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IN MEMORIAM: ROLAND E. BOUNDS, 1953-2002

Roland Bounds, President of the Friends of Mineralogy, Pa. Chapter, died on Friday, October 18, 2002, after a short illness. Several days later, members of the Chapter gathered together with members of the Delaware Geological Survey, where Roland worked, and many friends for a Memorial Service. Eric Meir, a Chapter member and Roland's partner in "Broken Back Minerals," and his wife, Chrissy, prepared a moving tribute to Roland, read at the service, and published in the Delaware Mineralogical Society's November, 2002, newsletter, edited by Diana Volchek. It seemed to the Chapter editor that these words, written by a couple who knew so many aspects of Roland's life, would be most appropriate here, and of interest to F.M. members who know and appreciate his service to the Chapter.

Eric spoke, as follows, at the Memorial Service:

"The Delaware Mineralogical Society lost a longtime member and a great friend when Roland Elliot Bounds passed away on Friday, October 18, after a short illness. Roland's interest in minerals began when he was about 12 years old, and he joined our club soon after. His display cases were always a welcomed addition to our annual show. They won many ribbons! In addition to their aesthetic quality, he frequently included humor into his themes, such as his recent exhibit of round formations titled, "It Takes Balls." Roland was also a regular fixture on club field trips, both locally, and as far away as Aurora, North Carolina.

He was always willing to volunteer his time, and held numerous committee and officer positions within the DMS. He was also active in the Friends of Mineralogy, where he held officer positions at both the regional and national levels. He became the first recipient of a research grant to perform master's degree research into the minerals of the Cedal Hill Quarry.

Roland was a partner in Broken Back Minerals. He traveled extensively in search of the perfect specimens for his personal collection, and also for the business. His favorite destination was his annual nine-day trip to the Tucson, Arizona, show. Roland would always drive, so that he would have his collecting tools handy, and to have room to transport numerous purchases back to Delaware. When the available funds were spent (usually within two days), the remainder of the trip would be spent visiting family, sightseeing, and visiting well-known Arizona collecting sites.

He was also an avid collector of Herkimer diamonds. He would make several trips a year to Herkimer, N.Y., in search of the perfect Herkimer specimens. His collection of matrix Herkimer specimens from Saint Johnsville is spectacular! Roland's other favorite collection destinations included the Hot Springs area of Arkansas and the Bancroft area of Ontario. Roland had many other interests. He had an extensive collection of stamps, coins, and postcards. He was an avid reader (3-5 books a week), and had a large library of both mineral and science fiction books. He loved to attend science fiction conventions, and would go to several conferences a year.

He loved adventure! He traveled to many exciting places like Alaska and did exciting things such as white water rafting on the Grand Canyon River. He was a nature lover and an avid sportsman, who enjoyed going on the target range and fishing on the Bay.

His love for the sport of hockey is also noteworthy. He was the biggest fan for the University of Delaware ice hockey team. He attended all of the home games, and went to many of the away games. He sat with a group of good friends who were also vocal fans. At one game, Roland and his friends had so many comments for the refs that the refs sent a pizza to the hecklers in an attempt to silence them. It didn't work for long!

Roland was a twenty-two-year veteran of the Delaware Geological Survey, and was responsible for most of the Survey's drilling prospects and water level testing in the state.

Roland loved life! It is difficult to imagine how one person could find enough hours in a day to take part in such a diverse range of activities. He had a great sense of humor and even a routine trip with him could be an

A TRIBUTE TO ROLAND BOUNDS

adveenture. All his past recipients will miss the off-color Christmas cards that Roland sent each year. As busy as Roland was, he always had time for his friends. He would always welcome their calls, and join them at any gathering he could. His presence will be sorely missed.

My family and I will greatly miss Roland, and our Broken Back Mineral followers will be broken-hearted as the news of his passing spreads. He was such a unique blend of great qualities that he could never be closely imitated, let alone replaced.

We will miss you, Roland, our fellow mineral collector, our friend."

Chrissy Meir composed this unusual tribute for the Memorial Service:

"**R** stands for the well RESPECTED man you were. Anyone who ever came in contact with you knew they could trust you, because you treated them with respect. Your values will be remembered, and we will all will try our hardest to live by them ourselves in your loving memory.

O stands for the OUTSTANDING friend you were. You touched many lives by sharing your time, your skills, your hobbies, and just your overall love of life. We will comfort each other by sharing stories of our times with you, and your spirit will be with us.

L stands for the LAUGHTER that you filled our homes, offices, and general surroundings with. Nobody had a better sense of humor than you! We will all keep the sight of you shaking with laughter, with your eyes squeezed shut, embedded in our memories.

A stands for the ADVENTUROUS spirit you had. Many of us had the pleasure of taking vacations with you, and seeing first hand how adventurous you could be. There will be many people sharing memories of rock collecting trips, trips to Alaska, white water rafting trips, etc. Even a trip to a hockey game with Roland Bounds could be considered an adventure! We will keep your spirit alive by sharing the stories of those adventures when we embark on new adventures.

N stands for the NATURE expert you were. Your love for nature was overwhelming. You were intrigued by the beauty of nature: you studied hard to learn all about the beauty of nature, and you taught others to appreciate the beauty of nature by sharing your knowledge so willingly. We will continue to teach others what you have taught us, so that the world can continue to be enriched by your knowledge.

D stands for the DELIGHTFUL person you were. Your presence will be sorely missed. You were a wonderful conversationalist! Your were the life of our gatherings. Although our gatherings will never be the same without you, we will take comfort in knowing that our lives were enriched by having you in them, and that we will be together someday. REST IN PEACE."

CHAPTER BUSINESS

Fall Symposium, 2002

The Fall Symposium, on pegmatites, was dedicated to Roland Bounds. Excellent talks on the subject were followed on Sunday by an interesting field trip to three "Gordon localities," led by Joe Dague and Jay Lininger. Fifteen members found various interesting minerals at historic Avondale Quarry, Corundum Hill, and Poorhouse Quarry, Chester County.

The Chapter's Future

Despite our loss with the passing of President Roland Bounds, the Chapter is alive and well. Members of the Chapter Board gathered at the Fall Symposium to discuss the future of the Chapter. It was agreed to have a meeting of the Board at Jay Lininger's home in Dillsburg, on Jan. 19. Already, several Board members have offered to fill in, or exchange, various positions, and Roger Mitchell has offered the facilities of the Delaware Institute of Science in Media for the 2003 Fall Symposium. Now is the time for members to volunteer to fill the Board roster.

RECOLLECTIONS OF THE DISCOVERY IN 1949 OF THE GRACE MINE IRON DEPOSIT AT MORGANTOWN, BERKS CO., PA.

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Background

Dr. Fraser, the Chief Geologist at Bethlehem Steel, was credited with the discovery of additional iron ore at the Company's historic Cornwall Mines near Lebanon, Pa., by means of ground magnetic surveys. Then, in 1948, the Company's Geology Department contracted with Aero Service Corporation in Philadelphia to make aeromagnetic surveys of the major Triassic basins in Pennsylvania, since these were known hosts for several important Cornwall-type iron deposits. Technical equipment for airborne magnetometer surveys had been developed by Gulf Research and Development Co., just before World War II, and improvements were made during the war through research for the U.S. Navy, which was interested in anti-submarine detection. An Aero Service geophysicist, William Agocs, was assigned to Bethlehem Steel to help evaluate the numerous magnetic anomalies shown on the new aeromagnetic maps. Two of the most promising anomalies were near Morgantown, Berks Co., Pa., and at Pine Swamp, near Warwick, Chester Co., Pa. A portion of the Morgantown aeromagnetic map (Bromery and Zandle, 1959, et al.) is shown on Fig. 3, p. 7. The latter surveys were flown in 1957 by the U.S.G.S. in cooperation with the Pennsylvania Geological Survey, about nine years after the the initial surveys for Bethlehem Steel.

Aeromagnetic surveys were a tremendous advance over the traditional ground magnetic surveys. They can cover large areas quickly, and at modest cost, with no need for permission from landowners. They can also cover very rough terrain without difficulty. The aeromagnetic surveys became important not only for discovering buried mineral deposits, but also were helpful in mapping subsurface geology and structure, therefore becoming a standard and useful tool for both oil and mining companies. The Grace Mine anomaly, identified in 1948, was the first instance of an ore discovery resulting from an airborne magnetometer survey (Sims, 1968, p. 109).

Drilling the Magnetic Anomaly at Morgantown

Land acquisition was quietly undertaken by Bethlehem Steel, covering the most promising anomalies. The first core drill was delivered to the Morgantown site on September 1, 1949 (Bingham, 1957, p. 45) My job was to "sit" on the rig and log the drill cores. I rented a room in Honey Brook, a few miles from Morgantown, so as not to attract attention. There was a lot of speculation by local residents after the purchase of groups of farms in the area, and, later on, by visits to the drill site by newspaper reporters and others trying to find out what we were up to. We were careful not to divulge anything. When we began, there was a single daylight shift at the drill, but progress was slow, often due to mishaps. The drill hole collared in Triassic red beds, sandstones, shales, and conglomerates of the Brunswick Formation, and later reached the basal Stockton Formation (Sims, 1968, Table II, p. 111). The drill cores often contained disseminated pyrite, which helped keep us interested as we did the logging.

People in the Bethlehem office soon became nervous, wondering if the anomaly might not actually amount to anything important, so a second shift was added at the drill site to speed

things up. Another geologist came down from Bethlehem to log core during the day shift, and I took over from around 4 p.m. in the afternoon to 11 p.m. in the evening. Finally, on December 19, 1949, iron ore was hit at a depth of 1524 feet. I was at the rig that afternoon, and we could see that something was up when the drill cuttings suddenly changed color from red to black. However, I decided to wait to see the drill cores, to be really sure it was iron ore, and then drove in to Reading in order to assure some privacy while phoning Dr. Fraser at his home. He and George Adair, a senior geologist, and a couple of Bethlehem Steel vice-presidents drove down to the drill site, arriving about midnight with a bottle of bourbon. We were all pretty excited! Even at this point, the experienced geologists at Bethlehem Steel were quite sure a major iron deposit had been discovered.

Geology and Ore Genesis

The Triassic red beds here were deposited on an ancient erosion surface formed on folded Cambrian strata, so the contact represents a profound unconformity, and also marks the top, or hanging wall, of the orebody. The iron ore was dominantly magnetite, which accounts for the prominent magnetic anomaly (Fig. 3, p. 7). The main accessory minerals were pyrite, chalcopyrite, and, locally, pyrrhotite. Less common were sphalerite, marcasite, galena, hematite, digenite, and goethite (Sims, 1968, p. 116-117). The magnetite mineralization replaced a large wedge of impure Cambrian limestone already altered to calcium and magnesian silicates by contact metamorphism from the thick, subjacent intrusive sheet of diabase (Sims, 1968, p. 122-123).

Sims further contends that after cooling and crystallization of the diabase, the altered limestone was invaded by mineralizing solutions, presumably from the same magma chamber that yielded the earlier diabase intrusives. Along with the introduction of magnetite and its accessory minerals, the silicate minerals in the altered limestone were hydrated and converted to serpentine, talc, chlorite, and tremolite, the main gangue minerals. The No. 1 drill hole cut over 400 feet of ore, followed by about 25 feet of weakly mineralized limestone, and, finally, about 20 feet of nearly pure tremolite in contact with the thick (up to 1200 feet) diabase sheet (Sims, 1968, Fig. 6, p. 121). Sims gives a summary description of the drill cores, including assays and mineral contents in Fig. 6. Other figures (Fig. 2, 3, and 4) in the same reference show a geological map of the mine area, a 3-dimensional block diagram, and a plan map of the orebody.

Discovery Leads to Grace Mine Development

I recall that the No. 2 drill hole (Fig. 1, p. 6) was spotted about 1000 feet south of the No. 1 discovery hole. Surprisingly, it was a blank hole, due to the abrupt termination of the orebody in that direction. In the meantime, several truck-mounted drills were moved into the area. I also recall one or another of the drill holes purposely drilled through the diabase to see if iron ore occurred along its lower contact. Bingham (1957, p. 45) stated that by January, 1951, the orebody had been delineated by 17 drill holes, averaging 2200 feet deep; mine development was then initiated. The new operation was named the Grace Mine in honor of Eugene C. Grace, the chairman of Bethlehem Steel at the time, and an enthusiastic supporter of the Company's exploration program. Bingham (1957, p. 47-48) added that the mine, having been designed

to produce 9600 tons per day of crude ore grading 42.5% iron, would yield about 5760 tons per day of iron ore pellets, averaging 65% iron. Design capacity of the mine and plant on a yearly basis were, respectively, 3,000,000 tons per year (tpy) of crude ore and about 1,500,000 tpy of iron ore pellets. Mine production began in 1958 (Sims, 1968, Table I, p. 110) and he lists annual outputs of crude ore for 1958 through 1964. Maximum production during that period was 2,911,054 tons of iron ore in 1962.

Sims (1968, Figs. 3 and 4, p. 113-114) reported that the orebody is roughly tabular, about 3500 feet long by 700 to 1500 feet wide, and from less than 50 feet to over 400 feet thick , ranging in depth from 600 to 2200 feet below sea level. It was estimated to contain about 118 million short tons of ore (Eben, 1996). The ore was concentrated, using magnetic separators, then pelletized for shipments to one or another of the 3 nearby Bethlehem Steel plants. Tailings from the magnetic separators were treated in a pyrite flotation plant, and the pyrite concentrate then shipped to Bethlehem's Sparrows Point, Md., sulfuric acid plant. Copper, cobalt, and gold were recovered from Cornwall ores, but only copper from Grace Mine ores, because of their lower contents of cobalt and gold (p.c., S.J. Sims, 1992).

Ground Checking of Some Prominent Airborne Magnetic Anomalies: A Near Miss

Personnel from Cornwall Mines took over the drilling program at Morgantown after a couple of months, and I was assigned to assist a senior geologist, Dick Lake, for field checking some of the other anomalies on the new aeromagnetic maps. We started near Gettysburg, and worked back towards the office in Bethlehem. One of our last projects, before I left to attend graduate school in September, 1950, was a ground magnetic survey of the major Pine Swamp anomaly near Warwick, Chester Co., Pa. We used a Hotchkiss Superdip instrument (Fig. 2, p. 6), and made a series of north-south traverses covering the anomaly. It was later drilled by Bethlehem Steel, and an iron deposit discovered, in this case replacing the Precambrian Franklin Marble, as at the nearby French Creek Mine. However, I was told that the deposit was not considered economic to mine. The Pine Swamp locality is also near the formerly important Jones, Hopewell, and Warwick Mines, but was not mined in the old days, because it was deeply buried, like the Grace Mine orebody, and had not been detected.

Successes Cut Short

The Grace Mine had a long and productive life. and was an important contributor to the regional economy. Employment peaked at 1,100 in the early 1970's (p.c., C.F. Eben, 2002). An air photo of the surface plant taken in 1977 gives some idea of the size and scale of the operation (Fig. 4, p. 8). Production began in 1958, and was suspended in 1977 due to depressed conditions in the U.S. steel industry, plus the fact that underground mining is much more expensive than in the increasingly important open pit operations. Barnes and Smith (2001, p. 19 and 24) report that at the time of closure a zone of ore 480 feet thick, and richer in copper, had been outlined by drilling to the northeast. A total of 45 million tons of crude ore were produced at the Mine, which compares favorably with the total of 106 million tons of iron ore produced at the Cornwall Mine between 1742 and June 30, 1973. Closure at Cornwall, like that at the Grace Mine, was premature. Serious flooding of the mine workings at Cornwall resulted from the heavy rains accompanying Hurricane Agnes in 1972, and it was decided to cease operations at the Mine.

THE GRACE MINE, BERKS CO., PA.

Acknowledgments

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Sims, S.J., 1968, *The Grace Mine Magnetite Deposit, Berks County, Pennsylvania*, Ore Deposits of the United States, 1933-1967, J.D. Ridge, ed., The Graton-Sales Volume, American Institute of Mining, Metallurgical, and Petroleum Engineers, Vol. I, p. 108-124.

Fig. 1: The No. 2 Drill Hole at the Morgantown Site. For scale, note the figure on the tripod platform. (collection of the author)

Fig. 2: The author with the Hotchkiss Superdip instrument at the Pine Swamp Anomaly, near Warwick, Pa. (collection of the author).

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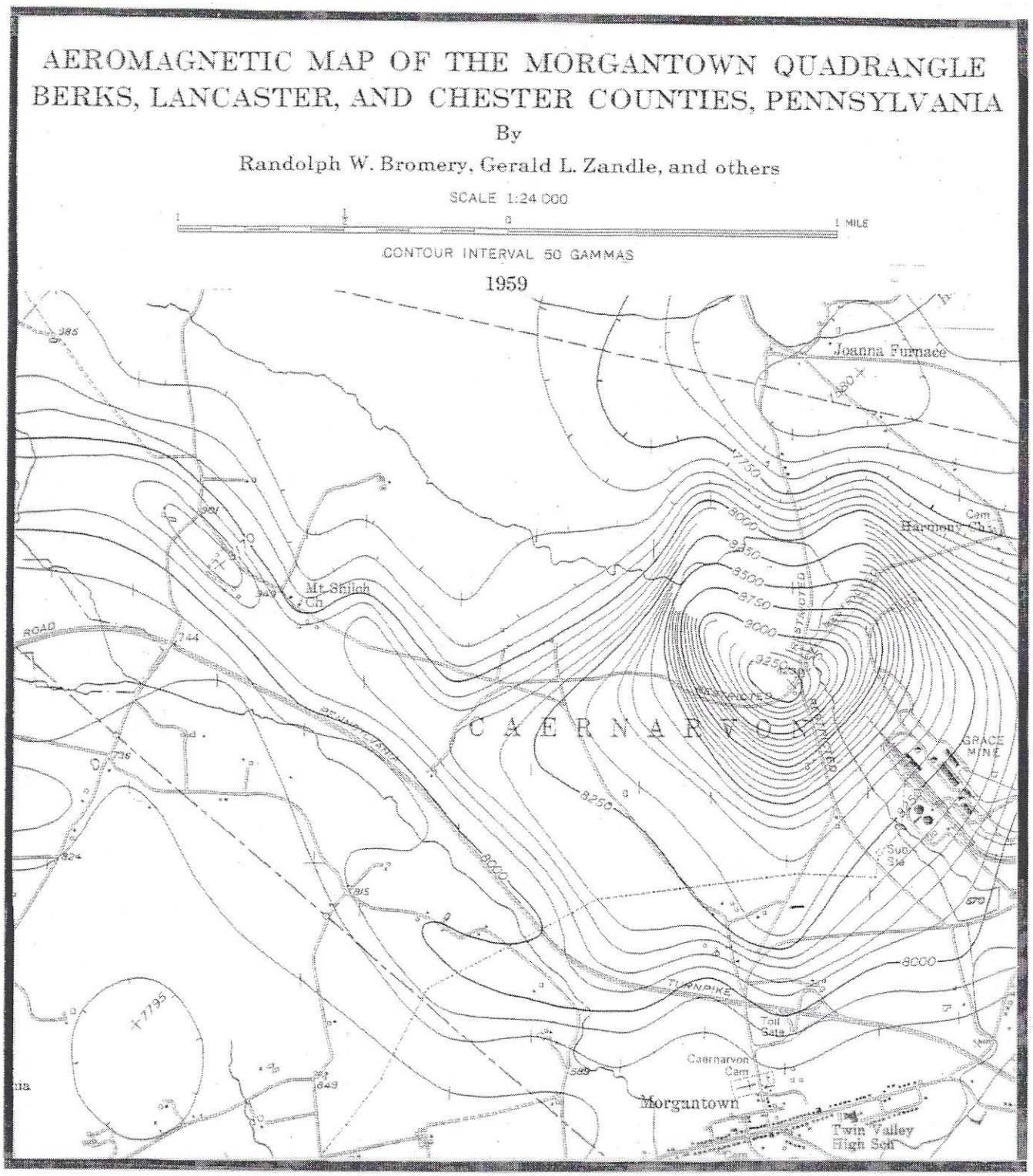

Fig. 3: Portion of an aeromagnetic map of the Morgantown Quadrangle showing the anomaly at the Grace Mine iron orebody (Bromery and Zandle, et al., 1959).

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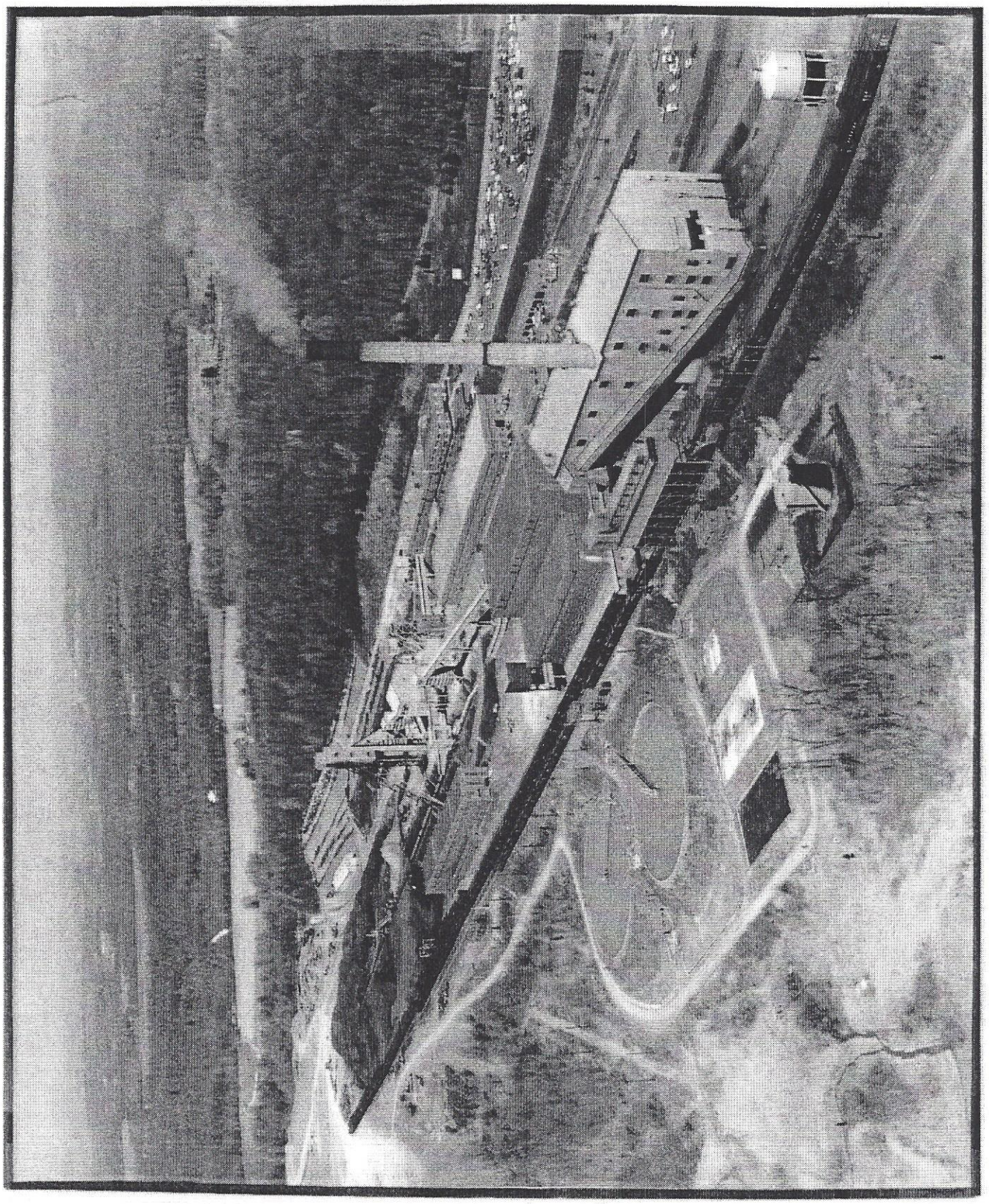

Fig. 4: The Grace Mine surface plant (an air photo taken in 1977, collection of S.J. Sims).