring, as a Scholarship Fund . . . . .	5,000 00
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Through the death of Miss Susan C. Dorr, the title of the Institute of Technology to two-thirds of the estate in Lenox, Mass., known as "Highlawn," became absolute, subject to the provision contained in the deed of gift of Mrs. Martha Ann Edwards, dated Nov. 21, 1876.

By Miss Dorr's will, the Institute is given an interest, of an as yet undetermined amount, in her own estate.

By the will of the late Samuel E. Sawyer, of Gloucester, the sum of \$4,000 was bequeathed to the Institute of Technology. This will is being contested by the heirs of Mr. Sawyer.

Besides the foregoing, a prospective addition to the means of the Institute is seemingly furnished by the provision of the Act of Congress, approved Aug. 30, 1890, "for the more complete endowment and maintenance of Colleges for the benefit of Agriculture and the Mechanic Arts now established, or which may be hereafter established in accordance with an Act of Congress approved July 2, 1862."

Of the income of the fund created within the State of Massachusetts by the provisions of the Act of July 2, 1862, above referred to, the Institute of Technology was, by the Act of the General Court, approved April 27, 1863, allowed a one-third share, the remaining two-thirds being allotted to the Agricultural College at Amherst. Our share of this fund has yielded last year, as will be seen by the Treasurer's report, the sum of \$4,960.82.

Whether or not the provisions of the State law of 1863 will operate to authorize the Governor and Council of the Commonwealth to apportion the new grant, without further legislation, is at present under consideration at the State House. If the existing legislation is sufficient to allow the apportionment of the new grant, the Institute of Technology will of course receive one-third of the annual appropriation from the national treasury, amounting for the present year to \$5,000; to rise yearly by the sum of \$333 $\frac{1}{3}$  to a maximum of \$8,333 $\frac{1}{3}$  in 1900 A. D.

Should it be decided that new legislation is needed to enable the Commonwealth to avail itself of the grant from the treasury of the United States, I recommend that the Corporation authorize its officers to memorialize the General Court, at the approaching session, to award to the Institute of Technology, as the College of Mechanic Arts for the State of Massachusetts, a larger share of the annual income thus to be received from the General Court.

At the time the Act of April 27, 1863, was passed, the Institute of Technology existed only upon paper. Its future was necessarily involved in grave uncertainty. The person then most confident of success could not possibly have anticipated such a development of its influence as has taken place. It might not unreasonably have been anticipated that its students would always remain few, and that its relations to the industries of the Commonwealth would be narrowly restricted within the familiar limits of civil engineering, and perhaps also of chemistry. Under the

circumstances, the proportions established by the Act of 1863 — two-thirds to the Agricultural College, one-third to the Institute of Technology — may be regarded as not unfair.

Within the twenty-seven years that have elapsed since the date of the Act referred to, however, this School of Industrial Science has grown into dimensions then inconceivable, and it has connected itself with the industrial life of Massachusetts in ways then unknown. Professions not named in 1863 have come into being, and have risen to transcendent importance, while the development of industrial science throughout the world, to which no single institution has contributed more than this our own school, has created demands which were not then felt. If Massachusetts would hold her proud pre-eminence in manufactures, she must do it by force of knowledge and technical skill, since her natural disadvantages in respect to transportation and the possession of the materials of production are weighing all the time more and more heavily against her. The Institute of Technology is, in spite of its large tuition fees, still painfully poor in relation to its needs. Without disparagement to any, it may be said that in no other way can Massachusetts so largely aid herself as by increasing the means of this institution available for chemistry, mechanics, and electricity.

# TREASURER'S REPORT.

## STATEMENT OF THE TREASURER.

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The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1890.

During the year the executors of the estate of the late George Bucknam Dorr have handed over to the Institute the following securities at the valuation set against each:—

International & Great Northern R. R. Bond . . . . .	\$1,110 00
Milwaukee & St. Paul R. R. 7 <sup>3</sup> / <sub>8</sub> s, \$3,000 . . . . .	3,510 00
Chicago, Burlington & Quincy R. R. 7s, \$7,000 . . . . .	8,715 00
Cincinnati & Indiana R. R. 7s, \$2,000 . . . . .	2,080 00
Union Pacific R. R. 1st Mortgage 6s . . . . .	1,140 00
Chicago, Burlington & Northern R. R. 5s, \$2,000 . . . . .	2,060 00
Atchison, Topeka & Santa Fé R. R. 4s, \$2,000 . . . . .	1,687 50
Atchison, Topeka & Santa Fé, Incomes, \$500 . . . . .	301 88
Chicago, Burlington & Quincy R. R. Stock, 14 shares . . . . .	1,477 00
Pittsburgh, Fort Wayne & Chicago R. R. Stock, 20 shares . . . . .	3,000 00
Morris & Essex R. R. Stock, 82 shares . . . . .	6,150 00
New York & Harlem R. R. Stock, 40 shares . . . . .	5,000 00
Pennsylvania Coal Co. Stock, 75 shares . . . . .	11,250 00
Consolidated Gas Co. of N. Y. Stock, 15 shares . . . . .	1,447 50
Cash . . . . .	644 59

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\$49,573 47

By the decease, Dec. 5, 1889, of Miss Susan C. Dorr. the title of the Institute to two-thirds of the estate at Lenox, Mass., known as "Highlawn," became absolute, subject, however, to the provision named in the deed of gift of Mrs. Martha Ann Edwards, dated Nov. 21, 1876.

Under circular 63 of Oct. 15, 1889, of the Atchison, Topeka & Santa Fé R. R., sundry bonds of former issues were exchanged into the present general mortgage four per cent and income five per cent bonds. The amount of bonds included in this exchange appears in the General Statement on the following pages.

The estate 1004 Walnut Street, Philadelphia, has been sold by the executors of the estate of Robert E. Rogers, producing for the interest of the Institute in the same \$990.48 more than the valuation entered on our books.

The income has been divided at the rate of  $4\frac{7.35}{1000}$  per cent among the funds to which it belongs.

Gifts and bequests have been received from : —

State of Massachusetts . . . . .	\$50,000 00
Subscription of 1887 . . . . .	36,000 00
Charles Lewis Flint, to found Scholarship Fund . . . . .	5,000 00
“ “ “ “ Library “ . . . . .	5,000 00
Elisha Thacher Loring, “ Scholarship “ . . . . .	5,000 00
Mrs. Wm. B. Rogers, for periodicals . . . . .	100 00
From a Friend, for Engineering Instruments . . . . .	500 00
Alumni of Institute towards Wm. B. Rogers Scholarship Fund . . . . .	2,000 00

The net result of the year has been an expenditure over receipts of \$3,216.38, which has been charged against Massachusetts Institute of Technology Account.

LEWIS WILLIAM TAPPAN, JR., TREASURER, *in account*

## GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

*Dr.*

Cash balance Sept. 30, 1889 . . . . .		\$26,570 12
From Augustus Lowell for Lowell Courses . . . . .	\$2,500 00	
" " " " C. Kastner's salary . . . . .	2,500 00	
" " " " Lowell School of Design . . . . .	1,000 00	
		<u>6,000 00</u>

## RECEIPTS FOR CURRENT EXPENSES.

Income of funds for salaries . . . . .	\$4,147 86	
" " " " scholarships . . . . .	2,916 49	
" " " " library . . . . .	177 58	
" " " " general purposes . . . . .	8,276 66	
" " Rogers Memorial Fund . . . . .	12,511 25	
" " Joy Scholarship Fund used . . . . .	200 00	
" " Susan H. Swett " " . . . . .	125 00	
Students' fees . . . . .	170,442 65	
State Agricultural Fund . . . . .	4,960 82	
Boston University . . . . .	1,150 00	
Laboratory breakage and supplies . . . . .	4,566 51	
Rents, per Table. (Page 12) . . . . .	5,342 50	
Gifts . . . . .	600 00	
Sale of printed lecture notes . . . . .	1,662 69	
Interest . . . . .	2,868 59	
James Henry Mirrlees Scholarship Fund, more than income (see per contra) . . . . .	76	
Profit and Loss, expenses more than income (see per contra) . . . . .	3,216 38	
		<u>223,165 74</u>

## BEQUESTS, NEW TRUSTS, ETC.

George Bucknam Dorr Fund . . . . .	\$49,573 47	
Charles Lewis Flint Library Fund . . . . .	5,000 00	
" " " Scholarship Fund . . . . .	5,000 00	
Elisha Thacher Loring " " . . . . .	5,000 00	
William Barton Rogers Alumni Scholarship Fund, " " " " " " . . . . .	2,000 00	
Interest . . . . .	330 06	
R. E. Rogers Fund, balance sale real estate, Phila., . . . . .	990 48	
Sale of 154 Chicago, Burlington & Quincy rights . . . . .	146 30	
Income Susan H. Swett Fund, not used . . . . .	182 95	
" James Savage Fund, " " . . . . .	508 76	
" Richard Perkins Fund, " " . . . . .	131 40	
" Charles Lewis Flint Fund, " " . . . . .	177 58	
" Elisha Thacher Loring Fund, " " . . . . .	157 84	
Interest Joy Scholarship, deposited in Savings Banks . . . . .	446 13	
		<u>69,644 97</u>

## SALE OF SECURITIES UNDER ROGERS MEMORIAL FUND.

Kansas City, E. & Southern R'y bonds . . . . .	\$7,000 00	
" Lawrence & Southern R'y " . . . . .	6,000 00	
Cowley, Sumner & Fort Smith R'y " . . . . .	2,000 00	
Florence, Eldorado & Walnut Valley R'y " . . . . .	1,000 00	
Quincy & Warsaw R'y " . . . . .	4,000 00	
Account of Bond Premiums . . . . .	3,116 25	
Sale of Atchison Scrip . . . . .	55 45	
" 220 Chicago, Burlington & Quincy Rights . . . . .	209 00	
		<u>23,380 70</u>

## SUNDRIES.

From State of Massachusetts . . . . .	\$50,000 00	
Subscriptions of 1887 . . . . .	36,000 00	
Income William Rogers Memorial Fund, credited to Advance Bond Premiums . . . . .	1,598 53	
Students' Notes Receivable . . . . .	2,248 00	
Sale 1004 Walnut Street, Philadelphia . . . . .	3,490 48	
		<u>93,337 01</u>
		<u>\$442,098 54</u>



## with THE MASS. INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPTEMBER 30, 1890.

Cr.

Paid for Lowell Courses . . . . .	\$2,500 00	
“ “ Charles Kastner's salary . . . . .	2,500 00	
Expense Lowell School of Design . . . . .	1,089 04	
		<u>\$6,089 04</u>

## EXPENSES.

Salaries, per Table. (Page 12) . . . . .	\$146,409 41	
Scholarships . . . . .	2,968 75	
“ Susan H. Swett . . . . .	125 00	
Repairs, per Table. (Page 13) . . . . .	9,740 43	
General Expense, per Table. (Page 13) . . . . .	14,384 63	
Fuel . . . . .	7,544 46	
Water . . . . .	1,111 77	
Gas . . . . .	1,906 06	
Printing and Advertising . . . . .	1,721 96	
“ Lecture Notes . . . . .	1,861 38	
“ Annual Catalogue . . . . .	1,595 23	
Rent paid Boston & Albany Railway Company . . . . .	180 00	
Laboratory Supplies, per Table. (Page 12) . . . . .	24,705 32	
Society of Arts . . . . .	17 87	
Interest, per Table. (Page 12) . . . . .	8,893 47	
		<u>223,165 74</u>

## INVESTMENTS, ETC.

Securities for Dorr Fund . . . . .	\$48,928 88	
Atchison, Topeka & Santa Fé Guarantee Note . . . . .	50,000 00	
Joy Scholarship Fund . . . . .	646 13	
Mirrlees Scholarship Fund, expenses over income, . . . . .	76	
		<u>99,575 77</u>

## PURCHASE SECURITIES FOR W. B. ROGERS MEMORIAL FUND.

\$16,000 Atchison, Topeka & Santa Fé 4s . . . . .	\$13,684 80	
\$8,400 Atchison, Topeka & Santa Fé Incomes . . . . .	5,376 00	
Atchison Scrip . . . . .	55 45	
		<u>19,116 25</u>

## SUNDRIES.

Students, on account deposits . . . . .	\$100 00	
On account of New Boiler, No. 2 . . . . .	607 59	
Building on Trinity Place . . . . .	67,289 34	
Equipment Engineering Building . . . . .	16,555 24	
Gain on sale of real estate, Philadelphia, carried to R. E. Rogers Fund . . . . .	990 48	
Profit and Loss, per contra . . . . .	3,216 38	
		<u>88,759 03</u>
Cash Balance, Sept. 30, 1890 . . . . .		5,392 71
		<u>\$442,098 54</u>

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1890:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

Cin., Ind., St. Louis & Chicago R. R. 6s . . . . .	\$4,000 00	
Omaha & Southwestern R. R. 8s . . . . .	7,000 00	
Mo. Valley, Blair R'y & Bridge Co. 6s . . . . .	20,000 00	
Saginaw & Western R. R. 6s . . . . .	50,000 00	
Kansas City, Clinton & Springfield R. R. 5s . . . . .	16,000 00	
Republican Valley R. R. 6s . . . . .	5,400 00	
Kansas City, Memphis & Birmingham R. R. 5s . . . . .	1,905 00	
Grand Rapids, Newaygo & L. Shore R. R. 8s . . . . .	34,000 00	
Burlington & Mo. River R. R. 4s . . . . .	25,787 50	
Ottawa, Oswego & Fox River R. R. 8s . . . . .	2,000 00	
Lincoln & Northwestern R. R. 7s . . . . .	1,000 00	
Atchison & Nebraska R. R. 7s . . . . .	1,000 00	
Kansas City Belt R. R. 6s . . . . .	25,000 00	
Atchison, Topeka & Santa Fé R. R. 4s . . . . .	13,684 80	
"    "    "    "    Incomes . . . . .	5,376 00	
Bonds . . . . .	\$212,153 30	
Advances to Premium Account . . . . .	16,381 36	
220 shares Chicago, Burlington & Q. R. R. Stock . . . . .	22,000 00	
		\$250,534 66

INVESTMENT OF JOY SCHOLARSHIP FUND.

Mass. Hospital Life Insurance Co. . . . .	\$5,000 00	
Deposits in Savings Banks . . . . .	3,159 63	
		8,159 63

INVESTMENT OF SWETT SCHOLARSHIP FUND.

Mass. Hospital Life Insurance Co. . . . .		10,000 00
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INVESTMENT OF OTHER TRUSTS.

Atchison, Topeka & Santa Fé R. R. 4s . . . . .	\$1,687 50	
"    "    "    "    6s . . . . .	50,000 00	
"    "    "    "    Incomes . . . . .	301 88	
Quincy & Palmyra R. R. 8s . . . . .	25,000 00	
Chicago, Burlington & Quincy R. R. 4s . . . . .	5,100 00	
"    "    "    "    7s . . . . .	7,000 00	
Burlington & Mo. Ry. Land Grant 7s . . . . .	15,000 00	
"    "    Nebraska 6s . . . . .	19,000 00	
International & G. Northern R. R. 6s . . . . .	1,000 00	
Milwaukee & St. Paul R. R. 7 <sup>3</sup> / <sub>8</sub> s . . . . .	3,000 00	
Cincinnati & Indiana R. R. 7s . . . . .	2,000 00	
Union Pacific R. R. 6s . . . . .	1,000 00	
Chicago, B. & Northern R. R. 5s . . . . .	2,000 00	
Bonds . . . . .	\$132,089 38	
Advances to Premium Account . . . . .	6,949 45	
		139,038 83
<i>Amount carried up</i> . . . . .		\$407,733 12

Amount brought up . . . . . \$407,733 12

**STOCKS.**

154 shares Chicago, Burlington & Quincy R. R.	\$15,400 00	
40 " New York & Harlem R. R.	2,000 00	
20 " Pittsburg, Ft. Wayne & C. R. R.	2,000 00	
82 " Morris & Essex R. R.	4,100 00	
55 " Old Boston National Bank	5,510 50	
12 " Coheco Manufacturing Co.	6,000 00	
35 " Everett Mills	3,150 00	
50 " Hamilton Woollen Co.	5,000 00	
27 " Essex Co.	4,050 00	
15 " Consolidated Gas Co., New York	1,447 50	
75 " Pennsylvania Coal Co.	3,750 00	
	<hr/>	2,408 00

**REAL ESTATE.**

Rogers Building	\$315,726 88	
New Building of 1883	190,492 44	
Mechanic Arts Building	52,416 49	
Gymnasium Building.	3,713 36	
Land on Garrison Street	50,840 00	
Land on Trinity Place	76,315 69	
Building on Trinity Place	106,616 87	
	<hr/>	796,121 73
Equipment Engineering Building	\$16,555 24	
" Mechanic Arts Building	20,628 56	
	<hr/>	37,183 80

**SUNDRIES.**

Notes Receivable	\$1,500 00	
Students' Notes	3,657 00	
Lowell School of Design	216 45	
Paid on account New Boiler	607 59	
Cash balance Sept. 30, 1890	5,392 71	
	<hr/>	11,373 75
		<hr/>
		\$1,304,820 40

The foregoing Property represents the following Funds and Balances, and is answerable for the same.

The Income of the following named is used for the general purposes of the Institute: —

Wm. Barton Rogers Memorial Fund . . . . .	\$250,225 00
Albion K. P. Welch Fund . . . . .	5,000 00
McGregor " . . . . .	2,500 00
Nathaniel C. Nash " . . . . .	10,000 00
Robert E. Rogers " . . . . .	7,680 77
Richard Perkins " . . . . .	50,000 00
Stanton Blake " . . . . .	5,000 00
Sidney Bartlett " . . . . .	10,000 00
Geo. Bucknam Dorr " . . . . .	49,573 47
General Institute " . . . . .	36,028 00

\$426,007 24

The Income of the following is used towards paying salaries: —

Jas. Hayward, for Professorship of Engineering,	\$18,800 00
Nathaniel Thayer, for " " Physics . . . . .	25,000 00
Wm. P. Mason, " " " Geology . . . . .	18,800 00
Henry B. Rogers " General Salaries . . . . .	25,000 00

87,600 00

#### SCHOLARSHIP TRUSTS.

Mrs. Susan H. Swett Fund . . . . .	\$10,182 95
Joy " . . . . .	8,159 63
Thomas Sherwin " . . . . .	5,000 00
James Savage " . . . . .	11,253 40
James H. Mirrlees " . . . . .	2,623 00
Wm. Barton Rogers Alumni Fund . . . . .	7,884 02
Richard Perkins Fund . . . . .	51,876 97
Farnsworth " . . . . .	5,000 00
Charles Lewis Flint Fund . . . . .	5,177 58
Elisha Thacher Loring Fund . . . . .	5,157 84

112,315 39

Charles Lewis Flint Fund for Library . . . . .	5,000 00
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5,000 00

#### MISCELLANEOUS.

Notes Payable . . . . .	\$20,000 00
Students' Deposits . . . . .	450 00
Subscription of 1887 . . . . .	123,500 00
M. I. T. Stock Account . . . . .	529,947 77

673,897 77

\$1,304,820 40

## COMPARATIVE STATEMENT OF FUNDS, ETC.

	Sept. 30, 1889.	Sept. 30, 1890.
Trusts for general purposes . . . . .	\$375,443 29	\$426,007 24
"    " Salaries . . . . .	87,600 00	87,600 00
"    " Scholarships . . . . .	98,181 43	112,315 39
"    " Library . . . . .		5,000 00
Income Joy Fund . . . . .	200 00	
Notes Payable . . . . .	20,000 00	20,000 00
Students' Deposits . . . . .	550 00	450 00
Subscriptions of 1887 . . . . .	87,500 00	123,500 00
M. I. T. Stock Account . . . . .	483,164 15	529,947 77
Advances to Bond Premiums . . . . .	9,146 25	
	<hr/>	<hr/>
	\$1,161,785 12	\$1,304,820 40
Increase . . . . .	143,035 28	
Consisting of:—		
Geo. B. Dorr Fund (new) . . . . .	49,573 47	
C. L. Flint Scholarship " " . . . . .	5,000 00	
E. T. Loring " " " . . . . .	5,000 00	
C. L. Flint Library " " . . . . .	5,000 00	
Increase of Robert E. Rogers Fund . . . . .	990 48	
"    " Wm. Barton Rogers Scholarship Fund . . . . .	2,330 06	
Increase of Scholarship Funds . . . . .	1,803 90	
Subscriptions of 1887 paid . . . . .	36,000 00	
Increase of Stock Account . . . . .	46,783 62	
	<hr/>	152,481 53
Students' Deposits less . . . . .	\$100 00	
Income Joy Fund deposited . . . . .	200 00	
Advances to Bond Premiums . . . . .	9,146 25	
	<hr/>	9,446 25
		<hr/>
		\$143,035 28
		<hr/> <hr/>

**INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.**

<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">Applied to Salaries . . . . .</td> <td style="text-align: right; width: 20%;">\$4,147 86</td> </tr> <tr> <td>“ “ Scholarships . . . . .</td> <td style="text-align: right;">2,916 49</td> </tr> <tr> <td>“ “ Library . . . . .</td> <td style="text-align: right;">177 58</td> </tr> <tr> <td>“ “ General Purposes . . . . .</td> <td style="text-align: right;">8,276 66</td> </tr> <tr> <td>“ “ Increase of Funds . . . . .</td> <td style="text-align: right;">1,305 64</td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black; text-align: right; padding-top: 5px;">\$16,824 23</td> </tr> </table>	Applied to Salaries . . . . .	\$4,147 86	“ “ Scholarships . . . . .	2,916 49	“ “ Library . . . . .	177 58	“ “ General Purposes . . . . .	8,276 66	“ “ Increase of Funds . . . . .	1,305 64	\$16,824 23		<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%;">From Dividends, Old Boston National Bank . . . . .</td> <td style="text-align: right; width: 20%;">\$220 00</td> </tr> <tr> <td>“ State Tax returned, Old Boston National Bank . . . . .</td> <td style="text-align: right;">85 69</td> </tr> <tr> <td>“ Railroad Bonds . . . . .</td> <td style="text-align: right;">4,993 88</td> </tr> <tr> <td>“ Essex Co. Dividend . . . . .</td> <td style="text-align: right;">162 00</td> </tr> <tr> <td>“ Coheco Co. Dividend . . . . .</td> <td style="text-align: right;">240 00</td> </tr> <tr> <td>“ Hamilton Woolen Co. Dividend . . . . .</td> <td style="text-align: right;">300 00</td> </tr> <tr> <td>“ Chicago, B. &amp; Q. Ry. “ . . . .</td> <td style="text-align: right;">645 00</td> </tr> <tr> <td>“ Consolidated Gas Co. “ . . . .</td> <td style="text-align: right;">37 50</td> </tr> <tr> <td>“ New York &amp; Harlem Ry. “ . . . .</td> <td style="text-align: right;">80 00</td> </tr> <tr> <td>“ Morris &amp; Essex Ry. “ . . . .</td> <td style="text-align: right;">143 50</td> </tr> <tr> <td>“ Pennsylvania Coal Co. “ . . . .</td> <td style="text-align: right;">300 00</td> </tr> <tr> <td>“ Pittsburg &amp; Fort Wayne Ry. “ . . . .</td> <td style="text-align: right;">35 00</td> </tr> <tr> <td>“ Dorr Estate . . . . .</td> <td style="text-align: right;">1,291 19</td> </tr> <tr> <td>“ Rent, 1004 Walnut St., Philadelphia . . . . .</td> <td style="text-align: right;">93 18</td> </tr> <tr> <td>“ Interest, Atchison Note . . . . .</td> <td style="text-align: right;">75 00</td> </tr> <tr> <td>“ Wm. B. Rogers Memorial Fund . . . . .</td> <td style="text-align: right;">228 82</td> </tr> <tr> <td>“ Interest on Funds not in Bonds and Stocks @ <math>4\frac{735}{1000}\%</math> the rate on earnings invested . . . . .</td> <td style="text-align: right; vertical-align: bottom;">7,893 47</td> </tr> <tr> <td colspan="2" style="border-top: 1px solid black; text-align: right; padding-top: 5px;">\$16,824 23</td> </tr> </table>	From Dividends, Old Boston National Bank . . . . .	\$220 00	“ State Tax returned, Old Boston National Bank . . . . .	85 69	“ Railroad Bonds . . . . .	4,993 88	“ Essex Co. Dividend . . . . .	162 00	“ Coheco Co. Dividend . . . . .	240 00	“ Hamilton Woolen Co. Dividend . . . . .	300 00	“ Chicago, B. & Q. Ry. “ . . . .	645 00	“ Consolidated Gas Co. “ . . . .	37 50	“ New York & Harlem Ry. “ . . . .	80 00	“ Morris & Essex Ry. “ . . . .	143 50	“ Pennsylvania Coal Co. “ . . . .	300 00	“ Pittsburg & Fort Wayne Ry. “ . . . .	35 00	“ Dorr Estate . . . . .	1,291 19	“ Rent, 1004 Walnut St., Philadelphia . . . . .	93 18	“ Interest, Atchison Note . . . . .	75 00	“ Wm. B. Rogers Memorial Fund . . . . .	228 82	“ Interest on Funds not in Bonds and Stocks @ $4\frac{735}{1000}\%$ the rate on earnings invested . . . . .	7,893 47	\$16,824 23	
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\$16,824 23																																																	

**INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND,  
AND APPLICATION THEREOF.**

<p>Paid Massachusetts Institute of Technology 5% on Amount of Fund (\$250,225) . . . . \$12,511 25</p> <p>Transferred to General Income for Amount over invested \$4,057.83 @ <math>5\frac{633}{1000}</math> rate earned by this Fund . . . . . 228 82</p> <p>Credited to Advances Bond Premiums . . . . 1,598 53</p> <hr style="width: 20%; margin-left: auto; margin-right: 0;"/> <p style="text-align: right;">\$14,338 60</p>	<p>From Railroad Bonds . . . . . \$13,293 60</p> <p>Dividend, 220 shares, Chicago, Burlington &amp; Quincy R. R. Co. . . . . 1,045 00</p> <hr style="width: 20%; margin-left: auto; margin-right: 0;"/> <p style="text-align: right;">\$14,338 60</p>
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**DETAILS SOME ITEMS IN TREASURER'S CASH ACCOUNT.**

**Rents.**

Huntington Hall, for Lowell Lectures . . . . .	\$2,500 00	
Lowell School of Design . . . . .	1,400 00	
Chauncy Hall School, for Gymnasium . . . . .	300 00	
State Board of Health, for use of Laboratories . . . . .	1,062 50	
Use of Lecture Rooms and Gymnasium . . . . .	80 00	
	<u>          </u>	<u>\$5,342 50</u>

**Department Supplies.**

Chemical Department . . . . .	\$6,439 83	
Physical " . . . . .	4,702 28	
Mining " . . . . .	1,774 54	
Mechanical " . . . . .	2,951 46	
Applied Mechanics " . . . . .	461 13	
Civil Engineering " . . . . .	1,460 19	
Biological " . . . . .	1,506 63	
Geological " . . . . .	207 33	
Architectural " . . . . .	1,632 67	
Drawing " . . . . .	22 82	
Mathematical " . . . . .	73 69	
English " . . . . .	1,118 71	
Workshops " . . . . .	1,252 06	
Periodicals . . . . .	1,101 98	
	<u>          </u>	<u>\$24,705 32</u>

**Salaries.**

Instruction . . . . .	\$118,952 47	
Administration . . . . .	13,286 19	
Labor . . . . .	14,170 75	
	<u>          </u>	<u>\$146,409 41</u>

**Interest Paid.**

Augustus Lowell, Trustee . . . . .	\$1,000 00	
On \$166,704.67 not invested in Stocks or Bonds . . . . .	7,893 47	
	<u>          </u>	<u>\$8,893 47</u>



**Repairs.****Department Improvements: —**

Mining Department . . . . .	\$952 96
Chemical " . . . . .	705 79
Physical " . . . . .	567 52
Drawing " . . . . .	418 34
Architectural " . . . . .	387 28
English " . . . . .	153 25
Biological " . . . . .	138 95

\$3,324 09

Reading, Lecture Rooms, and Secretary's Office, alterations . . . . .	349 10
Lunch Room . . . . .	815 51
Pointing Rogers Building . . . . .	513 19
" Building of 1883 . . . . .	324 19
Painting, etc., Halls and Rooms, Rogers Building,	1,100 48
Concreting Dynamo Room . . . . .	230 00
Gymnasium . . . . .	291 17
Workshops . . . . .	142 61
Sundries . . . . .	2,650 09

\$9,740 43**General Expenses.****Furniture: —**

Civil and Mechanical Engineering Department, Trinity Place, fitting the same . . . . .	\$1,509 78
Drawing Department, refitting . . . . .	737 50
Lecture Room, New Building of 1883 . . . . .	158 60
Architectural Department, Reading Room, etc., .	367 88

\$2,773 76**Electric Lighting: —**

Biological Department . . . . .	\$130 00
Architectural " . . . . .	115 00
Lamps, extending electric service, etc. . . . .	423 01

668 01

**Watchman's Clocks, Rogers, New, and Engineering Buildings,  
Eco Magneto Clock Co. . . . .**

530 96

**Insurance Premiums . . . . .**

1,343 69

**Engine Room Supplies: —**

Cotton Waste . . . . .	\$43 40
Covering Steam Pipes . . . . .	174 11
Reducing Valves . . . . .	92 25
Oil . . . . .	186 28

Amount carried forward . . . . . \$496 04

<i>Amount brought forward</i>	\$496 04	
Oil Cabinet	36 00	
Damper Regulators	259 50	
Small Engine in exchange, setting, etc.	369 79	
Fan Engine	69 02	
		\$1,230 35
Machinery, Mining Department		440 79
Postage and Stationery		1,155 64
Fire Sprinklers		313 27
“ Hose		299 36
“ Escapes		188 12
Lunch Room:—		
Steam and Gas Cooking Apparatus, Kitchen and Dining-Room		
Furniture		399 24
Linen Chair Covers, Huntington Hall		209 00
Window Shades:—		
Engineering Building	\$432 50	
Other Buildings	132 73	
		565 23
Diplomas, Commissions, and Expense of Drills		413 40
Entrance Examinations		456 59
Library Supplies		72 93
Office Supplies		346 13
Union Safe Deposit Vaults, rent		50 00
Legal Fees, Dorr Estate		100 00
Boston Electric Time Co.		31 50
Telephone, Rent of		51 81
Express Charges		349 54
Gymnasium, Stove, etc.		50 00
Mats, Waste Baskets, etc.		67 56
Paints, Varnish, etc.		321 14
Washing		280 16
Ice		237 47
Janitor's Supplies:—		
Brushes, Pails, Sponges, Soap, etc.		392 37
Grounds, Improving Lawns, etc.		163 25
Towels, etc.		59 39
Window Glass		45 40
Hardware (petty)		68 79
Moving Effects to Engineering Building		205 51
Petty Supplies, “ “		197 81
Ventilation		59 40
Drawings for publication		26 00
Sundries		221 06
		<u>\$14,384 63</u>

BOSTON, December 3, 1890.

An examination of the accounts of the Treasurer of the Massachusetts Institute of Technology for the year ending Sept. 30, 1890, has been made, and they are found to be correctly cast, and with proper vouchers. The Ledger Balances agree with the Trial Balance. We have verified the evidences of personal property held by the Institute.

FREDERIC W. LINCOLN,

CHARLES C. JACKSON,

*Auditing Committee.*