PENNSYLVANIA GEOLOGY

PENNSYLVANIA GEOLOGICAL SURVEY
150TH ANNIVERSARY
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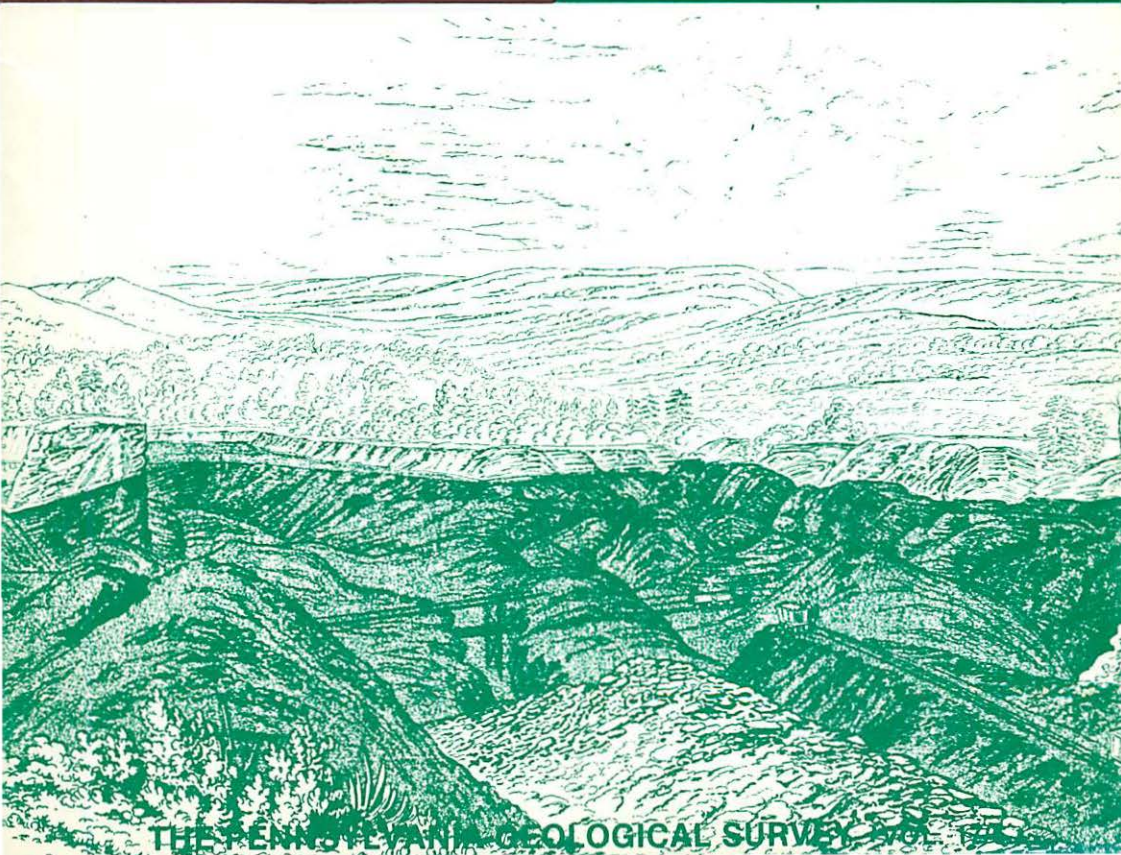

THE PENNSYLVANIA GEOLOGICAL SURVEY, VOL. 15

COMMONWEALTH OF PENNSYLVANIA
Dick Thornburgh, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
John P. Krill, Acting Secretary

OFFICE OF RESOURCES MANAGEMENT
Patrick J. Solano, Deputy Secretary

TOPOGRAPHIC AND GEOLOGIC SURVEY

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ON THE COVER: Reproduction of a portion of a copper plate lithograph entitled "Part of Summit mine of Lehigh County, looking west", sketched by George Lehman, an artist employed by Henry D. Rogers in the 1840's to illustrate *The Geology of Pennsylvania, a Government Survey,* published in Philadelphia, Pa. in 1858.

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CREDIT WHERE CREDIT IS DUE

The success of any organization is firstly the success of an individual, and only secondarily the success of the organization. Our Survey is composed of geologists, hydrogeologists, clerks and typists, cartographic draftsmen, administrative and statistical assistants, laboratory technicians and a librarian, all of whom have worked, in most cases, for many years as civil servants. They have devoted themselves to providing the best possible geological and hydrogeological information about our Commonwealth.

Recently three of the Survey's staff were honored by our Department and were given awards for excellence in their individual jobs. If our Survey is in any way perceived as providing excellent public service it is due to the efforts of such people as these. And they are but a sampling of the bureau's personnel, all of whom can be considered for such awards in their own project or program responsibility. And thus we give credit where credit is due to—

JANET L. WOTRING

WILLIAM D. SEVON

CHERYL COZART

Mining Today—Rising to the Challenge[1]

by Ann Dore McLaughlin[2]

The mineral industry today faces challenges that will test severely the ability, creativity, and flexibility of its managers, and I see these challenges reflected in this "compass-word"—competition. It is sometimes misunderstood. Cynics do not believe in it. But I know this audience understands competition. You see more competition in one day than most businesses see in a lifetime. Because of the abundance of coal in this Nation, domestic producers have to compete vigorously among themselves for a market. Also, you have seen nuclear power swallow a portion of the traditional utilities market. You see some cement plants recently switching to natural gas. You see Australia, Canada, South Africa, and, most notably, Colombia offering coal in the international market at increasingly competitive prices. You see the price of oil dropping to the point that new coal-fired generating plants currently are uneconomical to build. You saw the highest barrier to overseas sales was not some foreign tariff, but our own bloated dollar!! So, there is nothing I can really tell you that you haven't learned first hand and long ago about this "compass-word" competition.

The most influential economist of our time is not Lord Maynard Keynes, with his brief for hugh government spending, but an Austrian most Americans have never heard of—Joseph Schumpeter. Schumpeter saw the key to the effectiveness of a free economic system in what he called "creative destruction." By that he meant those endeavors that are unable to respond to changing needs and demands are destroyed by those more creative endeavors that see the needs and respond to them. The main thrust of his economic theory is that capitalist society owes its dynamism, its capacity to produce the most for the greatest number at the lowest price, to the creative destruction caused by the unremitting pressure of competition. Anyone who has studied the way our system operated from the very beginning knows this to be a hard fact of industrial life. There must have been conventions

[1]Excerpted remarks presented to the American Mining Congress Coal Convention, Pittsburgh, PA, May 5, 1986. Although primarily intended for an audience of coal producers and related service industries, these remarks contain some thought provoking questions and challanges that face Pennsylvania's entire mineral industry. Full text is presented in the USBM (1986), Minerals and Materials, April/May, p. 1-5. Reprinted with the author's permission.

[2]Under Secretary of the U.S. Department of the Interior.

of the American Society of Buggy Whip Makers even while Henry Ford was tinkering around the barn.

It is clear from this example that it was not just something called "competition" that whipped the buggies. It was rather two other aspects of any economic system that isn't stone dead or controlled by the state. First, a changing environment; and, second, an incapacity to see that the environment is changing, or an unwillingness to adjust, or both.

Now, what am I leading up to? That the coal industry is the equivalent to making optional equipment for horse-drawn vehicles? Far from it. Even as we all see the clouds currently over the industry, we know that somewhere down the road, after much sweat, blood, and tears, you are going to be covered with sunshine. OPEC, like a volcano, is only sleeping. Nobody is creating more oil, worldwide demand is rising, and the oil being found is more expensive to drill. One of these days we will all be back once again on the coal standard. But, meanwhile, how do we get from here to there?

We have to realize that the environment has changed. The nuclear genie, despite the accident in the Ukraine, will not be pushed back into the atom. Concern about the environment will not go away. The demand for safe workplaces is not a sometime thing. And you are determined to be creative rather than destroyed. If you wish to rise to the challenge of competition and change, what must be done? Where do you begin? What do I suggest? Five keys. These five important, vital, interrelated steps are, first, look within; second, measure strength; and third, fourth, and fifth, commit yourselves to innovate, innovate, innovate.

Looking within we find an industry facing substantial domestic competition from oil and, due to the now global reach of technology that has broadened the competitive base internationally, a potential competitive challenge from overseas producers. Traditional market expansion appears very modest, and profit margins are probably thin due to the modest growth potential and the ability of the industry at present to easily absorb this growth within existing production capacity. In short, I see the industry approaching a period of heightened competition with all the potential for "creative destruction" noted by Schumpeter.

Key number two, measuring strength means recognizing that trends are not fate, that while competition is a hard fact of life, change can be harnessed. I am distressed by the reaction of some in the industry, who list a parade of horribles—starting with reduced investment in research and development—that sound very similar to a bureaucratic response to budget cuts. It is a bureaucratic truth that, if your office is faced with a budget cut, you respond by cutting the most important, most visible program you have. Thus, in the case of National Park Service, the first action you take is reducing the hours or closing the doors to Washington Monument.

This brings us to the main point of my comments - the need to innovate, innovate, innovate. On a level playing field we can compete with, or we can outcompete with, anyone if we build on our strength and cure our weaknesses. As Peter Scott, Chairman and CEO of Emhart Corp., put it in a recent Wall Street Journal op ed piece, ..."In our cozy maturity we looked at our remarkable manufacturing accomplishments and thought we saw, reflected, the whole course of our future. A guaranteed future. "We were wrong. Dead wrong!" he adds. "We were wrong because we didn't see that what made America strong is our history of rejecting guaranteed future. We became what we were because we worked, and risked, and invented. "Competitiveness cannot be legislated. We have to become more competitive by changing our fundamental thinking."

There have been recent innovations in the coal industry, of course. But where is the determination to conduct major, focused research and development? Where are the research institutes and centers, the intense search for new ways to mine coal, to use it, to break it down into new products, to contend through science, not legislation, with environmental constraints? To develop new markets?

The challenge you face is cause to look deep into the very fundamental assumptions about how you do business and where the future lies and to act, not react, to develop your competitive edge.

New Staff of the Pennsylvania Geological Survey

Antonette K. Markowski

Antonette K. Markowski joined our Bureau in June, 1986 as an Oil and Gas Geologist assigned to the Pittsburgh office. Toni will engage in investigations on the oil and natural gas geology, stratigraphy and structural geology of subsurface rocks of Pennsylvania, and provide geologic service to requestors of information on oil and gas geology.

Toni has a B.S. degree in Earth Science/Environmental Education from Shippensburg University in 1978 and did graduate work at Millersville University and Southern Illinois University.

Toni previously worked as a Geologic Aide for the Bureau of Topographic and Geologic Survey in the Harrisburg office and we welcome her back.

Michael E. Moore

Michael Moore joined the Bureau of Topographic and Geologic Survey in June, 1986 as a hydrogeologist in the Environmental Geology Division. His current assignment is a study of the groundwater resources of Warren County.

Mike brought to the Survey a Penn State Bachelor of Science Degree in geology and more than eleven years of applications in the fields of geology and engineering. While the majority of his experience is in the environmental aspects of bituminous coal mining, he has participated in projects ranging from the cleanup of hazardous waste spills to the design of wastewater treatment plants.

Dawna S. Yannacci

Dawna S. Yannacci joined the Environmental Geology Division of the Bureau of Topographic and Geologic Survey in Harrisburg as a hydrogeologist in October 1986. Her initial work will include participation in a cooperative study with the U.S. Geological Survey on the aquifer characteristics of the rocks of Pennsylvania.

Dawna was raised in Darragh, Westmoreland County, Pennsylvania and graduated from Juniata College in 1981 with a BS in geology. She received an MS degree in geology from Kent State University in May, 1986. We welcome Dawna to our staff.

New Survey Publications Pennsylvania's 1985 Oil and Gas Developments

The Bureau of Topographic and Geologic Survey has released its annual report of the oil and gas industry in Pennsylvania for 1985. The industry reported 4,657 new wells drilled in the Commonwealth during 1985, a 79 percent increase over the number reported in 1984, and it broke the old record of 4,224 wells reported that was set in 1982. The total included 2,471 oil wells, 1,894 gas wells, 77 combination oil-and-gas wells, 104 service wells, and 111 dry holes. Although the number of dry holes increased by 83 percent from 1984, the "success" rate for all wells drilled remained at 98 percent. Oil production for 1985 was 4,850,968 barrels, and gas production was 150,541 million cubic feet, for a total value of approximately $596 million. Recoverable oil reserves declined slightly to 53,007,000 barrels, and gas reserves increased slightly to 1,979,369 million cubic feet. Some interesting exploratory and development highlights continued expansion of fields in Clearfield and Centre Counties, and the discovery of Macedonia pool in Erie County.

The oil and gas developments report for 1985 is replete with facts and figures such as these. It includes information on all aspects of oil and gas drilling, production, and exploration in Pennsylvania. Other topics of interest include natural gas storage areas, geophysical activity, oil and gas prices, drilling costs, activities on state lands, and summaries of all the new wells reported during the year.

The new Survey report is Progress Report 199, **Oil and Gas Developments in Pennsylvania in 1985**. Copies of the report are available from the State Book Store, P. O. Box 1365, Harrisburg, PA 17105 for $2.55 plus 15¢ sales tax for Pennsylvania residents. Checks made payable to the Commonwealth of Pennsylvania must accompany the order.

FREDERICK AUGUSTUS GENTH -- QUINTESSENTIAL SCIENTIST

by John Barnes
Pennsylvania Geological Survey

Laboratory of the University of Pennsylvania,
Philadelphia, December 31, 1874.

Prof. J. P. Lesley,
State Geologist:

SIR: – In obedience to instructions, I have prepared and have now the honor to submit the accompanying *Preliminary Report* on the Minerals found in the State of Pennsylvania.

These words, written in the formal manner that was the custom a century ago, begin the first state-sponsored survey of the mineralogy of Pennsylvania, undertaken as a part of the Second Geological Survey of Pennsylvania. They were written by a man who, by training, temperament, and experience, was well-qualified to undertake such a formidable task.

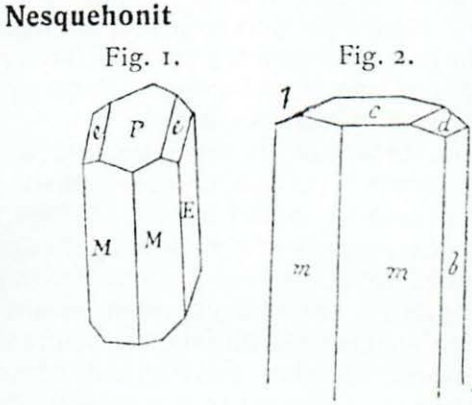
Friedrich August Ludwig Karl Wilhelm Genth was born on May 17, 1820, in the village of Waechtersbach, in the German state of Hesse; the son of the high warden of the forests to Prince Issenbourg. It is from his father that Friedrich is said to have received early training that developed his powers of observation and his interest in the natural sciences (Barker, 1902).

The young Genth received formal training at the Hanau Gymnasium, the director of which called attention to his great interest in the natural sciences. After studying chemistry, geology, and mineralogy at the University of Heidelberg, he continued his studies by specializing in chemistry at the universities at Giessen and Marburg. Upon receiving his doctorate from the University of Marburg, he remained there for three years as assistant to his mentor, the emminant Professor Robert Wilhelm Bunsen (Barker, 1902; Myers and Zerfoss, 1946).

In 1848, Genth left Marburg, and Germany, and sailed to Baltimore. He soon established a chemical laboratory in Philadelphia, which he left in 1849 when offered a position as superintendent of a mine in North Carolina. In 1850 he returned to Philadelphia, where he was to remain, reopening his private laboratory, establishing relationships with the Geological Survey, the Pennsylvania Board of Agriculture, and the University of Pennsylvania, all while carrying out independent research projects on subjects of interest to him (Barker, 1902; Myers and Zerfoss, 1946).

Genth's work in mineralogy was prodigious not only in quantity, but also in scope. As his reputation grew, and he established contacts with the leading scientists of his day, specimens of interesting minerals from many places were submitted to him for his analysis. He shared the results of his work through proceedings of the American Philosophical Society and the Philadelphia Academy of Natural Sciences, and especially through a series of papers called "Contributions to Mineralogy," most of which were published in the *American Journal of Science.* Most of these papers presented news of activity in the Genth laboratory, which might include a study of apophyllite from the Bay of Fundy (Genth, 1853a), aciculite from Beresofsk, Siberia (Genth, 1855), a "so-called Gibbsite" from Chester County (Genth and Penfield, 1890b), or an occurrence of arsenate of cobalt with pyrite at French Creek, Chester County (Genth, 1890). A single paper included descriptions of lanthanite from Bethlehem, bismuthine from Sweden, and wavellite from Chester County (Genth, 1857). One topic in which he took special interest was the serpentine bodies of Chester and Lancaster Counties, and the associated chromium ore (Genth, 1862b, 1866). In an open letter to Professor Dana, he stated that the discovery of a large crystal of "chrysolite" (olivine) from "...the great (or once great) chrome mine, called Wood's mine...confirms my views as to the parent rock of the serpentine and talc of the chrome region" (Genth, 1866, p. 120), a view that is still held today, that the serpentine formed from alteration of olivine.

Nesquehonite, a mineral originally discovered in Schuylkill County and first described by F. A. Genth (Genth and Penfield, 1890a). (Illustration from Goldschmidt, 1920).



Genth observed the conventions of courtesy, but he was not one to look the other way when he felt that his work was unfairly questioned. For example, in one installment of "Contributions to Mineralogy" he states:

> It is with great regret that I feel it my duty to investigators to call their attention to several omissions and misapprehensions in Rammelsberg's great work, "Mineralchemie," which I consider of too much importance to be allowed to pass unnoticed. Not intending to write a criticism of the work itself, I will limit my remarks to those investigations only, which have been made in my laboratory either by myself or under my immediate supervision (Genth, 1862a, p. 204).

He then proceeds to present two pages of such remarks, such as this answer to a question concerning one of his analyses:

> My analyses are of course open to re-examination by any chemist, provided he uses the same material upon which I operated and equal care, and criticisms based upon such re-examinations are perfectly justifiable. But wherever that has not been done, I earnestly protest against an author casting a shadow of doubt over my investigations, when I know that all pains have been taken to furnish reliable information (Genth, 1862a, p. 205).

Genth described several new mineral species, among them lansfordite and nesquehonite from Schuylkill County (Genth and Penfield, 1890a), penfieldite from Laurion, Greece, named for the crystallographer with whom he collaborated in his later years (Genth, 1892), and "owenite," which Genth collected himself at Harpers Ferry, Virginia (now West Virginia) (Genth, 1853b), but which he soon withdrew after recognizing it as identical with thuringite, claiming he had placed "too much confidence in Prof. Rammelsberg's analysis, to think it would need a repetition, since the difference was about 16 pr. ct. of alumina" (Genth, 1854, p. 411).

Other topics to which Genth devoted his time, and which he addressed in publications outside the "Contributions to Mineralogy" format, included a study of the Gap Nickel Mine, Lancaster County, published in Germany shortly after his arrival in America (Genth, 1851). He also studied unusual white plant fossils from the anthracite fields of Schuylkill County (Genth, 1879) and discovered that they are composed of the mineral pyrophyllite, a discovery that that is still news to many people one hundred years later. He took an interest in the discovery of gold at Sutter's Mill, California, publishing a report on the minerals associated with gold in that state (Genth, 1852). Closer to home, after panning sand and gravel from a cellar on Arch Street in Philadelphia, finding magnetite, ilmenite, zircon, garnet, and olivine, he wrote, "The observed mineral generally accompany gold, but not a particle of the latter could be found. This negative result, however, does not prove its absence..." (Genth, 1871, p. 439). Genth also devoted much effort to formulating a concept concerning the role of corundum as a primary mineral in

pegmatites, from which many other minerals were proposed to have formed by alteration (Genth, 1873, 1882). Unlike his idea of primary olivine being the source of serpentine bodies, this concept has not stood the test of time. Experimental evidence has indicated that a magma is not likely to contain sufficient alumina to form appreciable quantities of primary corundum (Deer and others, 1962).

Genth spent eight years associated with the Second Geological Survey of Pennsylvania, beginning in 1874 (Lesley, 1886). During this time he remained in Philadelphia. His most significant lasting contribution in that role was undoubtedly his *Preliminary Report on the Mineralogy of Pennsylvania,* published in 1875. This 238-page report gave descriptions, physical properties, localities, and some chemical analyses for 173 minerals known to exist in Pennsylvania at that time. Of that total, 14 are not considered mineral species today and 23 were not verified as occuring in Pennsylvania as of 1975 (Smith, 1978). This means that of the 276 species verified for Pennsylvania according to Smith (1978), an impressive 136, or 49%, were known to Genth a century earlier, before the advent of X-ray diffraction, electron microprobes, and other modern methods of mineral identification!

Pennsylvanian plant fossils composed of the white mineral first identified by F. A. Genth as pyrophyllite (Genth, 1879). (Specimen from St. Clair, Schuylkill County, collected by Alan R. Geyer).

One year after this *Preliminary Report* appeared, a *Second Preliminary Report on the Mineralogy of Pennsylvania* was published (Genth, 1876), containing updated information on some species, information on an additional species (strontianite), and data on the waters of certain springs in Pennsylvania. The letter of transmittal to the State Geologist, Professor Lesley, indicated this to be a report of progress for the year, and suggested that further work would be done on investigating the "crystallographic peculiarities" of the minerals, which had not been dealt with in either volume. He also indicated

that the study of rock bodies was of great importance. "Henceforth, I intend to devote the greater part of [my time] to this very important subject, in order to embrace the results of the labors of some of your assistants and my own, in a Lithology of Pennsylvania" (Genth, 1876, p. vii).

But the *Lithology of Pennsylvania* did not appear, nor did any further reports on the mineralogy of Pennsylvania. Genth's association with the Second Geological Survey continued until 1882 (Lesley, 1886), but the only other published report that we have covering this period is a section of *The Geology of Philadelphia County and of the Southern Parts of Montgomery and Bucks,* by Charles E. Hall (Hall, 1881). The contribution by Genth, co-authored by his son, F. A. Genth, Jr., consisted of numerous chemical analyses of rocks of that region. According to Hall's letter of transmittal to Governor Hoyt, the analyses included in this report represented only a portion of the work of Genth, "...special lithological investigations of these and other rocks of the State, by Dr. Genth are reserved for publication in his own Mineralogical Report" (Hall, 1881, p. v), a report, again, that did not materialize. We can only presume that Genth conveyed much valuable information to the Second Geological Survey in unpublished form.

Genth's contribution to the understanding of the mineralogy of Pennsylvania was by no means the first by the Pennsylvania Geological Survey. In the report of the First Geological Survey, H. D. Rogers included an extensive list of "Localities of well-characterized crystalline minerals within the gneissic districts of Pennsylvania" (Rogers, 1858, p. 709-711), among other contributions. But Genth's work has left us a milestone, the *Preliminary Report on the Mineralogy of Pennsylvania* being, to our knowledge, the first comprehensive report dealing with the mineralogy of the entire state. It established a base upon which others have built, in particular as seen in the series of mineralogies of Pennsylvania by Gordon (1922), Montgomery (1965), and Smith (1978).

A short article such as this cannot even list all of Genth's accomplishments, much less properly discuss the many ramifications that his work still carries. As we have seen, Genth's interests were not centered only on Pennsylvania, or even on the subject of mineralogy. Among his publications are analyses of Egyptian obelisks, the soils and waters of Palestine, and Chinese coins; experimentation with wood gases; and a series of reports on the analysis of fertilizers for the Pennsylvania Board of Agriculture (Barker, 1902; Myers and Zerfoss, 1946). Genth appears to have been a man of great talent, inexhaustable energy, and wide-ranging interests, who was fortunate enough to be able to apply his talent

and energy toward a greater understanding and appreciation of the world. That he was able to channel a portion of that talent and energy toward the efforts of the Second Pennsylvania Geological Survey is one of the things that we celebrate as we look back this year; a significant part of the history and traditions of this 150-year-old institution.

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In Memorium

Robert C. Fenton

Robert C. Fenton, a staff member of the Topographic and Geologic Survey in the Bureau's Pittsburgh office, died August 19, 1986 in Pittsburgh from complications following skin-graft surgery. Bob, who was a native of the Pittsburgh suburb of Blawnox, came directly from high school graduation to work for the Oil and Gas Geology Division of our Survey as a Laboratory Technician. He spent the early part of his 15 years with the Survey preparing oil and gas well-cutting samples and assisting in geological laboratory work. For the last ten years, however, Bob's primary responsibility had been accurately locating new oil and gas well locations on the Division's oil and gas maps, a vital part of the Survey's commitment to providing quality information to the public.

Bob's quick wit and sharp sense of humor were an important and familiar part of the Pittsburgh office. He was rarely at a loss for a joke and was capable of enlivening any situation with his seemingly inexhaustive supply of one-liners.

Bob, who was only 32, is survived by his wife, Mary Beth, and their daughter Molly. He will be sorely missed by his colleagues in

Pittsburgh, other Bureau staff who shared the laughter from his wit, and by the users of the Bureau's maps on which Bob painstakingly plotted with care and accuracy.

Norman K. Flint

Dr. Norman K. Flint, Professor Emeritus of Geology at the University of Pittsburgh, died at his home on October 18, 1986 after a short bout with cancer. He was 65 years old. At the time of his retirement in 1983, Dr. Flint, or Norm to those of us who knew him, had spent 35 years at the University of Pittsburgh teaching, conducting or overseeing research, and consulting.

Many readers will remember Dr. Flint, perhaps, for his report, "Geology of Southern Somerset County", which was published by the Pennsylvania Geological Survey as County Report 56A. He authored or co-authored two dozen published technical and three dozen unpublished consulting reports during his career. He became well known in the mid-1960's for his work on landslides and other geological hazards in the Pittsburgh area.

Despite these activities, however, Dr. Flint will be best remembered as an outstanding teacher who was totally committed to his students, whether in the classroom or the field.

In addition, Dr. Flint will be remembered as a scientist who contributed his geological abilities to his community.

With the death of Dr. Norman K. Flint, Pennsylvania and the science of Geology have suffered a great loss.

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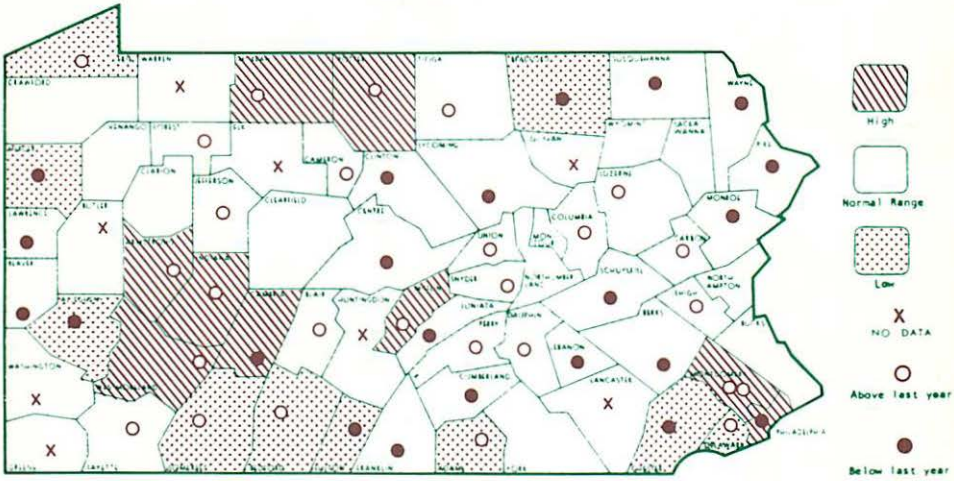

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