GEOL OGY AT LEHIGH UNIVERSITY

1866 - 1966

BRADFORD WILLARD
LEHIGH UNIVERSITY
Bethlehem, Penna.

Geology at Lehigh University,
Its History
1866-1966

With sincere apologies from the compiler of this bulletin, the following names and corrections to list of Alumni in Geology are submitted:

**Additions**
Frank L. Fisher, Jr., B.A. '32
Albert J. Getz, B.A. '38, M.S. '39
G. Conrad Heikes, B.A. Geol. '23
H. E. Hinman, Jr., B.A. '51
C. H. Snyder (15) Retired
Paul Solomon, E.M. '58 (Geol.-split prog.)

**Corrections**
E. A. Fisher, B.A. '40 instead of A. L. Fisher
R. O. Jensen, B.A. '44 instead of R. C. Jensen
F. P. Puskas, M.S. '61 instead of F. P. Puskus

**Add to Teaching Staff:**
G. V. Carroll, B.A. Lehigh '43, Ph.D. Yale '52
GEOLOGY AT LEHIGH UNIVERSITY,
ITS HISTORY
1866-1966

Compiled by Bradford Willard
"All Summer in the Field, and all Winter in the Study"
R.W.E.
1966
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Foreword

The dream of Asa Packer has been a reality for one hundred years—Lehigh University at the time of this writing is celebrating its Centennial Anniversary. From the first, geology has been part of the Lehigh curriculum. Thus, it seems appropriate that the Department of Geology should mark the occasion of the University's Centennial in some special way. This book which is distributed to all of the alumni of the Department is our way of doing this.

During much of the first hundred years of the University, geology was regarded largely as an adjunct to engineering. Engineering was considered to be the main business of the University, and it was the main function of the Department of Geology to provide students of engineering with necessary background of knowledge about geology and its applications in engineering. This view has now largely disappeared. Although the Department of Geology still does perform an important service function to students in other fields, we now regard the development of professional geologists and the advance of geology as a pure science as our primary function. Over the past 25 years, our undergraduate program has been greatly strengthened, and we have added a rapidly growing graduate program.

Probably no one now has done more to establish the identity of the Department of Geology than Bradford Willard, the author of this volume. Dr. Willard's association with Lehigh began in 1915 when he matriculated as a freshman. From 1939 to 1959, he served as Professor and Head of the Department of Geology. Under his leadership, undergraduate enrollment in the geology major reached an all time high—50 majors during the academic year 1955-1956. Also under his leadership, the Ph.D. program was initiated just after World War II. The first Lehigh Ph.D. in geology was granted in 1950—by June, 1966, 18 young men had earned the degree.

Those of us who are active members of the Department are grateful to Dr. Willard and to other of our predecessors for passing on to us a healthy and alive Department. We are grateful also to you, our former students, for making the experience of college teaching worthwhile.

J. Donald Ryan, '43
Professor and Chairman
Department of Geology

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GEOLOGY AT LEHIGH UNIVERSITY, ITS HISTORY
1866-1966
Compiled by Bradford Willard

THE ENVIRONMENT

Lehigh University, located at Bethlehem in the Lehigh Valley of east-central Pennsylvania, is ideally situated for the study and teaching of geology. Few colleges or universities have at their doors such a variety of rocks, minerals and geological phenomena. Within less than a hundred miles, one can observe the entire Paleozoic succession except the Permian (the nearest Permian outcrops are in southwestern Pennsylvania), much of the Mesozoic (except the Jurassic), the Tertiary and Quaternary. From the Precambrian metamorphic complex of South Mountain underlying the upper part of the campus, and traveling north, one crosses a complete sequence of Paleozoic sedimentary formations into the Pennsylvanian of the Anthracite fields at Mauch Chunk (alias Jim Thorpe). If one faces south, the Triassic is within easy reach, and beyond, southeastward in New Jersey, are the Cretaceous and Tertiary of the Coastal Plain. Bethlehem lies at the limit of Pleistocene glaciation, and related outwash sediments trail southward into the Saucon and Delaware Valleys.

Throughout the sequence there is almost every phase or “species” of sedimentary deposit from deep-water and near-shore marine sediments to continental beds and glacial till. Facies changes are impressively illustrated among the Paleozoic systems. Marine invertebrate fossils abound in the Ordovician, Silurian, Devonian and Cretaceous strata. Fossil plants, of course, are legion in the coal measures, and are occasionally found in the Mississippian, Devonian and Triassic formations. Vertebrate fossils are not common, but a few fish are known, mostly from the non-marine Silurian and Devonian beds. Foot-tracks of reptiles and amphibians have turned up among the Triassic red beds, and, if one is lucky, he may uncover a bone or two in the New Jersey Coastal Plain.

Igneous phenomena can be observed where the Triassic basic intrusives and extrusives crop out, plus at least one area of older (Devonian?) basic rocks near Jonestown. Ordovician bentonites have been identified locally. Metamorphism, both regional (Precambrian) and contact (Triassic and Paleozoic) is illustrated at many places.

It seems almost superfluous to mention the economic mineral deposits of a State which from colonial days has been a source of metallic and nonmetallic products. We have iron, zinc and coal mines, limestone for cement manufacture, slate, building and ornamental stones, gravel and sand. We do lack ready access to gas and oil fields, but water supply and its problems are well exemplified hereabouts.
Because Lehigh is in the Appalachian Mountains, typical Appalachian structures are there for the observing—thrusts, folds (some recumbent), gravity faults, unconformities, and disconformities, slaty cleavage, all readily at hand.

The physiography of the region, at least from the Lehigh Valley northward, is modified by Pleistocene ice influences. However, disregarding such, the vast peneplanation of the general area is phenomenal and classic. The rivers descend through water gaps between which wind gaps notch the even-crested ridges. Entrenched valleys, flood plains, morainal and melt water deposits and erosional features are a dime a dozen. On some fine autumn day, when a northwest breeze has cleared the air over the Lehigh Valley, climb to the Lookout on South Mountain on the upper part of the Campus. There, standing on part of the Older Appalachians, to the north the Younger Appalachians (Kittatinny Mountain plus) along the horizon display wind and water gaps and are separated from the older ridges by the Great Valley eroded from limestone and slate. Next, to the south, if one passes beyond the Saucon Valley, is the Triassic Lowland, and beyond that the Piedmont and Coastal Plain.

PRE-LEHIGH YEARS

Man’s appreciation of Pennsylvania’s geology goes back to the mid-eighteenth century when Lewis Evans, a cartographer, published his remarkable maps of the central colonies. Evans’s descriptions of the country include much about the rocks, minerals and “the lay of the land”, although he cannot be called a geologist because the science, so-nominated, was not invented in his day. A real understanding of geology as such for Pennsylvania may be said to begin in 1809 when William Maclure published his hand-colored geologic map of the eastern States. Even prior to Maclure, F-C. Volney issued in France a little-known but similar map. Maclure with a few other geologists who lived in or near Philadelphia organized in 1817 the Geological Society of Pennsylvania with the express purpose of memorializing the State Legislature to establish a Geological Survey. The petition finally bore fruit, for in 1836 Henry D. Rogers from the University of Pennsylvania was appointed our first State Geologist. The Survey terminated in 1858 with the publication of an all-inclusive, two volume report and a large, magnificent and color-printed geologic map of the Commonwealth. Because this publication describes so well the geology of our section of the State, it answered many basic questions when the Lehigh faculty began to teach earth science.
Pennsylvania in the early nineteenth century was perhaps the leading mineral producing state in the East. To be sure, actual exploitation of petroleum did not begin until 1859, a year after the printing of the Rogers report, but consider what was mined and quarried? At the risk of being repetitious, but for emphasis, there were exploited near Bethlehem the following: coal ("hard"), iron, zinc, a little copper, limestone for burning but not yet used for cement which was first successfully made in the Lehigh Valley in the 1870's. The now almost forgotten school slates were manufactured in Northampton and Lehigh Counties, leading producers of those educational necessities. Building stones were many. Need one mention the serpentine and marble front steps of old Philadelphia dwellings, the brownstone facades of the houses of the 1800's, and the massive limestone-walled and slate-roofed barns and houses of old Pennsylvania German farms?

All these comments which clutter the first few paragraphs of this "unvarnished tale" may seem superfluous, but are recorded here to illustrate why Lehigh University is so fortunately and advantageously placed for the study of geology in most of its phases and ramifications. That this was realized by the Founders (consider Asa Packer's association with anthracite exploitation) and has been projected into the present, is substantiated by the following account of the development of the teaching of geology at Lehigh University.

GEOLOGY AT LEHIGH, FIRST OUTCROPS

Lehigh was not the first institution in Pennsylvania to offer instruction in geology. Henry D. Rogers taught earth science at the University of Pennsylvania. Lafayette College had geology in the curriculum as early as 1837. Dickinson probably had a course about 1830. Many of the data on geology as offered at Lehigh have been gleaned from the yearly Registers (i.e. Catalogues) commencing in 1866, and supplemented by other publications, letters, and manuscripts left by our academic ancestry.

Lehigh opened in 1866 with a faculty of eight* and about fifty stu-

*Including the Janitor. Judging from his assigned duties, his position corresponded to our Superintendent of Buildings and Grounds.

dents. There were several "schools", that is what today are designated as curricula or major sequences. Among them was the School of Mining and Metallurgy. As might be expected, geology played a part in this curriculum. The Register lists William Theodore Roepper, Esq., Professor of Mineralogy and Geology and Curator of the Museum. Roepp-
per, a local resident, had built a reputation as a mineralogist. Apparently he was self-taught. His greatest contribution undoubtedly was the identification of zinc minerals in the limestones of the Saucon Valley. After teaching two years, he relapsed into the curatorship.

The Mining and Metallurgy course for the Freshman and Sophomore years was uniform and identical with those of the other engineering curricula. Thereafter, specialization began. It is stated “In the study of this School are included Mineralogy and Geology; the methods of mining for various ores, with special instruction as to iron, coal, zinc, lead, copper, gold, and silver.” In the Junior year, the major included the following (kindly note the promiscuous use of capital letters):

Geology. Physical Geography, Geognosy [knowledge of mineral characters, properties of rocks], Palaeontology, Beds, strata, seams, Workable coal-beds. Lodes or mineral Veins. Dislocations and rules for finding the dislocated or lost portions of a deposit.

Mineralogy, Dana’s. Lectures by the Professor, Crystallography. Analysis of metallic ores, iron, copper, lead, zinc, gold, silver and coal. Access to the mineralogical cabinet.

There was also offered under “Drawing”, “Crystals, Maps of geological and mineralogical surveys,” while under Metallurgy was “analysis of minerals, blowpipe and assays”.

A graduation essay was required. Geology was also an unavoidable subject for students in “The School of Analytical Chemistry.”

For a number of years there was no startling alteration in the curriculum. The staff changed from time to time. Most of the teachers are today forgotten, but one stands the test of the years, Benjamin W. Frazier, who came to Lehigh in 1876 and remained on the staff until his death in 1905, one of the longest tenures among the faculty. In the 1870's the Sophomores took a term course in mineralogy. It is perhaps astonishing to us moderns that mineralogy was then taught prior to the students having had a course in geology. This sequence continued well into the 1920's.

For the edification of those now teaching or studying geology at Lehigh, a few comments of a more or less academic complexion have been skimmed from the early catalogs. Each professor while teaching his courses was expected to lecture on “Christian Evidence”. On Sundays the Faculty rounded up the student body and marched it off to “Devine Services”. There was no smoking, drinking (alcoholic), carrying of fire arms, card playing or gambling on the campus. No student should ride a horse or go boating on the Lehigh River on the sabbath. Profanity and scribbling on the walls were ruled out. The President's
permission to leave Bethlehem was required as also his consent to eat in a restaurant which served intoxicating liquor. One of the President's functions was to see that the students were properly housed in the dormitory (Christmas Hall in the beginning). There were strict rules about class and chapel attendance. At first, tuition was free, but even in 1869-70 the expenses seem nominal by today's costs:

<table>
<thead>
<tr>
<th>First and Second Years</th>
<th>Third and Fourth Years</th>
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<tbody>
<tr>
<td>Tuition ... $125</td>
<td>Tuition ... $150</td>
</tr>
<tr>
<td>Board, 40 weeks @ $5</td>
<td>Board, 40 weeks @ $5</td>
</tr>
<tr>
<td></td>
<td>200</td>
</tr>
<tr>
<td>Books</td>
<td>Books</td>
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<tr>
<td></td>
<td>20</td>
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<tr>
<td>Washing</td>
<td>Washing</td>
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<td></td>
<td>25</td>
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<td></td>
<td>$370</td>
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<td></td>
<td>$395</td>
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</table>

The appointment of Edward Higginson Williams, Jr. as Professor of Mining and Geology in 1881 marks the coming of our first outstanding teacher of geology. In his long association with the University (over 40 years), as a student, Professor and in his old age after retirement, a Lecturer, he did much to advance the teaching of earth science and biology. Simultaneously, Williams carried out extensive investigations of the Pleistocene*.

*Two extracurricular footnotes: Williams's father, E. H. Williams, Sr. gave the science building at the University of Vermont. It is well known that Lehigh and Cornell were founded simultaneously, but, perhaps not so widely recognized is the coincidence that a Geologist, S. H. Williams at Cornell founded the Society of the Sigma Xi, and a Geologist, E. H. Williams at Lehigh founded Tau Beta Pi.

Professor Williams's greatest contribution to Lehigh was not strictly confined to Geology. He it was who gave and equipped Williams Hall. It was dedicated September 25, 1903. Because he intended the building to be used for Geology and Biology, Williams, R. W. Hall, newly appointed to teach Biology, and John D. Irving, who succeeded Williams as Head of the Department of Geology, conferred on the design, furnishing and equipment of Williams Hall. Williams was outspoken in his insistence that the building be used by those two departments and none other. The following rather long paragraph (with irrelevant deletions) is quoted from a letter he wrote September 10, 1904, from Andover, Massachusetts, to Professor Hall:
I will go back to some ancient history regarding the use of the rooms by Professor Eckfeldt [Head of the Mining Department]. Last summer immediately after vacation I had a letter from Dr. Drown [President of Lehigh] regarding a place [for meeting] as I understand it—owing to the large number of metallurgists. I wrote to Dr. Drown that I thought the present drawing room in Christmas Hall amply large enough for the miners and as for the metallurgists I did not think it a very bad thing if they did a little hustling for their own quarters as I had been doing all the providing for them for several years and had fitted out the present room out of my own pocket. I also said that I did not wish the metallurgists to come into the Science Building [i.e. Williams Hall], and that the miners were only in it on sufferance. I also said that I had built the building . . . for what was generally looked down upon at Lehigh—namely, for a course which was by no means a “bread and butter” course; but was merely general culture, and as such had no friends among the powers that be, and I did not propose to have the courses of Geology and Biology hampered or dwarfed in any manner by an intrusion of technical work. I was then told that the matter was rather imperative. I then said that I had no authority to enforce anything one way or another and that, as the [building] had been erected for pure science, it was no more than right that the two men in charge of the two scientific courses should have the say as to whether the miners or anyone else should come in. And in the event that they did give consent, it should be understood that such was only temporary AND FOR ONE YEAR ONLY AND MUST BE RENEWED FROM YEAR TO YEAR.

Professor Williams, after leaving Bethlehem and active teaching, retired to Andover, Massachusetts, but used to return for short visits. At those times he usually delivered a lecture or two to the students in mining and geology. The talks were on his observations of Pleistocene phenomena—it is said that during his teaching years he sometimes took groups of students on fairly extended field trips entirely at his own expense. The kindly old gentleman became quite deaf as his years advanced. Consequently, prior to his arrival, Professor B. L. Miller, Head of the Department, informed the class of Williams’s infirmity and suggested that “loud applause” would be welcome. The room vibrated in response to the lectures, to Dr. Williams’s distinct gratification.

Williams and Frazier handled all the geological courses for a brief interval, then were joined part-time by Joseph W. Richards. Richards, destined to become one of the country’s foremost metallurgists (“aluminium”), contributed to geology in his unparalleled development of blowpipe analysis, both qualitative and quantitative. In the late 1880’s the offerings in earth science were: Junior Year: Geology, general and dynamic; Crystallography, Lithology, Theory and practice exercises in determining rocks. Historical Geology using LeConte’s famous text. As before, Mineralogy, based on Dana’s book, of course, preceeded Geology. Blowpipe under Professor Richards had come to its own and
was to remain in the curriculum well into the twentieth century. In the Senior year the Geology course embraced definitions and principles, dynamic, historic and economic.

The opening of the college year of 1888-1889 saw Mining and Metallurgy divorced. Thereafter the two curricula lead to their appropriate engineering degrees. Geology was still a substantial part of each curriculum, although chronologically more and more was required in Mining and less and less in Metallurgy.

In 1896 the University printed a pamphlet, "The Course in Mining Engineering", which includes a long description of offerings in mineralogy and geology. The descriptions hardly warrant repeating, for we shall presently quote in full the courses as taught, 1899-1900, in the Department of Geology when its independence was established. Nevertheless, the titles of some of the offerings in 1896 are indicative of progress:

Mineralogy and Blowpipe Analysis

Mineralogy

Blowpipe Analysis
1. Qualitative Analysis
2. Determinative Mineralogy
3. Quantitative Analysis

Advanced work in Mineralogy

Geology

Lithology
Structural Geology, etc.
Historical Geology
Geological Surveying

THE GEOLOGY DEPARTMENT IS BORN

A second curriculum split took place in 1899-1900 when Geology came to its own as a separate "course". The faculty included Williams, Frazier, H. E. Hiefer, E. W. Miller and Joseph Barrell, an alumnus, had been appointed in 1895. He was destined to become one of, if not the most famous geologist Lehigh ever produced. The description of the new curriculum is here quoted in full.

The course [Geology] is designed to meet the requirements of the teacher, the geological surveyor, and the prospector who desires to go in the field and acquire proficiency in practice, or to extend this knowl-
edge of the subjects treated by graduate work in the University. It includes all of the mathematics, physics and analytical mechanics taught in the technical courses, thus ensuring an ability to grasp and solve the problems of geological dynamics. A reading knowledge of French and German is acquired during the course, so that the student feels at home with foreign periodical literature in those languages.

The surveying courses afford practice in accurate mapping and the location of stations by latitude and longitude, as well as the noting of the geological features, so that the geologist or prospector will be able to record his work according to the most approved methods.

The courses in crystallography, mineralogy, geology, petrology, and physiography will permit him with slight effort not only to recognize the constituents of the earth’s crust, but to value the portion surveyed from an economic standpoint as it is adapted, or not, for mining operations.

The ordinary course in geology is extended by excursions into the foundations of Botany, Zoology, and Biology and supplemented by work in the courses in Surveying and Physiography. The ability readily to determine the character of ores and minerals met with is guaranteed by extended courses in Crystallography, Mineralogy, Megascopic and Microscopic Rock Analyses, Economic Geology and both Chemical and Blowpipe Analysis. The course in Chemistry includes assaying, quantitative wet analysis and the discussion of chemical problems, so that mineralogical formulae can be calculated from the results of analysis. The blowpipe covers quantitative and qualitative work. Economic Geology is taught in a thorough manner and applied by courses in refractory materials and general metallurgy which contains problems depending upon the composition and impurities of ores and gangues; by a course in ore dressing which treats of the separation of ores and impurities, and by a course in prospecting which treats of the presentation of ores and gangues at the surface and the rules for their discovery.

THE COURSE IN GEOLOGY

Freshman Year

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<tr>
<th>First Term</th>
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<tr>
<td>Algebra and Geometry</td>
<td>Analytic Geometry</td>
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<tr>
<td>Chemistry</td>
<td>Physics</td>
</tr>
<tr>
<td>Chemical Laboratory</td>
<td>German (3) or French</td>
</tr>
<tr>
<td>German (3) or French</td>
<td>Qualitative Analysis</td>
</tr>
<tr>
<td>Freehand Drawing</td>
<td>Blowpipe Analysis</td>
</tr>
<tr>
<td>Hygiene</td>
<td>English Language and</td>
</tr>
<tr>
<td>Rhetoric and Essays</td>
<td>Essays</td>
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<tr>
<td>American Literature</td>
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Summer Term, Land Surveying

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## Sophomore Year

<table>
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<tr>
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<tbody>
<tr>
<td>Elementary Mechanics</td>
<td>Calculus</td>
</tr>
<tr>
<td>Physics</td>
<td>Physics</td>
</tr>
<tr>
<td>Physical Laboratory</td>
<td>Mineralogy</td>
</tr>
<tr>
<td>Crystallography</td>
<td>Stoichiometry</td>
</tr>
<tr>
<td>Chemical Philosophy</td>
<td>French (2) or German</td>
</tr>
<tr>
<td>French (2) or German</td>
<td>Literature, critical and Essays</td>
</tr>
<tr>
<td>English Literature and Essay</td>
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</table>

### Summer Term, Topographic Surveying

### Junior Year

<table>
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<tr>
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<th>Second Term</th>
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<tbody>
<tr>
<td>Botany</td>
<td>Geology</td>
</tr>
<tr>
<td>Zoology</td>
<td>Biology</td>
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<tr>
<td>Petrology</td>
<td>Petrology</td>
</tr>
<tr>
<td>Blowpipe Analysis</td>
<td>Quantitative Analysis</td>
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<tr>
<td>Assaying</td>
<td>Economics</td>
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<tr>
<td>Quantitative Analysis</td>
<td>French (2) or German</td>
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<td>Economics</td>
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<tr>
<td>French (2) or German</td>
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<tr>
<td>Oratory</td>
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### Senior Year

<table>
<thead>
<tr>
<th>First Term</th>
<th>Second Term</th>
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<tbody>
<tr>
<td>Mining Engineering</td>
<td>General Surveying</td>
</tr>
<tr>
<td>Economic Geology</td>
<td>Metallurgy</td>
</tr>
<tr>
<td>Physiography</td>
<td>Mining Engineering</td>
</tr>
<tr>
<td>Mine Surveying</td>
<td>French</td>
</tr>
<tr>
<td>Descriptive Astronomy</td>
<td>Philosophy of Religion</td>
</tr>
<tr>
<td>French</td>
<td>Thesis</td>
</tr>
<tr>
<td>Geodetic Surveying</td>
<td></td>
</tr>
</tbody>
</table>

### Graduate Courses

Geology (3), Prof. Williams; Physiography (3), Mr. Barrell; Invertebrate Paleontology, Mr. Barrell, combined with Zoölogy, 1st and second terms, 2 hrs. each.
Course descriptions in geology, somewhat abbreviated, follow:

142. Megascopic Lithology. Determination of rocks which can be safely distinguished with the pocket lens, supplemented by ordinary chemical and blowpipe tests. Lectures and recitations followed by laboratory work on hand specimens. Prerequisite Mineralogy (3). First term.

144. Petrology. The optical properties of minerals and their study with petrographic microscopes . . . (2). 1st 2 months.

145. Petrology. The determination of rocks, their origin . . . (2). The last 7 months of the year. Deposit of $5.

146. Geology. A brief course in structural, dynamic, and historical geology for those who desire to pursue the subject as a cultural study . . . Prerequisite Mineralogy (3).

147. Geology. Structural and dynamic and historical geology. A broader course adapted to the needs of those who will use geology professionally . . . (4). Prerequisite Mineralogy and Zoology.

148. Economic Geology. Theories of the formation of deposits, their structure, geological horizons and geographical distribution (2). Prerequisites 146 or 147.

149. Physiography. The classification of land forms; their stages of development; their dependence on climate, and geographical distribution (3-5). Prerequisites 146 or 147.

151. Geological Surveying. The identification of rocks and tracing of boundary planes under capping. Forms of field notes. [This course included field work.] (2) Prerequisites 146 or 147.


At the time of the formation of an independent Department of Geology, certain required courses which we today associate with the curriculum were taught under "Metallurgy and Mineralogy".


129. Mineralogy. Elementary course in physical, chemical and descriptive Mineralogy with practical exercises in the determination of about two hundred of the more common mineral


These courses in the field of Mineralogy were transferred to the Department of Geology in 1908 when, as B. L. Miller remarks in his manuscript, “an amicable agreement was reached” (cf. post.) between the departments. The bachelor’s degree (B.S.) in Geology was discontinued in 1918, but in 1937 reappeared (B.A.) in the College of Arts and Science. Nevertheless, a geology major was available (two such were produced in 1921).

MODERNIZATION

The Department took on new life in 1907-8 when Benjamin Leroy Miller became Head. Miller had taught at Bryn Mawr, after completing his graduate work at the Johns Hopkins University. He remained at Lehigh until his death in 1944. Dr. Miller is remembered professionally chiefly for his monumental work, “The Limestones of Pennsylvania”. He was the author of many other publications, among them his bulletins on the Geology of Northampton and Lehigh Counties, which, like the “Limestones”, were issued by the Pennsylvania Topographic and Geologic Survey. Miller was primarily an economic geologist with emphasis on the non-metallic. Under his leadership new and expanded courses in that field were offered, both in the undergraduate and graduate categories. When an undergraduate subject as Economic Geology or Paleontology was offered also on the graduate level, the name was retained for the graduate course, but preceded by the adjective “Advanced”. Miller, doubtless from his own graduate experience at “Hopkins”, revised the curriculum, not only as to the courses in the Department, but stressed the importance of collateral studies in chemistry, physics, metallurgy and mining.

About the time that Miller took over the Department Chairmanship, Edgar T. Wherry joined the staff. Parenthetically, Barrell had
left to become Professor of Geology at Yale. Wherry was primarily a mineralogist and taught a new course in Chemical Crystallography. He was (and still is) one of those remarkable people who are famous in two sciences, in his instance, geology and botany. Eventually he became Professor of Botany at the University of Pennsylvania. Because of his dual knowledge he has contributed much to the relationships between plants and the outcrops on which they grow.

The staff continued to change, but the offerings remained fairly static for a few years. Among the teachers was John D. Irving already cited. He had been with the United States Geological Survey and was well-recognized for his work in economic geology in the West, particularly with S. F. Emmons in revising the “Leadville Monograph”. Irving joined the American Expeditionary Force as an engineer and died in France during World War I.

At the time of his death, Professor Miller was preparing a paper, “Geology at Lehigh, 1866-1941”. Unfortunately, it was never completed, but it has been referred to in writing part of the present history. Among other items which Miller described were “Equipment” and “Room Space”. The following paragraphs are quoted direct from the manuscript:

At no time has the Department of Geology been in possession of elaborate equipment but on the other hand it has always had all of the essential instruments, books, collections, maps, etc. Men in charge have had to be frugal throughout and at times resort to ingenious devices. The administration seems to have recognized the importance of the science and have been appreciative of the work done.

The chief expenditures have been for the purchase of microscopes. At no time have there been as many serviceable instruments on hand as could have been profitably used but efficient teaching of the microscopic phase has continued.*

*The Department still owns a “Leitz” petrographic microscope of the vintage of 1887. Although preserved as an heirloom, it is in working order.

The mineral, rock and ore collections have grown steadily. Some purchases have been made from time to time but the growth has come largely by gifts from faculty, students, alumni and other friends of the University. The teaching staff has made the most extensive contributions. Almost the entire collection of ores used in the instruction in Economic Geology has been brought together by the writer [Miller] and largely personally collected by him. These represent practically all the important mining districts of the United States, Canada, South America and several countries of Europe, Asia and Africa.

The collections of lantern slides and maps have been due almost entirely to the efforts of the writer.
The mineralogical collections were started by Prof. Roepper. His personal collection came to the University and the specimens continue to be labeled as the "Roepper Collections". In 1876 the "Keim Collection" of about 1,000 specimens was presented by the heirs of George Keim of Reading. Other generous donors have aided in the building of the collection.

Due to lack of room and sufficient funds for the purchase of suitable display cases there has never been opportunity to satisfactorily display the collections of the Department. This has never seemed to the writer to be a serious handicap. There has always been sufficient material in the collections to illustrate the subjects taught except in the case of Vertebrate Paleontology. Little work has been offered in this subject. For many years an annual trip has been taken to the American Museum of Natural History for the study of the extraordinarily fine collections of fossil vertebrates.

The instruction in Mineralogy and Geology was given in Packer Hall for a number of years. On the erection of the Chemistry building to house Chemistry and Metallurgy and Mineralogy courses being given by the Department of Metallurgy were transferred there. Geology continued to be taught in Packer Hall until Williams Hall was built in 1903. Since then all classes in Geology have met there as have all in Mineralogy since its transfer to the Department of Geology in 1908.

Miller's comments on room space and equipment are amplified in the Catalog for 1925-6. In Williams Hall, the Department occupied the west end of the first floor with two lecture rooms, two offices, a library, mineralogical museum and a laboratory for petrology and petrography. In these quarters were housed the collections of rocks, economic minerals and ores. Optical work was taught with the aid of "15 high-grade petrographic microscopes". The rock collection contained over 6,000 specimens. There was a meteorological observatory with recording instruments in the first floor corridor, electrically connected to an anemometer and windvane a-top the University Library next door.* In the basement of Williams Hall were the mineralogical

*The introduction of meteorology and the meteorologic station deserves a brief, if personal, comment from Willard. When he went on to graduate work at Harvard, so inclusive was his Lehigh preparation under Miller's guidance that the only undergraduate course he was required to take was Robert DeC. Ward's "Meteorology". When Willard passed this word on to Dr. Miller, it was not long before he, Miller, offered a course in Meteorology and had the weather station established. As will be patent further along, this same equipment figured in the Conservation Curriculum.

and blowpipe laboratories and a small chemical laboratory. Another
room contained a grinding lap and machinery for making thin-sections of rocks. Although the second floor was primarily biological territory, there was one room referred to as “the Paleontological Museum” (actually, it contained chests of drawers of dusty, poorly identified fossils). The third floor had office space and a laboratory with a Goldschmidt two-circle goniometer. There was a large drawing room shared with the Department of Mining Engineering.

The foregoing citations of equipment and building are subject to a few remarks by one who knew the Department a few years earlier as an undergraduate (Class of 1921). The distribution of the rooms and their occupancy was essentially the same as described. However, in 1921 the building was illuminated by gas jets, some graced with Welsbach mantles. The only power line into the Department was for the operation of the rock grinding and polishing tools. Dr. Miller had in his office the sole telephone. There were two freight elevators. They were hand operated. You climbed aboard and heaved on a vertical rope dangling inside the cage and slowly raised the car, should we say by its bootstraps. Needless to say, it was far easier to walk than ride up stairs. Finally, the drawing room on the third floor (then the top) was skylighted. When winter snow melted, some leaky panes dripped disconsolately upon the tables. But, we didn’t know any better, and “what you don’t know won’t hurt you”.

A few comments about the teaching: There were plenty of outdoor trips during Miller’s years. Street cars meandered throughout the Lehigh Valley and beyond, and by this means classes visited the cement and slate regions and way points to the north, the zinc mines (then abandoned pro tem) in the Saucon Valley, and to Hellertown to explore the Cave which was freely open to anybody who cared to enter. Once, under Professor F. F. Hintze, the class as usual rode the street car to Hellertown and walked to the cave. Professor Heintze caught a bat, wrapped it carefully in his pocket handkerchief and stuffed it in his jacket pocket to take home for the youngsters. Back on the street car, he forgot the little pet and sat on it. Injurious to bat, handkerchief and composure of the professor. An even more dramatic event terminated one of the zinc mine trips. The trolley across South Mountain to Center Valley was one of those four-wheeled “Toonerville” type. If enough of the class stood on the rear platform and did “setting-up exercises” in unison the vehicle commenced to see-saw in sympathy, so that the crew felt obliged to stop “her” until “she” settled down. One of the crew must have phoned ahead on one occasion, for when the class disembarked at Fourth and New Streets, the Bethlehem Police Force was there and marched the boys off for a hearing.
A bachelor’s thesis was required. Lloyd W. Fisher and Bradford Willard wrote one jointly on the geology of the Delaware Water Gap. On fine week-ends they’d catch the first car out of Bethlehem (6 a.m. about) for Nazareth, change for Pen Argyl, again change for Portland and there change once more on the last leg of the trip via a “jerkwater” line that squeezed through the water gap, zig-zagged up Godfrey Ridge and slid down into Stroudsburg. They arrived about noon and spent the rest of Saturday and all day Sunday in the field. Sunday night there was a R.R. train to Phillipsburg, N. J., where one changed cars for Bethlehem and could be back in time to snatch a few winks before Monday chapel at 7:45 a.m. Why didn’t those primitive people use automobiles? They were invented. Be it known, that it is distinctly recalled that among the Class of 1921, in its Senior year, only one student owned a “benzine buggy”.

The really outstanding trip was one which was made yearly and lasted the better part of a week. It was participated in by all upper classmen in geology and mining, and was strictly economic geology. The group boarded the morning train for Lebanon, Pennsylvania, there to change cars for a short ride to Cornwall, and the open cut iron mines. Thence, again by railroad, to put up at Pottsville and the following day visit one of the anthracite mines. Back to Bethlehem for a night’s repose, the class was off next morning for northern New Jersey by train to Easton and thence, more “steam cars” (Lehigh and Hudson River R.R.) to their objective. Two inspections were made. The first was to a subsurface iron mine near Oxford. The class was lowered by skip to the bottom of the shaft. Somehow, it was rather damp down under, and the skip operator didn’t stop quite soon enough. On to Franklin for the night, and next day, of course, was spent at the New Jersey Zinc operations. The high point of this visit was a revolving picking table where one could stand and grab choice specimens fresh from below. But, to return to our history.

An activity participated in by the students in the curricula of Mining Engineering and Geology as the Mining and Geology Club, later renamed the Eckfeldt Society in memory of Professor Howard Eckfeldt, Head of the Mining Department. The students usually met one evening a month to hear from leaders in their fields, men from the United States Geological Survey, State Surveys (Pennsylvania and New Jersey, chiefly), practicing geologists, mining engineers and visiting professors. An annual picnic or dinner was sometimes scheduled toward the end of the college year. Today, after the discontinuance of the Mining Curriculum, the geology majors continue the tradition with regular meetings of the Geology Club.
There were the usual turnovers in the staff, but Miller remained constant. At the time just prior to the First World War, the teachers were B. L. Miller, F. F. Hintze, Otto Van Schlichten, and B. F. Wallis. After the war, of this group only Miller continued. Replacements were Homer G. Turner and A. Henry Fretz. Professor E. H. Williams was still listed as Lecturer, but died shortly thereafter. During the late 1920's Charles H. Behre joined the staff. He is remembered for his extensive studies of the Slate Belt. In 1930-1931 Miller, Turner and Fretz were still present and to them was added (1930) Lawrence Whitcomb. Turner left soon thereafter, and Donald M. Fraser joined the Faculty. Whitcomb was destined to remain with the staff until his retirement in 1965, completing one of, if not the longest careers as a member. Besides being a respected teacher, Whitcomb is known for his original investigation of Ordovician bentonites. After a few years, Fraser joined the staff of the Bethlehem Steel Company. Robert D. Butler was briefly with the staff but left at the time of the Second World War, to be replaced by Duncan Stewart, whose residence was short when he resigned to become Department Head at Carlton College, Northfield, Minnesota.

In the fall of 1937, while Miller was on leave of absence, Bradford Willard of the Pennsylvania Topographic and Geologic Survey substituted in the Department, but returned to Harrisburg at midyear's. In 1939, when Miller retired, Willard reappeared to head the Department and remained a fixture until he, too, was retired, 1959. During the years Willard was with the State Survey he devoted most of his energies to unravelling the Devonian stratigraphy of Pennsylvania. Upon taking up the post at the University, he continued summer field work, mostly on the Cambrian and Ordovician of Pennsylvania. After his retirement, he carried on the identification of specimens of a large collection of fossils from Peru, donated to the University by Dr. Harvey Bassler who had spent some twelve years assembling the collection (see footnote, p. 25).

While Willard was "dictator" new faces came and went. Hugh R. Gault was appointed in 1945, and next year Frederick Betz joined the staff. The latter soon left, but Gault stayed on to succeed Willard as Head. Among all these recent staff members none was beloved by the students as was "Harry" Fretz. His inimitable "Hope Diamond Lecture" became an annual "must" while he taught, and has since been repeated for the benefit of the uninitiated. After his retirement, whenever one of the students who knew him drops in at the Department, he is sure to ask, "How's Harry Fretz?" The answer is, "He hasn't changed a might."
After the Second War, the student body swelled and the intumescence included geology majors, both undergraduate and graduate, the latter in response to the ever growing insistence among prospective employers that men have advanced degrees. By 1946, graduate assistants (part-time) were regularly hired to handle the increased number of sections in elementary laboratory instruction. Many of these men have become teaching geologists, others are in industry. From among the many alumni, a few random selections have been picked to indicate what has become of our majors. Naturally, these choices are intended to be impartial. It would be impossible to include everybody. A complete list of those receiving Lehigh degrees in Geology will be found in the Summary to this account.

Dr. J. Donald Ryan ('43) is now Department Chairman, having succeeded H. R. Gault who lived less than two years after taking office. Louis F. Dellwig ('43), following his assistantship, acquired his Ph.D. at the University of Michigan and now teaches at the University of Kansas. Robert E. Stevenson completed the doctorate (1950, our first earned doctorate) and at this writing heads the Department at the University of South Dakota. J. Peter Trewyer ('50) has a growing department which he inaugurated at Juniata College. William W. Virgin, another Ph.D. winner ('64), and yet another Thomas Mentzer ('63) are at Dickinson College, Virgin as Departmental Head. Robert C. Ramsdell ('43) and Charles Hamilton ('53) are members of the staff at Rutgers in Newark. A graduate of the Class of 1912 and Instructor in the Department in 1917, is C. A. Bonine. He later became Department Head at the Pennsylvania State University (then "College").

Other alumni, not all of whom were staff members or assistants, have attained geologic recognition. Dr. J. O. Fuller ('34) is Dean of the College of Arts and Science at the Ohio State University in spite of which he still does a bit of field work now and then. Kemble Widmer ('37) is State Geologist of New Jersey. Widmer succeeded Meredith E. Johnson, M.E. '18. In Johnson's day graduates in Mining Engineering were capable of becoming first rate geologists. A large proportion of our graduates, especially in the 1940's, obtained positions with oil companies as the Palmer Brothers, Richard and John (sons of Dean P. M. Palmer). "Dick" Palmer is now Assistant to the President of the Texas Company. J. Bracket Hersey (Ph.D. '43 in geophysics) carries out research at the Woods Hole Oceanographic Institution, and Allen Be ('52) is working with the Lamont Geological Observatory, Columbia University. Carl A. Warmkessel with three Lehigh degrees in Geology is Chief Geologist for the Lehigh Portland Cement Company, while Fred W. Wright is Assistant Vice-President of the Orinoco Mining
Company in Venezuela. B. Frank Buie (M.S. '32) is Chairman of the Geology Department at the Florida State University. Minchen M. Chow (Ph.D. '51) when last heard from was with the Institute of Vertebrate Paleontology at Academia Sinica, Peking, China. John H. Johnsen (Ph.D. '57) is Professor of Geology at Vassar College, while Eugene G. Williams ('50) has made a name for himself at the Pennsylvania State University. Edwin W. Roedder ('41) is well-known for his petrographic research with the United States Geological Survey. Among recent exportations is Owen P. Bricker (M.S. ’60) who earned his Ph.D. at Harvard and teaches at the Johns Hopkins University. Bruce K. Goodwin (Ph.D. '59) and a former Graduate Assistant, teaches at William and Mary, and another former Graduate Assistant and Ph.D. '59, Ernest H. Ern, is on the staff at the University of Virginia. A neighbor of his is W. C. Sherwood (Ph.D. '61) with the Virginia Survey.

In recent years, with the growth of offering of high school courses in geology, earth science and the like, the demand for competent teachers in such “disciplines” is growing. Several of our recent alumni have gone into that field, but usually have been required to attain a few extra credits in education courses before being awarded permanent certification. During Willard’s term of office, our recipients of the bachelor’s degree, who continued in graduate work, were spread among about thirty-five universities, and conversely, our graduate students other than our own men came from about an equal number of colleges and universities.

Under Willard’s regime, in accord with the changes in staff and the new members’ specializations, new courses were offered, old ones deleted. The predominance of Economic Geology was eased. Geochemistry came into recognition as did Geology of Mineral Fuels, which in part supplanting the old non-metallic economic geology offering. More field problems were added in the Senior year. Whitcomb’s “History of Geology” for graduates was in the fore. Stratigraphy became Stratigraphy and Sedimentation, and Willard added Applied Stratigraphy, North American Index Fossils and Geology of Pennsylvania. He even had the temerity to offer a graduate course in Vertebrate Paleontology, although he admitted he “didn’t know much about the subject, but liked to teach it.” Cartography, a one hour course, took up the growing use of aerial photographs and map interpretation. Heikki V. Tuominen from Finland (1957-1960) had a broadening influence in the “hard rock” category with his courses in metamorphic and igneous geology. Under supervision of the whole staff, two spring field excursions of three or four days duration were introduced. Sched-
uled for alternate years, the one visited central Pennsylvania, the other the State's southeastern counties and the New Jersey Coastal Plain.

In 1949 a new curriculum, Conservation, was opened. Its contents were split between Biology and Geology. Unfortunately, it was short-lived, but with its inception George R. Jenkins became a staff member as an expert in Meteorology, Climatology, Soil and Water Resources. After the extinction of the Conservation Curriculum, Jenkins joined the Lehigh Institute of Research of which he is now head.

The emphasis on field practice has long been recognized. Perhaps it seems today archaic, but the dictum that the field is the geologist's first laboratory was long established here. Therefore, in 1956 attendance by upper class majors at a recognized summer camp was recommended. Lehigh had none of its own. As an incentive to taking this intensive, uninterrupted study, those who received credit for such a course could be excused from some of the field work scheduled during the regular college year.

Early on the morning of January 7, 1956, disaster struck Williams Hall. Or was it a proverbial "blessing in disguise?" Over the 'phone came the word, "Williams Hall is burning!" Away in smoke and ashes went the roof and much of the third floor and its contents—furniture, books, papers, almost a total loss. The remaining stories were thoroughly water dowsed. It was indeed a sight to break the stoutest heart. Yet, the damage to the Department of Geology was less than had at first been thought—at least to the rooms and equipment in the basement and on the first floor.

Rather than restore the original upper floor and repair the ravages below, the University saw fit to repair the downstairs damage, and, before covering the top with a new roof, to add a fourth floor. For the first time in years there was room enough for offices, library, laboratories, lecture rooms and storage. The new roof does not leak. Because it is flat, it provides a convenient site for the exterior weather instruments. An open house was proclaimed when the new quarters were ready. One visitor, Professor Kirtly F. Mather, commented that this is the best housed department of geology for its size he had visited. So, the disaster was, after all a benefit. To those who knew the old and took up quarters in the new, the fire and reincarnation were the finest things that ever happened to the Department of Geology.

In the fall of 1959, Hugh Richard Gault took over the departmental chairmanship. Keith E. Chave was added to the personnel. His double experience in geology and marine science made him a welcome member through the opening of new fields of instruction. The regime under
Gault had hardly gotten under way when the new Department Head died. Fortunately, under the potentially bad situation, J. Donald Ryan took command in 1961. As an experienced staff member and an alumnus, he "knows the ropes". Ryan's more important contributions to geology are with the U.S. Geological Survey in the West, Wyoming and South Dakota—field investigations in the neighborhood of the Black Hills. He has also been interested in interpretations of recent photographs by the United States Government of the surface features of the moon.

Under Gault's leadership a number of new courses were introduced which tended to emphasize the application of chemistry to geology, as Chemical Geology, Techniques of Geochemistry and Industrial Minerals and Rocks plus new offerings on ores and ore minerals. Petrology and mineralogy underwent revision, and new courses in Marine Geology and Paleoecology were listed. In 1960, Dale R. Simpson joined the staff. There continued the usual turnover among the graduate assistants. The years 1961 and 1962 brought few important changes or additions save for Mineral Phase Relations by Simpson. In 1962, Paul B. Myers (Ph.D., Lehigh 1960) after teaching at Franklin and Marshall became a member of the permanent staff.

In 1963, the staff consisted of J. D. Ryan, Head, R. T. Gallagher, K. E. Chave, Lawrence Whitcomb, G. R. Jenkins, D. R. Simpson, P. B. Myers and A. C. Neumann. George L. Adair was carried as a lecturer in economic geology. Among the graduate assistants new names were J. R. Craig, G. B. Glass, J. W. Larimer and J. S. Nagle. A list of the new courses introduced in 1963 follows:

Geol. 14. Earth Materials Laboratory
Geol. 63. Introduction to Oceanography, Neumann
Geol. 201. Earth Science I—Geology
Geol. 202. Earth Science II—Meteorology and Astronomy
Geol. 301. Introduction to Geophysics, Gallagher
Geol. 302. Geophysical Prospecting
Geol. 312. Stratigraphy, Chave
Geol. 313. Sedimentation, Neumann
Geol. 336. Mineral Phase Relations, Simpson
Geol. 337. Sedimentary Geochemistry, Chave
Geol. 339. Techniques in Geochemistry, Neumann
Geol. 351. Geology of Fuels, Chave
Geol. 354. Elements of Mining, Gallagher
Geol. 437, 438. Igneous and Metamorphic Processes, Simpson and Myers
The demise of the Department of Mining Engineering in 1963 was doubtless warranted, but it was a shock to the older alumni who remembered the close relationships between it and Geology, particularly during the time of B. L. Miller and Howard ("Skipper") Eckfeldt, Head of Mining. Professor Robert T. Gallagher from heading the Mining Engineering curriculum was transferred, part-time, to Geology, thereby allowing the introduction of courses listed above as taught by him. New offerings in Geophysics by Dr. Gallagher were:

Geol. 401. Seismic Methods
Geol. 402. Electric Methods
Geol. 403. Magnetics and Gravity

In the 1965 Catalog is a description of the newly organized "Marine Science Center". Staffed by men who are biologists or geo-biologists, it is largely a research organization with quarters in Williams Hall, and ties in with the Bermuda Biological Station, thereby offering to geology majors an opportunity to learn at first hand the principles of marine sedimentation and ecology with their application to stratigraphy, paleontology and paleoecology.

TODAY—100 YEARS AFTER THE BEGINNING

As Department Head, Dr. Ryan in December, 1965, prepared for a visiting committee of well-known geologists a résumé of courses, staff members and other pertinent matters concerning the Department. This summary, somewhat condensed, is here reproduced.

SUMMARY REPORT
ON THE
DEPARTMENT OF GEOLOGY
LEHIGH UNIVERSITY

Proposed Major Program in Geology
1966-67

Freshman Year

First Semester

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>Geol. 1</td>
<td>Principles of Geology</td>
<td>(3)</td>
</tr>
<tr>
<td>Chem. 1</td>
<td>Chemical Principles I</td>
<td>(3)</td>
</tr>
<tr>
<td>Chem. 11</td>
<td>Chemical Principles I Lab.</td>
<td>(1)</td>
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Second Semester

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<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Geol. 2</td>
<td>Principles of Geology</td>
<td>(3)</td>
</tr>
<tr>
<td>Chem. 3</td>
<td>Chemical Principles II</td>
<td>(3)</td>
</tr>
<tr>
<td>Chem. 13</td>
<td>Chemical Principles II Lab.</td>
<td>(1)</td>
</tr>
<tr>
<td>Math. 22</td>
<td>Anal. Geom. &amp; Cal. II</td>
<td>(4)</td>
</tr>
</tbody>
</table>
Sophomore Year

Geol. 13 Sedimentation (3) Geol. 23 Structural Geol. (3)
Biol. 11 General Biology (4) Phys. 16 General Physics (3)
Phys. 1 Mechanics of Phys. 17 General Physics Lab. (2)
Mass Parts (3)

Junior Year

Geol. 301 Intro. to Geophysics (3) Geol. 311 Paleontology (3)
Geol. 333 Crystallography (3) Geol. 336 Mineral Phase Relations (3)
Chem. * (3)

Senior Year

Geol. 315 Regional Stratigraphy (3) Geol. ** (3)
Geol. 334 Petrol. & Petrog. (4)

*Chem. 39, 95, or 150

**Chosen with approval of major adviser from Geol. 281 (3), Geol. 282 (3), Geol. 302 (3), Geol. 337 (3), Geol. 351 (2), Geol. 354 (4), Geol. 357 (3), Geol. 363 (3).

All geology majors are required to take a course in field geology at an approved summer field camp operated by a College or University.

Some Figures on the Department of Geology,
Lehigh University

1. Staff:
   
a) Professors Emeriti ........................................ 3
   Professors Willard, Whitcomb, Fretz

b) Full-time teaching and research ............................ 6
   Professors Ryan, Chave, Myers, Simpson,
   Daetwyler, McLeroy

c) Half-time teaching, half-time administration .......... 1
   Dean Gallagher

d) Part-time lecturer and research director ............... 1
   Dr. Kullerud

e) Graduate teaching assistants ............................. 6
   Mrs. Force; Messrs. Force, Layton, Eby, Dygas, Moose

f) Fellows, research fellows and assistants .............. 9
   Messrs. Popper, Cormick, Flory, Schau, Moose,
   Roland, Strong, Suess, Taylor
2. Current student enrollment:
   a) Undergraduates ........................................ 19
   b) Graduates .................................................. 28*
       Total ....................................................... 47

   *Seven of these are registered for only one course and are not
candidates for a degree.

3. Degrees conferred during 25-year period 1941-1966:
   Bachelor's ..................................................... 157
   Master's ....................................................... 78
   Ph.D. (first degree given in 1950) .......................... 18

4. Where our graduate students come from:
   Graduate students presently in residence and candidates for
   an advanced degree hold degrees previously earned from the
   following colleges and universities:
   Acadia (Nova Scotia), University of Berlin (Germany), Buck-
   nell, Clark, City College of New York, Dickinson, Franklin and
   Marshall, University of Indiana, Johns Hopkins, Kansas State,
   Lehigh, Univ. of Massachusetts, Memorial (Newfoundland),
   Occidental, Univ. of Reading (England), Rutgers, Smith, Up-
   sala, Utah State, Yale, U. of Tulsa, Newark State College,
   Northwestern.

5. Ph.D. dissertations by year:
   a) 1951—Minchen Ming Chow
      "The Pennsylvanian Mill Creek limestone in Pennsyl-
       vania"
   b) 1950—Robert Evans Stevenson
      "Stratigraphy and structural geology at central New
       York"
   c) 1951—Carl Andrew Warmkessel
      "Geology in the vicinity of Fordwick, Virginia"
   d) 1957—John H. Johnsen
      "Schoharie Formation: A Redefinition"
   e) 1957—Satyabrata Ray
      "The Mineralogy of the Jacksonburg Formation in
       Eastern Pennsylvania and Western New Jersey"
f) 1959—Ernest H. Ern, Jr.
   "Bedrock Geology of the Randolph Quadrangle, Vermont"

g) 1959—Bruce K. Goodwin
   "The Geology of the Island Pond Area, Vermont"

h) 1960—Paul B. Myers
   "Geology of the Vermont Portion of the Averill Quadrangle"

i) 1961—William C. Sherwood
   "Structure of the Jacksonburg Formation in Northampton and Lehigh Counties, Pennsylvania"

j) 1962—F. T. Mackenzie
   "Paleocurrents in the Cloverly Group of Wyoming"

k) 1963—Robert B. Biggs
   "Deposition and Early Diagenesis of Modern Chesapeake Bay Muds"

l) 1963—Thomas C. Mentzer
   "Composition Trends in a Folded Gneissic Layer, Sussex County, New Jersey"

m) 1963—A. C. Neumann
   "Processes of Recent Carbonate Sedimentation in Harrington Sound, Bermuda"

n) 1964—William W. Virgin
   "The Structure and Petrography of the Concord Granite in the Concord Area, New Hampshire"

o) 1965—James Roland Craig
   "A Systematic Study of Phase Equilibria in the Ag-Bi-S System and Exploration of the Geologically Significant Portion of the Ag-Bi-Pb-S System"

p) 1966—Lynton S. Land
   "Diagenesis of Metastable Skeletal Carbonates"

q) 1966—John W. Larimer
   "The Petrology of Chondritic Meteorites in the Light of Experimental Studies"

r) 1966—George W. Roland
   "Phase Relations and Geologic Application of the System Ag-As-S"
6. Some notes on post graduation activities of Lehigh undergraduate and graduate majors:

a) Of the 157 men who received the B.A. degree during the 25-year period 1941-1966*:

*Honorary degrees were awarded by Lehigh University to the following geologists: E. H. Williams (1912), Joseph Barrell (1916), Barnum Brown (1934), D. F. Hewett (1942) and Harvey Bassler (1945). In 1965, Dr. Hewett received the Geological Society of America’s highest award, the Penrose Medal. Dr. Bassler gave the University his large collection of fossils from Peru and also his library of South Americana. Two alumni who distinguished themselves in geophysics were also awarded honorary doctorates, William Bowie (Class of ’95), Honorary ’22, and Nicholas Hunter Heck (Class of 1903), Honorary 1930. Harvey H. Stoek, ’87, taught geology at Lehigh briefly, then distinguished himself as a mining engineer and was awarded an honorary Sc.D. in 1922.

1) 53 have attended graduate school
2) 18 have earned the doctor’s degree
3) 30 others received the master’s degree
4) 7 presently are candidates for the doctor’s degree

b) It is estimated that about 75% of all geology degree recipients presently are employed as professional geologists.
1) Most are employed in the petroleum industry.
2) About 30 Lehigh degree holders are engaged in college or university teaching.

7. The Department as a part of the University

a) Service Courses: The courses offered by the Department are largely populated by students not majoring in geology. Two of these courses (Geol. 1, Principles of Geology, Geol. 2, Principles of Geology) are offered each semester; another of these courses (Geol. 63, Introduction to Oceanography) is offered only during the first semester. Registration figures for the first semester of the current year and pre-registration figures for the second semester follow:

<table>
<thead>
<tr>
<th></th>
<th>First Semester</th>
<th>Second Semester</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geol. 1</td>
<td>149</td>
<td>88</td>
<td>237</td>
</tr>
<tr>
<td>Geol. 2</td>
<td>33</td>
<td>61</td>
<td>94</td>
</tr>
<tr>
<td>Geol. 63</td>
<td>30</td>
<td>—</td>
<td>30</td>
</tr>
<tr>
<td>Totals</td>
<td>212</td>
<td>149</td>
<td>361</td>
</tr>
</tbody>
</table>
ADDENDUM BY THE AUTHOR HIMSELF

"The old order changes", some alterations are deadly slow, others are seismic. Course offerings, curricula evolve and may presently suffer extinction save as a vague memory. "Essential" topics of early days are deleted as fashion varies the emphasis. Teachers come and go—some stay for decades and finally die or decay in office, others vanish after a brief residence, and are heard of no more. There have been good, poor and mediocre teachers, ones to be remembered, and others the sooner forgotten the better. Some were recognized by Lehigh for their teaching ability and classroom performance, others for their research and publications, rarely has a man been recognized for both teaching and investigation. Not many in later years can have the broad background of yore and are omniscient in earth science. The age of specialization dominates.

As one who was an undergraduate when Lehigh was at the half century mark and as a teacher at the three-quarters period, it has been a privilege to be allowed to combine here personal reminiscences with known stories and traditions. In late years, the department chairmanship tends to become hereditary, for I succeeded my former mentor, B. L. Miller, and now (save for a brief interval), one of my own students takes over. It is a satisfaction indeed when nearing the state of fossilization to see my successor succeed. Although Dr. J. D. Ryan has his specialities, he is broadly cognizant of the ramifications of Geology today. He appreciates that a really good curriculum must at least sample generously as many of those branches as feasible.

SUMMARY OF STAFF MEMBERS WHO HAVE TAUGHT GEOLOGY AT LEHIGH FROM 1866

The following rosta include Professors, Associate and Assistant Professors and Instructors, but not Graduate Assistants. It has been compiled from notes by B. L. Miller and references to the University Catalogs.

Adair, George L., B.A. (Wisconsin, 1918).
Barrell, Joseph, B.S. (Lehigh, 1892), M.S. (Lehigh, 1897), Ph.D. (Yale, 1900), Sc.D. (Hon. Lehigh, 1916).
Behre, Charles H., Jr., B.S. (Chicago, 1918), Ph.D. (Chicago, 1925).

Brown, C. W., Ph.B. (Brown, 1900), A.M. (Brown, 1901).

Buch, Newton W., A.C. [Analytical Chemist] (Lehigh, 1901).


Burrill, Meredith F., A.B. (Bates, 1925), A.M. (Clark, 1926).


Chave, Keith E., Ph.B. (Chicago, 1948), M.S. (Chicago, 1951), Ph.D. (Chicago, 1952).


Daetwyler, Calvin C., B.S. (Syracuse, 1952), Ph.D. (Scripps Inst., 1965).


Fraser, Donald M., A.B. (Oregon, 1925), A.M. (Oregon, 1927), Ph.D. (Columbia, 1932).


Gilbert, Chester G., Ph.B. (Rochester, 1905).


Hintze, Ferdinand F., A.B. (Utah, 1908), A.M. (Utah, 1911), Ph.D. (Columbia, 1913).


Irwin, Joseph S., B.S. (Missouri, 1912), E.M. (Missouri, 1922).


Just, Evan, B.A. (Northwestern, 1922), M.S. (Wisconsin, 1925).

Kiefer, Herman E., B.A. (Lehigh, 1892), M.S: (Lehigh, 1894), Ph.D. (Lehigh, 1896).

Kimball, James P., A.M. (Goettingen, 1857), Ph.D. (Goettingen, 1857).


Lawall, Charles E., Jr., E.M. (Lehigh, 1914), M.S. (Lehigh, 1921).

McCaskey, Hiram D., B.S. (Lehigh, 1893), M.S. (Lehigh, 1907).


Miller, Benjamin L., A.B. (Kansas, 1897), Ph.D. (Johns Hopkins, 1903).

Miller, Edward W., B.S. (Lehigh, 1896), E.M. (Lehigh, 1897).


Peterson, Fayette B., C.E. (Lehigh, 1885).


Rock, Miles, C.E. (Lehigh, 1869).

Roepper, William Theodore

Rogers, James K., A.B. (Syracuse, 1927), A.M. (Cincinnati, 1929).

Shapleigh, Waldron, A.C. (Lehigh, 1871).


Stewart, Duncan, B.S. (Michigan, 1926), Sc.M. (Brown, 1930), Ph.D (Michigan, 1933).


Tuominen, Heikki V., Ph.Mag. (Helsinki, Finland, 1945), Ph.D. (Helsinki, Finland, 1957).


Williams, Edward H., Jr., B.A. (Yale, 1872), B.S. (Lehigh, 1875), E.M (Lehigh, 1876), Sc.D. (Vermont, 1912), L.L.D. (Hon. Lehigh, 1913).
GRADUATES IN GEOLOGY FROM LEHIGH UNIVERSITY

All degree categories are included. There are a few names of men who were graduated in other fields than geology, but eventually became geologists.

Abbott, F. R., B.S. '14  
(Deceased)
Adair, D. L., B.A. '51
Adams, H. J., B.A. '52
Adamson, J. H., B.A. '36
Agocs, W. B., Ph.D. '46
Ahrenholz, H. W., Jr.,  
B.A.-B.S. '38
Aldrich, M. J., M.S. '66
Anderson, F. J., B.A. '48
Apgar, H. K., B.A. '57
Ayers, W. B., B.A. '38
Bacho, A. B., Jr., B.A. '53
Banino, G. M., B.A. '64
Be, A. W-H, B.A. '52
Becher, A. E., M.S. '62
Bellerjeau, O. T., M.S. '52
Bergenback, R. E., M.S. '50
Bernstein, W. C., B.A. '54
Bertolet, R. C., B.A. '55
Bieller, L. G., M.S. '61
Biggs, R. B., B.A. '59, M.S. '61,  
Ph.D. '63
Bingler, E. C., B.A. '59
Bischoff, F. J., B.A. '61
Blank, L. F., B.A. '59
Blanco, N. W., B.A. '46
Bodder, J. M., B.A. '56, M.S. '60
Bolton, W. B., B.A. '53

Booth, R. C., B.A. '55
Bouline, G. D., Jr., B.A. '53
Bowman, D. A., M.S. '51
Bricker, O. P., M.S. '60
Brown, E. A., B.A. '41, M.S. '42
Browne, G. L., B.A. '36
Buie, B. F., M.S. '32
Burns, R. E., M.S. '50
Carlson, C. J., M.S. '50
Carroll, G. V., B.A. '43
Carroll, J. L., M.A. '59
Carter, G. M., M.S. '57
Carter, W. H., B.A. '43
Casiraghi, G. A., B.A. '51
Caster, B. W., B.A. '53
Charlesworth, L. J., Jr., B.A. '56
Chick, J. I., B.A. '57
Chow, M. M., Ph.D. '51
Claus, R. C., B.A. '56
Coburn, J. W., B.A. '36
Conklin, A. H., B.A. '42
Cowin, R. B., Jr., B.A. '43
Craig, J. R., M.S. '64, Ph.D. '65
Creel, J. P., B.A. '61
Dahlhausen, J. K., M.S. '57
Davidson, D. F., B.A. '48
Davis, S. H., Jr., B.A. '50
Dean, J. P., B.A. '33
Deily, R. L., B.A. '34
Delaney, J. R., B.A. '64
Dellwig, L. F., B.A. '43, M.S. '48
Deppe, T. P., B.A. '57
Derington, J. E., B.A. '55
Diehl, L. G., B.A. '40
Dixon, W. R., B.A. '56
D’Olier, W. L., Jr., B.A. '48
Donohoe, H. V., B.A. '66
DuMontelle, P. B., M.S. '57
Eby, G. N., B.A. '65
Edelstein, W. S., B.A. '58
Eichhorn, N. D., B.A. '52
Emery, J. R., B.A. '61
Engel, J. A., B.A. '31, M.S. '34
Ern, E. H., Jr., M.S. '57, Ph.D. '59
Erney, R. C., B.A. '53
Essig, H. G., B.A. '51
Ewing, Maskell, B.A. '39
Feakes, W. L., B.A. '62
Fiedler, F. J., B.A. '57
Fishel, J. J., B.A. '40
Fisher, A. L., B.A. '40
Fisher, L. W., B.A. '21 (Deceased '51)
Fisher, R. C., B.A. '64
Fitter, W. W., B.A. '57
Fleck, W. P., B.A. '52
Fox, F. L., B.A. '54
Fraunfelter, G. H., B.A. '48
Freeland, G. L., M.S. '54
Fuller, J. O., B.A. '34
Gaines, W. L., B.A. '53
Galow, G. E., B.A. '49
Gard, T. M., M.S. '64
Genther, F. J., B.A. '56
Gilroy, R. W., B.S. '14
Glass, Gary, M.S. '65
Good, F. R., B.A. '56 (changed name from Gut to Good)
Goodwin, B. K., M.S. '57, Ph.D. '59
Goth, J. H., Jr., B.A. '47
Graham, T. K., M.S. '59
Grow, G. C., B.A. '38
Hale, P. F., B.A. '57
Halliday, N. H., B.S. '48
Hamilton, C. L., B.A. '53
Hamlen, D. A., B.A. '58
Harris, M. L., B.A. '38
Haselton, J. D., M.S. '63
Hatfield, E. R., B.A. '55
Heany, F. M., B.A. '56
Heck, W. A., B.A. '48
Heinzerling, W. P., B.A. '57
Hersey, J. B., Ph.D. '43
Hewett, D. F., Jr., Met.E. '02
Hitzrot, H. W., Jr., M.S. '65
Hoffaker, B. F., Jr., B.A. '46
Holmes, J. A., III, B.A. '52
Holtvedt, J. A., B.A. '51
Holtzman, S. R., B.A. '32
Howells, Lewis, M.S. '60
Hopping, R. A., B.A. '35
Horak, G. C., M.A. '59
Horvath, M. J., B.A. '51
Hutton, C. W., B.A. '35
Irving, R. W., B.A. '54
Jablonski, L. A., B.A. '58
Jadamec, J. R., B.A. '61, M.S. '62
Jennings, David, B.A. '64
Jensen, R. C., B.A. '44
Johnsen, J. H., Ph.D. '57
Johnson, M. E., E.M. '18
Johnstone, R. A., B.A. '57
Jones, A. M., Jr., B.A. '62
Jones, Evan, B.A. '46
Joyce, J. E., B.A. '49
Kell, J. A., M.S. '52
Keller, D. L., B.A. '52
Kenly, R. G., Jr., B.A. '53
Kidder, J. H., B.A. '42
Klinger, R. F., B.A. '42
Knowlton, K. B., M.S. '56
Kuhn, F. G., B.A. '38
Lake, Simon, III, B.A. '37
Lamb, D. C., Jr., M.S. '55
Land, L. S., Ph.D. '66
Langstroth, W. T., M.A. '49
Larimer, J. W., B.A. '62, M.S. '63, Ph.D. '66
Lawall, C. E., M.S. '21
Layman, F. G., M.S. '52
Lees, C. A., III, B.A. '57
Lein, C. A., M.S. '57
Lenox, W. E., M.S. '57
Lessentine, R. H., M.S. '52
Limons, R. A., B.A. '50
Loder, Theodore, M.S. '65
Lohse, J. W., B.S. '33
Long, M. A., M.S. '51
Lowe, W. O., M.S. '49
Luckenbach, L. J., B.A. '19
Lutsey, R. A., Jr., M.S. '58
McCallum, J. A., M.S. '58
McConnell, C. L., B.A. '64
McGuken, J. G., M.S. '59
McInerney, R. M., B.A. '43
MacGregor, L. M., B.A. '52
MacFadyen, J. A., Jr., M.S. '50
Mackenzie, F. T., M.S. '59, Ph.D. '62
MacPhee, A. V., B.A. '60
Malcolm, D. C., Jr., B.A. '52
Manley, F. N., Jr., B.A. '57
Marshall, E. E., Jr., B.A. '35
Matzko, J. J., B.A. '42
Meissner, C. R., Jr., B.A. '48
Mentzer, T. C., M.S. '58, Ph.D. '63
Meyerson, A. L., M.S. '61
Miller, C. P., B.S. '52
Miller, D. H., B.A. '39
Mills, J. R., M.S. '49
Moyer, G. L., B.A. '49
Munford, J. R., B.A. '44
Murphy, D. L., B.A. '51
Myers, P. B., Jr., M.S. '57, Ph.D. '60
Myers, P. B., B.A. '32, M.S. '34
Naimi, A. I., B.A. '62
Nagle, J. S., M.S. '64
Neumann, A. C., Ph.D. '63
Noble, D. C., B.A. '65
Noel, J. A., B.A. '49
O'Brien, G. D., B.A. '49
O'Connell, J. F., B.A. '55
Olson, H. J., B.A. '53
O'Neill, W. F., B.A. '39, M.S. '40 (Deceased '53)
Otten, W. J., B.A. '50
Pachman, J. M., B.A. '56
Palmer, J. T., B.A. '48
Palmer, R. B., B.A. '43
Petersen, R. G., B.A. '46, M.S. '48
Phillips, H. J., B.A. '55
Phillips, R. W., B.A. '32
Pomeroy, J. S., B.A. '51
Pursell, D. D., B.A. '57
Puskus, F. P., M.S. '61
Quick, A. N., B.A. '52
Rader, H. LeR., M.S. '51
Raine, J. W., B.A. '52
Ramsdell, R. C., B.A. '43
Randolph, J. M., B.A. '51
Randolph, J. R., M.S. '54
Ratway, Joseph, B.A. '38
Ray, Satyabrata, Ph.D. '58
Read, E. W., M.S. '53
Rentschler, J. S., B.A. '54, M.S. '62
Reppert, Richard, M.S. '55
Resch, N. K., B.A. '60
Rhindress, R. C., M.S. '66
Robertson, David, B.A. '58
Rodgers, J. A., M.S. '62
Roedder, E. W., B.A. '41
Roland, George W., M.A. '64, Ph.D. '66
Rolfsen, J. A., Jr., B.A. '54
Roloson, C. L., B.A. '40
Rooth, G. H., M.S. '60
Rosalsky, M. B., B.A. '32
Ross, N. L., B.A. '48
Royer, R. Z., B.A. '50
Rudd, P. B., B.A. '54
Ryan, J. D., B.A. '43, M.S. '48
Rynearson, G. A., M.S. '41
Sabol, R. G., B.A. '60
Schlottman, A. W., B.A. '51
Schoonover, S. J., B.A. '61
Schwendinger, W. W., B.S. '48
Scovil, C. E., B.S. '52
Seebald, J. W., B.A. '53
Semmel, T. H., B.A. '47
Serman, R. C., B.A. '49
Seward, R. C., B.A. '49
Shear, R. R., B.A. '37
Sheppard, R. C., B.A. '65
Sheridan, C. B., Jr., B.A. '37
Sherwood, W. C., Ph.D. '61
Shields, J. A., B.A. '39
Siegrist, J. G., Jr., B.A. '56
Skinner, W. S., M.S. '48
Small, F. A., B.S. '51
Smith, P. C., B.A. '43
(Deceased '50)
Smith, R. C., B.A. '46
Smythe, J. A., B.A. '43
Sneden, R. J., B.A. '56
Snodgrass, H. E., Jr., B.A. '29
Snyder, W. P., B.A. '44
Speed, F. R., B.S. '12 (Deceased)
Spink, W. J., B.A. '57
Staley, Richard, B.S. '64,
M.S. '65
Stapleton, R. P., M.S. '65
Stephenson, T. E., M.S. '47
Stevenson, R. E., Ph.D. '50
Stingelin, R. W., M.S. '59
Stocker, R. L.; B.A. '64
Taylor, R. N., M.S. '50
Tierney, E. M., B.A. '17
Tooker, E. W., M.S. '49
Torrens, J. R., B.A. '40
Tremel, P. S., B.A. '44
Trexler, J. P., B.A. '50, M.S. '53
Turner, P. A., B.A. '57
Van Alen, William, M.S. '52
van de Kamp, P. C., B.A. '62
Van Ness, C. G., M.S. '60
Vine, A. C., M.S. '40
Virgin, W. W., M.S. '55,
Ph.D. '64
Wakefield, R. E., B.A. '57
Walker, John, B.A. '52
Walters, F. C., B.A. '25
Walters, Robert, B.A. '51
Ward, A. D., B.A. '52
Warmkessel, C. A., B.A. '30,
M.S. '42, Ph.D. '51
Watson, R. L., B.A. '65
Wehnau, R. A., B.A. '55
Weicker, R. W., B.A. '35
Weiler, K. A., M.S. '55
Weitz, J. H., M.S. '40
Wertman, R. L., B.A. '56
Weysser, J. L. G., E.M. '37
Whalen, S. L., M.S. '57 (Mrs.
A. M. Stock)
Wheeler, B. D., M.S. '61
Widmer, Kemble, B.A. '37
Wilkens, R. A., M.S. '53
Willard, Bradford, B.A. '21
Willard, Gates, B.A. '51
Williams, C. R., B.S. '14
(Deceased)
Williams, E. G., B.A. '50
Williams, F. H., B.A. '39
Williams, R. J., B.A. '66
Williamson, A. J., M.S. '33
Wolle, P. C., B.A. '53
Woodruff, K. D., M.S. '61
Worzel, J. L., B.S. '40
Wright, F. W., Jr., B.A. '42
Yost, C. W., B.A. '52
Young, R. C., B.A. '61
Young, R. W., B.A. '58