[AMERICAN JOURNAL OF SCIENCE, VOL. 250, SEPTEMBER 1952, PP. 625-635]

American Journal of Science

SEPTEMBER 1952

ONE HUNDRED AND FIFTY YEARS OF GEOLOGY AT YALE

M. L. JENSEN

ON September 9, 1802, Benjamin Silliman was appointed to the Professorship of Chemistry and Natural History in Yale College at New Haven, Connecticut. This marked the advent of a Department of Earth Science and it seems fitting, therefore, that we should recall this academic birth of Geology in America now, a century and a half later.

At the time Silliman received his appointment he was but 23 years of age but he was a graduate of Yale College and had been admitted to the practice of law in the State of Connecticut. He had not been trained in chemistry or natural history but he spent the following four years in preparing himself to teach the subjects of chemistry, mineralogy, and geology. He also began collecting specimens to be used in the mineralogy course, and he attended the lectures on chemistry by James Woodhouse and Benjamin S. Barton in Philadelphia during the two winters immediately following his appointment. He visited Europe and in the words of his son-in-law, J. D. Dana, in "the mines, quarries, and cliffs of England, the crags of Scotland, and the meadows of Holland, he looked for knowledge, and from these and the teachings of Murray, Jameson, Hall, Hope, and Playfair, at Edinburgh, Professor Silliman returned, equipped for duty,—albeit a great duty, —that of laying the foundations and creating almost out of nothing a department not before recognized in any institution in America" (Gilman, p. 160).

Silliman began the collection of minerals and rocks by sending a "half bushel of unlabeled stones" to Philadelphia to be named.

In 1810, through the influence of Silliman, Col. George Gibbs of Newport, R. I., offered to deposit at Yale his rich

and extensive collection of minerals, which he had obtained in Europe. Fifteen years later, this collection was purchased at a cost of $20,000 and became the property of Yale College. This entire sum was raised through individual donations by citizens of Connecticut and other eastern states. This formed the nucleus of the mineralogical collection which Yale now has. In contrast to the "half bushel of unlabeled stones," Yale recently received on loan the Carl Bosch Mineralogical Collection, the shipping of which to New Haven required the use of 2½ railroad cars.

It was through the arguments of Col. Gibbs that Silliman (1834) undertook the task of providing a scientific journal for the naturalists of America. The first number was published in 1818 and contained the following title:

THE
AMERICAN
JOURNAL OF SCIENCE
MORE ESPECIALLY OF
MINERALOGY, GEOLOGY,
AND THE
OTHER BRANCHES OF NATURAL HISTORY,
INCLUDING ALSO
ARCHITECTURE
AND THE
ORNAMENTAL AS WELL AS USEFUL
ARTS

CONDUCTED BY
BENJAMIN SILLIMAN

In contrast, the present policy of the editors of the Journal is to limit the subject matter of papers to topics pertaining essentially to geology.

The Journal, more popularly known as Silliman's Journal, was a success from the beginning in all respects except for the "pecuniary" aspect. The editorial preface of vol. III (Silliman, 1820) states that "we are now bound in justice to the interest of American Science, not to withhold from its patrons, the fact that the two first volumes of this Journal have been thus far, in a pecuniary way, losing concerns." The same volume also contains the note that "the editor is compelled to postpone many miscellaneous articles which were in readiness." Silliman realized, quite obviously, the great need

of his Journal as a scientific periodical and he therefore provided "pecuniary" support from his own pocket. No wonder it was called "Silliman's Journal."

The preface of vol. V (Silliman, 1822) states that "a trial of four years has decided the point, the American Public will support this Journal. Its pecuniary patronage is now such, that although not a lucrative, it is no longer a hazardous enterprise."

Economic difficulties did not dampen Silliman's philosophical attitude. In one of his earliest papers (Silliman, 1818, p. 230) he comments, "How happy is it, that the poison of the rattlesnake, is not conjoined with the size of the Boa-constrictor, and with the speed of the antelope." It does seem, however, that he had characteristics of the forgetful professor. In a note "to correspondents," Silliman (1821) confesses that "some memoranda of errata forwarded to us have been mislaid; they are, however, either obvious or unimportant.—(Editor)."

Schuchert (1918, p. 51) has described Silliman as "the first [in America] to take up actively the teaching of mineralogy and geology based on collections of specimens. He spread the knowledge in popular lectures throughout the Eastern States, graduated many a student in the sciences, making of some of them professional teachers and geologists, provided all with a journal wherein they could publish their research, organized the first geological society, and through his students, the first official geological surveys, and by his kind words and acts, fostered, and held together American scientific men for fifty years."

It might be added that he fostered four sons and five daughters, five of whom were of great aid in continuing his high hopes and ideals of science (three sons and one daughter died in infancy). His son, Benjamin Silliman, Jr., became Professor of Chemistry at Yale College and second editor of the American Journal of Science. This son should receive an important share of the credit for initiating the petroleum industry. The results of a chemical study upon the various properties of a fractionated sample of Pennsylvania crude oil, collected from a seep, were described in a "Report on the Rock Oil, or Petroleum, from Venango Co., Penn. with special reference to its use for illuminating and other purposes," which was written by Benjamin Silliman, Jr., and dated April

16, 1855. In the conclusion of the report, he stated, "gentlemen, it appears to me that there is much ground for encouragement in the belief that your Company have in their possession a raw material from which, by simple and not expensive process, they may manufacture very valuable products."

In the words of Bateman (1950, p. 652), "Casual discussion of [Silliman's] discovery with three of his friends led to forming a small company to drill for oil, just as was done for salt. One member supplied a young temporary conductor from his railroad, who was sent to Oil Creek, Pennsylvania. To give him dignity in the community they bestowed upon him the title of Colonel by addressing letters in advance of his arrival to Col. E. L. Drake." It is now, of course, common knowledge that "Colonel" Drake's well struck oil at a depth of 69 feet and became the first producing oil well.

Two of Silliman's most promising students became his sons-in-law. One, O. P. Hubbard, became Professor of Chemistry at Dartmouth College whereas the second, James Dwight Dana, who married Henrietta Frances Silliman, remained at Yale. Soon after their marriage, Dana received overtures from Harvard University, through Asa Gray, to join the distinguished group at Cambridge. He, however, accepted the newly created chair of Silliman Professorship of Natural History at Yale, presumably to the great delight of his wife, her family, especially her father who wished to retire, and his New Haven friends. Actually, the chair was made possible through the financial aid provided by Professor Edward Salisbury. Dana's son, Edward Salisbury Dana, named after this kind benefactor, became Curator of Mineralogy in the year 1874 and was Professor and Professor Emeritus until 1935.

It would require a voluminous work to treat adequately and trace fully the genealogy of instruction in geology at Yale. Figure 1 may suffice, however, to indicate schematically the general evolution and specialization of geologic instruction at Yale. The abscissa of the diagram is a plot of time for one and one-half centuries; the ordinate represents roughly the specialized fields that have developed during that time within the broad scope of geology.

The description and composition of rocks and minerals formed the foundation of geology and it is, therefore, not surprising that the field of mineralogy has received great

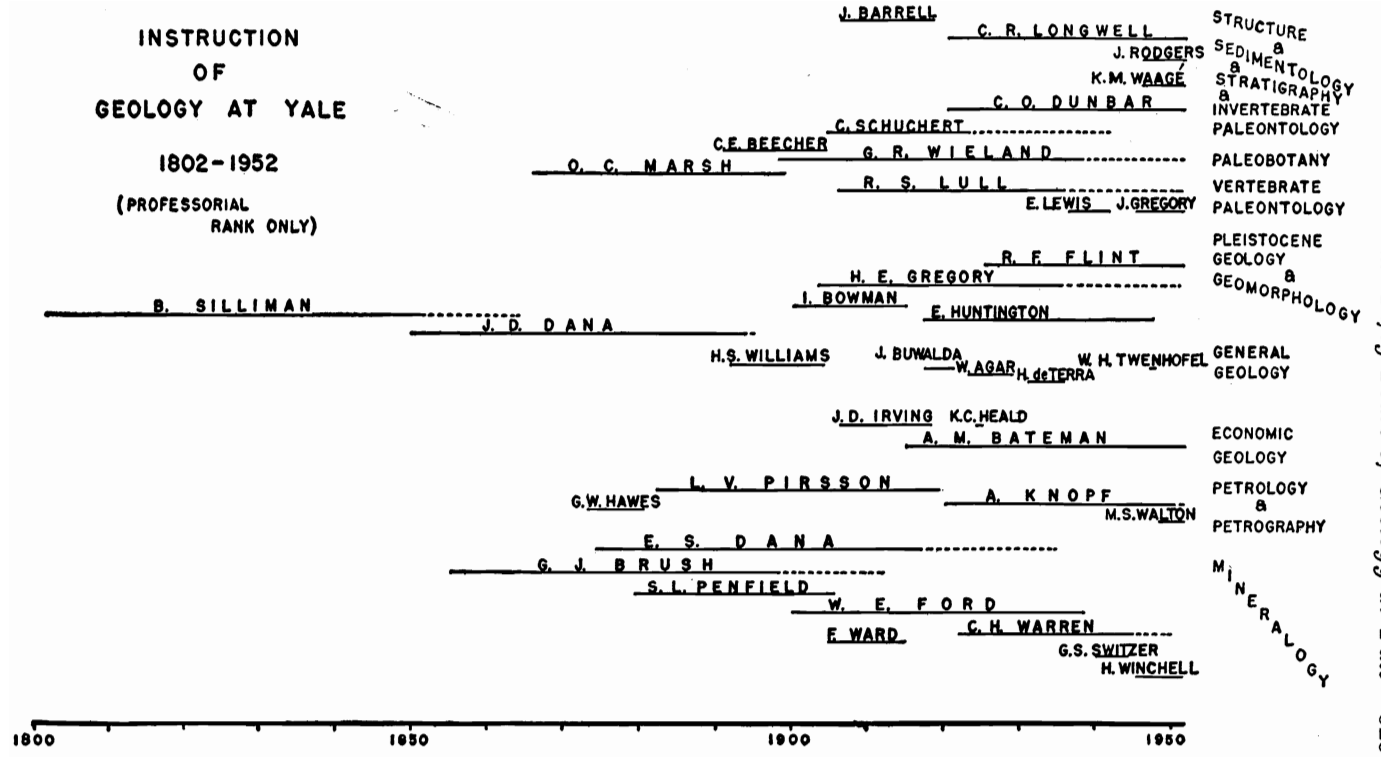
INSTRUCTION
OF
GEOLOGY AT YALE
1802-1952
(PROFESSORIAL
RANK ONLY)
J. BARRELL
C. R. LONGWELL
J. RODGERS
K. M. WAAGE
C. O. DUNBAR
C. SCHUCHERT
C. E. BEECHER
G. R. WIELAND
O. C. MARSH
R. S. LULL
E. LEWIS
J. GREGORY
R. F. FLINT
H. E. GREGORY
I. BOWMAN
E. HUNTINGTON
B. SILLIMAN
J. D. DANA
H. S. WILLIAMS
J. BUWALDA
W. AGAR
H. deTERRA
W. H. TWENHOFEL
J. D. IRVING
K. C. HEALD
A. M. BATEMAN
L. V. PIRSSON
G. W. HAWES
A. KNOPF
M. S. WALTON
E. S. DANA
G. J. BRUSH
S. L. PENFIELD
W. E. FORD
F. WARD
C. H. WARREN
G. S. SWITZER
H. WINCHELL
STRUCTURE & SEDIMENTOLOGY & STRATIGRAPHY & INVERTEBRATE PALEONTOLOGY
PALEOBOTANY
VERTEBRATE PALEONTOLOGY
PLEISTOCENE GEOLOGY & GEOMORPHOLOGY
GENERAL GEOLOGY
ECONOMIC GEOLOGY
PETROLOGY & PETROGRAPHY
MINERALOGY
1800
1850
1900
1950

Fig. 1

emphasis. As can be seen from figure 1, there has been some overlap of instruction in this field in the past.

As an aid in identification of minerals, G. J. Brush presented, in 1874, his "Manual of Determinative Mineralogy with an Introduction on Blowpipe Analysis." (The determinative tables were based upon Professor von Kobell's "Tafeln zur Bestimmung der Mineralien.") The text was later enlarged and revised by S. L. Penfield.

The Danas, both father and son, were active mineralogists. The "System of Mineralogy and Crystallography," first published in 1837 (J. D. Dana was then but 24 years of age), reached the sixth edition before the turn of the century. This edition, published in 1892, was "entirely rewritten" by E. S. Dana with some aid from his father. J. D. Dana's "Manual of Mineralogy" first appeared in 1848 and went through fourteen editions at Yale. A fifteenth edition was contemplated by W. E. Ford at the time of his death in 1939, and was later "entirely revised and rewritten by Cornelius S. Hurlbut, Jr.," of Harvard University in 1941. The sixteenth edition appeared this year. The mineralogy group at Harvard is now completely revising the "System." This work was initiated by W. E. Ford but because of his failing health, the group at Harvard relieved him of this extra burden.

C. H. Warren received his doctoral degree from Yale and became Professor of Mineralogy and Petrology at Massachusetts Institute of Technology. In 1922 he returned to Yale to accept the position of Dean of the Sheffield Scientific School, a position he held until his retirement in 1945. During much of this time, he remained in contact with undergraduate students through teaching a course in megascopic petrology.

G. W. Hawes is referred to by his successor, L. V. Pirsson (1918, p. 228) as "the earliest of the petrographers in this country." Pirsson himself, however, was certainly one of the early investigators in this field, even though his undergraduate training at Yale was in chemistry and he served as an analytical chemist for several years after his graduation. In 1889 he was offered the position of field assistant to J. P. Iddings and W. H. Weed of the U. S. Geological Survey. Upon his return from the summer field season (spent in Yellowstone National Park) he was determined to become a geologist. Incidentally he was an enthusiastic fisherman and the trout streams of the West may have influenced his decision.

In 1893 Pirsson began teaching physical geology. This led to the publication, in 1915, of the first Yale Physical Geology and Historical Geology textbooks, Schuchert being author of the Historical Geology volume.

Pirsson retained, however, his specialty of petrology and was a member of the famed C.I.P.W. (Cross, Iddings, Pirsson, Washington) group. According to Cross, Pirsson was recognized as the "moderator" during lively sessions of these four petrologic authorities.

Adolph Knopf undertook the duties of Professor of Petrology at Yale in 1920 and was the latest professor to retire from the department. Upon his retirement, the respect and admiration for this man by Yale geology students and over 300 of his former students was such that they presented a commemorative plaque, now on display outside his former office, bearing his profile and the following inscription: "Adolph Knopf, Inspiring Teacher, Scholar, Friend. Presented by his students of 1920-1951."

J. D. Irving, although specially trained in petrography, entered the allied specialty of economic geology and surely seemed destined for fame in the field of mineral dposits when he died in France, at the youthful age of 44, while serving with the A. E. F. He was succeeded by a former student, who has now been teaching economic geology at Yale for over thirty-five years, Professor Alan M. Bateman.

Organic geology[1] became a recognized specialty at Yale in the year 1866 with the appointment of O. C. Marsh as Professor of Paleontology. Professor Marsh received his B.A. and M.A. degrees at Yale and performed his doctoral requirements at Heidelberg. Fortunately for Yale, Marsh was not only an able but also a rather persuasive man and the nephew of Mr. George Peabody. On November 1, 1866, Yale gratefully accepted a gift from this benefactor for the establishment of a Museum of Natural History, and ten years later the first Peabody Museum of Natural History at Yale was completed.

R. S. Lull taught vertebrate paleontology for thirty years and became Professor Emeritus in 1936. He is, however, still an active man and he can often be found at work in the Peabody Museum.

[1] Although the phrase "organic geology" seems rather unusual, it is of interest to note that L. V. Pirsson occupied the position of Professor of Inorganic Geology while instructing in petrology, petrography, and physical geology.

C. E. Beecher taught invertebrate paleontology and stratigraphy until his death in 1904, when he was succeeded by Charles Schuchert. Schuchert had left school at the age of fourteen and had entered his father's furniture business only to see the establishment destroyed twice by fire. The collecting of fossils had been his hobby from the time he was eleven years of age, with the result that he became a recognized authority on brachiopods, even though he began as an amateur paleontologist and never attended a college lecture until he gave his first lecture at Yale at the age of 46! His attempts to organize and improve the instruction of stratigraphy led him to adopt a method of plotting the location and thickness of stratigraphic sections on base maps. This led to his great interest in paleogeographic maps and made him the world's recognized leader in paleogeography. His portrait, presented to him by his former students when he became an octogenarian, hangs alongside that of O. C. Marsh in the Peabody Museum (Dunbar, 1942).

Schuchert's successor was his protegé and former student, C. O. Dunbar, who is now the Director of the Peabody Museum of Natural History.

G. R. Wieland has been at Yale for over fifty-five years where he has acquired a worldwide reputation as a paleobotanist. When the King (then Crown Prince) of Sweden visited New Haven in 1926, he spent almost all of his time with Wieland discussing the latter's fine collection of cycadeoids, much to the disappointment of the Welcoming Committee.

Although Joseph Barrell occupied the position of first Professor of Structural Geology at Yale, the subject of this field had received previous recognition. In fact, Barrell (1918, p. 152) himself has referred to the description of an overturned fold submitted to Silliman and his Journal by J. H. Steele, in 1825, and Barrell noted that as far as he "is aware this is the first recognition in geological literature of the evidence of a horizontally compressive and overturning force as a cause of folding."

Barrell was a great believer in the importance of knowledge gained from a study of the history of ideas pertaining to a subject (which incidentally is an excuse for writing a paper of this type), for he has said (1918, p. 134), "Those interested in any branch of science should, as a matter of education,

read the history of that special subject. A knowledge of the stages by which the present development has been attained is essential to give a proper perspective to the literature of each period. Much of the existing terminology is an inheritance from the first attempts at nomenclature, or may rest upon theories long discarded. Popular notions at variance with advanced teaching are often the forgotten inheritance of a past generation."

Joseph Barrell was one of three professors of geology at Yale who died during the 1918-19 academic year, the other two being L. V. Pirsson and J. D. Irving. C. R. Longwell returned from France in 1919, completed his doctoral requirements and began teaching structural geology at Yale in 1920.

H. E. Gregory received his Ph.D. from Yale and began teaching courses in geography and physiography at the turn of the century. He was immensely interested in the geology of the Colorado Plateau where he spent many field seasons. Isaiah Bowman and Ellsworth Huntington represented geography while that subject was allied with geology in one department at Yale.

In 1925, R. F. Flint entered the department, and he has since stressed the great importance of Pleistocene geology, espcially the stratigraphic aspects of this field. The C^{14} isotope has become a further tool in this field and the Geochronometric Laboratory at Yale has been set up for the purpose of determining the age of suitable specimens which are known to be accurately placed stratigraphically.

H. S. Williams, the originator of the Sigma Xi Society, taught a general historical geology course until 1904 at which time he returned to Ithaca, New York, and accepted the position of head of the department of geology at Cornell University. Several men have conducted the introductory general geology course but only those of professorial rank are included in figure 1. A number of those there listed in special fields have given important parts of their time to the teaching of general geology.

At the conclusion of World War II, the Department of Geology at Yale consisted of five full professors. Within a year, considerable young blood was infused with the additions of J. T. Gregory, John Rodgers, K. M. Waagé, and Horace Winchell. A few years later, M. S. Walton also entered the fold.

Many a professor has remarked during a moment of exasperation that teaching would be wonderful if it were not for the students. It is, however, needless to say that Yale is proud of her geologic graduates and the successes they have achieved. A complete record of the number of undergraduate degrees awarded in geology at Yale is unavailable. Figure 2, however, is a graphical representation of the number of graduate degrees awarded during the past. It is obvious from the graph that the number has been gradually increasing. The first Ph.D. in geology, and the tenth Ph.D. given by Yale[2] was awarded to William North Rice in the year 1867. His dissertation was entitled, "The Darwinian theory of the origin of species." In 1950, seven master's degrees and ten doctor's degrees were awarded in the field of geology.

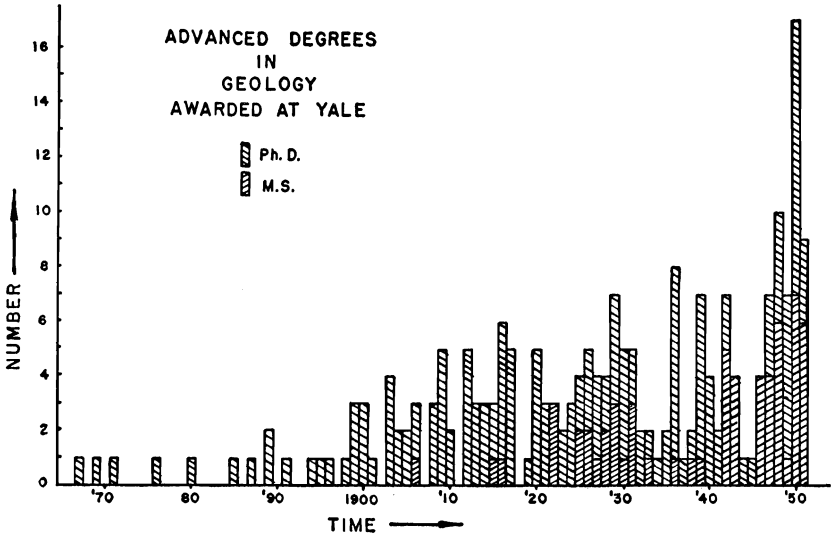

Fig. 2

[2]Yale was the first institution in America to award the degree of Doctor of Philosophy.

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