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Coal And Its Mineral Matter*

By A. W. Gauger[1]

Coal as mined contains varying quantities of inorganic compounds (mineral matter) which, on combustion, result in the residue known as ash. The weight of residue does not as a rule equal the weight of the mineral matter originally in the coal because of the chemical changes that occur during the ashing process. The ordinary chemical analysis of the ash presents its result in the form of a mixture of oxides with little or no clue to the identity of the mineral species originally present in the coal. Only in the case of pyritic and sulfate sulfur is an attempt made to determine the mineral component.

The ordinary methods of ash analysis are concerned with nine variables, namely: silica, alumina, lime, iron oxide, magnesia, titania, oxides of sodium and potassium and compounds of phosphorus. Of these nine variables, compounds of silicon, aluminum, calcium and iron make up the greater proportion of the coal ash; compounds of the other five occur in lesser quantity. According to Fieldner and Selvig (1), the chemical composition, although varying widely in different coals, in general comes within the following limits:

TABLE 1. TYPICAL LIMITS OF COAL ASH ANALYSES

	Per cent
Silica, SiO_2	40—60
Alumina, Al_2O_3	20—35
Ferric oxide, Fe_2O_3	5—25
Calcium oxide, CaO	1—15
Magnesium oxide, MgO	0.5— 5
Titanium oxide, TiO_2	0.5— 3
Alkalis, $Na_2O + K_2O$	1— 4

Thiessen, Ball and Grotts (2) have reached a similar conclusion, as is indicated by the following quotation, "Examination of numerous coal ash analyses, calculated to a sulfur-trioxide free basis, indicates that over 95% of all coal ash is composed of alumina, silica, ferric oxide, lime and magnesia. The magnesia content is frequently negligible. The remaining 5% includes such items as sodium oxide, potassium oxide, phosphorus pentoxide, chlorine, titanium oxide, together with analytical errors."

RARER ELEMENTS IN COAL

The results of several investigations have appeared indicating the presence of a large number of chemical elements in the ash of some coals. Thus Fuchs (3) has reported in the ash from brown coal near Cologne the elements shown in Table 2.

TABLE 2. ELEMENTS FOUND IN GERMAN BROWN COAL ASHES

Gravimetric Analysis Per cent		Spectrophotographic Analysis 10^{-6} Per cent	
Ca	35.56	Cu	100—1000
Fe	10.74	Ba	10— 100
Mg	4.86	Pb	10— 100
Si	3.31	Sr	10— 100
Al	1.60	Bi	10— 100
Na	2.30	Ni	10— 100
K	0.19	Zn	10— 100
Mn	0.35	Ti	10— 100
P	Traces	Au	1— 10
C,O,H,N,S	Also present	Ga	Traces
		Ge	Traces

Goldschmidt (4) has considered the concentration of rare elements, as compared with the average percentage in the earth's crust, which occurs in ashes of many (but not all) coals. Table 3 gives data for a number of such elements; the data refer to percentages and are representative only for such ashes as show the phenomenon of enrichment.

TABLE 3. RARE ELEMENTS IN ASHES OF COAL AND IN THE EARTH'S CRUST

Element	*Maximum percentage*	*Ave. percentage of "rich" ashes*	*Percentage in earth's crust*	*Factor of enrichment Maximum*	*Factor of enrichment Ave. of "rich" ashes*
Be	0.1	0.03	0.0002—0.001	100—500	30—150
B	0.3	0.06	0.0003	1000	200
Sc	0.04	0.006	0.0003—0.0006	70—130	10—20
Co	0.15	0.03	0.004	40	8
Ni	0.8	0.07	0.01	80	7
Zn	1	—	0.02	50	—
Ga	0.04	0.01	0.001—0.0015	30—40	7—10
Ge	1.1	0.05	0.0004—0.0007	1600—2800	70—120
As	0.8	0.05	0.0005	1600	100
Y	0.08	0.01	0.001	80	10
Zr	0.5	—	0.02	25	—
Mo	0.05	0.02	0.0015	30	13
Sb	0.1	0.02	—	—	—
Sn	0.05	0.02	0.005	10	4
Pb	0.1	—	0.0016	70	—
Bi	0.003	—	—	—	—
Ag	0.0005—0 001	0.0002	0.00001	50—100	20
Au	0.00002—0.00005	—	0.0000005	40—100	—
Rh	0.000002	—	—	—	—
Pd	0.00002	—	—	—	—
Pt	0.00007	—	—	—	—

At present, many of the data presented in Tables 2 and 3 are chiefly of scientific interest. However, it is known that certain of the elements present may be catalytically active in some coal reactions. This is particularly true in the case of hydrogenation. As we learn more and more about coal and the mechanism of the various processes that it undergoes in utilization, we may find that some of the rarer elements play specific roles in some of these processes.

ESTIMATION OF MINERALS PRESENT IN COAL

ers published the results of an examination of seven samples of coal and three samples of washery refuse for the purpose of obtaining an estimate of the minerals present. These samples were selected from central and western Pennsylvania and from the Pocahontas seam of West Virginia. The examination consisted of concentrating the inorganic material by means of float and sink separations followed by petrographic studies of the separated materials.

Successive separations were made at specific gravities of 1.6, 2.0 and 2.6 so that each sample was divided into four fractions. The plus 1.6 fractions were not studied because the large amount of carbonaceous matter completely obscured the minerals which were present. Even the plus 2.6 fractions contained enough carbonaceous material to make the petrographic examination difficult.

The minerals recognized in the samples are listed in Table 4. It should be emphasized that these are by no means all the minerals which may be present. They are only those positively identified.

Where the principal minerals present in a coal are known and an analysis of the ash is available, it is possible to calculate the mineral composition of the original coal with a reasonable degree of certainty. This has been done in the Mineral Industries Experiment Station with the results given in Table 5.

This table indicates very clearly that percentage of ash as determined by proximate analysis is not the same as percentage of minerals originally present in the coal.

Table 6 presents the calculated mineral analysis of five other samples. All the samples are from the Miller or B vein in Pennsylvania.

For detailed description of the method of rationalization of the analyses the reader is referred to the original paper of Gauger,

*—Editor's note: This paper includes with some additions a digest of material presented before the 1936 meeting of the Eastern States Blast Furnace and Coke Oven Association, and published in Blast Furnace and Steel Plant, Apr., May, and June, 1936.

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TABLE 4. RESULTS OF PETROGRAPHIC STUDY OF TEN SAMPLES

Name	*Formula*	*Remarks*
Pyrite	FeS_2	Found in all samples
Kaolin minerals	$Al_2O_3 \cdot 2SiO_2 \cdot xH_2O$	Found in all samples
Chlorites:		
Prochlorite*	$2FeO \cdot 2MgO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	Found in all samples
Penninite*	$5(MgFe)O \cdot Al_2O_3 \cdot 3SiO_2 \cdot 2H_2O$	Found in 3 samples
Muscovite	$KNaO \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$	Found in all samples
Calcite	$CaCO_3$	Found in 9 samples
Quartz	SiO_2	Found in all samples
Diaspore	$Al_2O_3 \cdot H_2O$	Found in 2 samples
Limonite	$2Fe_2O_3 \cdot 3H_2O$	Found in 7 samples
Magnetite	Fe_3O_4	Found in 7 samples
Gypsum	$CaSO_4 \cdot 2H_2O$	Found in all samples
Rutile	TiO_2	Found in 2 samples
Hematite	Fe_2O_3	Found in 1 sample
Tourmaline	Not constant; a complex aluminum borosilicate	Found in 2 samples
Siderite	$FeCO_3$	Found in 2 samples
Zircon	$ZrSiO_4$	Found in 2 samples
Garnet	$Ca_3Al_2Si_3O_{12}$	Found in 1 sample

*—These two forms not positively identified but two different chlorites were present and they were tentatively identified as penninite and prochlorite.

TABLE 5. ASH ANALYSES AND CALCULATED MINERAL ANALYSES

	Ash Analysis % in coal Sample No.				*Minerals % in coal Sample No.*			
	1	*2*	*3*		*1*	*2*	*3*
SiO_2	3.92	2.82	2.58	Pyrite	5.40	3.01	0.38
Fe_2O_3	3.73	2.13	0.31	Prochlorite	0.29	0.12	0.12
Al_2O_3	2.68	2.44	2.20	Calcite	0.34	0.28	0.19
CaO	0.19	0.16	0.11	Muscovite	3.60	1.80	0.20
MgO	0.05	0.02	0.02	Kaolin	3.03	4.25	5.27
K_2O	0.36	0.18	0.02	Quartz	0.76		

TABLE 6.
ASH ANALYSES CALCULATED TO MINERALS

(Separations made at 1.35 specific gravity)

Mineral	Sample A	Sample C	Sample E	Sample R	Sample RW
Pyrite	0.36	2.10	1.05	2.66	1.91
Gypsum	0.11	0.16	0.05	0.16	0.11
Apatite	0.65	0.03	0.02	0.07	0.07
Calcite		0.09	0.14	0.11	0.13
Prochlorite	0.21	0.31	0.10	0.23	0.14
Limonite	0.03	0.22	0.10	0.50	0.26
Rutile	0.11	0.11	0.17	0.12	0.10
Muscovite	0.89	1.10	0.65	1.22	0.94
Kaolin	5.13	5.04	3.86	6.05	5.71
Quartz		0.76	0.24	0.18	0.18
Diaspore	0.36				
Total M.M.	7.85	9.92	6.28	11.30	9.55
Ash per cent	7.1	8.5	5.4	9.4	8.0

Similar studies have been conducted by Ball and others (6, 2) in the Illinois State Geologic Survey. Two columns were studied from the Herrin No. 6 coal bed in Franklin and Washington counties, Illinois, and three blocks each from the Upper Freeport bed, Allegheny County and Pittsburgh bed, Allegheny and Fayette Counties. Thiessen, Ball and Grotts conclude from these studies that the separable mineral matter from Illinois and western Pennsylvania coals is composed of over 95% detrital clay, kaolinite, calcite, and pyrite, with other minerals unimportant. On the basis of this investigation, the original results reported by the writer and co-workers (2) are criticized because in the case of one sample, muscovite is assumed to be an important mineral. It has been our experience in investigating the mineral matter of many coals that the same minerals are found in nearly all samples, but that the proportions may vary widely from sample to sample. The writer's paper referred to was published for the purpose of indicating a method of approach to the determination of the minerals in coal, and no claim was made, for example, that central Pennsylvania coals are characterized by th presence of large quantities of muscovite The drawing of general conclusions from study of six Pennsylvania coals and tw Illinois coals is dangerous for experienc has shown that the relative proportions o the various ash-forming minerals not onl vary from seam to seam but frequently ma vary within the same mine. In fact, th only conclusion that the writer is prepared to draw at the present moment on the basi of examination of several hundred ash an alyses is that there is a tendency for lim to exist in increasingly larger amounts a one proceeds to the south and west from th eastern edge of the Pennsylvania bitu minous coal area. In other words, in gen eral, western Pennsylvania, West Virgini and Illinois coals have larger percentages o compounds of calcium than do the coals o central Pennsylvania.

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Department of Metallurgy

A recent visitor to the Metallurgy De partment was Mr. Ormond W. Claypo B.S. Metallurgy '30, who is at present As sistant to the Assistant Vice President i Charge of Specifications at the Weirto Steel Company, Weirton, West Virginia Mr. Claypool reports other Penn State me holding important metallurgical positions i the Weirton Steel Company as follow John D. Gold, B.S. '15, Chief Metallurgis Archibald Miller, Jr. B.S. Metallurgy '3 Assistant Metallurgist for three tin mills and Joseph Robbins, B.S. Metallurgy '3 Assistant Metallurgist in the strip mills.

The Penn State Chapter of the Amer ican Society for Metals held its secon meeting on November 11th. Mr. Franc Tatnall, Chief Engineer of the Southwar Division of the Baldwin-Southwark Com pany, Philadelphia, Pa., spoke on "The Ro mance of Testing." Mr. Tatnall empha sized the growing complexity of physic tests; their importance in relation to th modern developments in metallurgy; the necessity of metallurgists being traine in their use and interpretation. The im portance of dynamic tests as distinguishe from the commonly used static tests wa emphasized also. Finally a discussion wa given of recent developments in using vibrator to test structures and to brin about stress annealing.

Clifford E. Horner, B.S. Metallurgy has accepted a position in the Metallurg Department of the RCA Corporation a Harrison, New Jersey. Two other Pen State men are already in this department George W. Seagren, '32 and Kenneth H Mairs, '34. Mr. W. C. Drill '31, has take

Department of Ceramics

The Department of Ceramics has been rengthened this year through the addition its faculty of a technologist of interna- onal reputation in the person of Dr. Wol- emar Weyl.

Dr. Weyl was born in Darmstadt, Ger- any, in 1901 and studied chemistry at the echnische Hochschule in that place, being raduated with he degree of ipl-Ing. He next ccepted a posi- on as chemist in n agricultural xperiment sta- on where he re- ained for two ears. In 1926 he ent to Berlin- ahlem where the Kaiser Wilhelm- nstitut für Sili- atforschung had een founded ecently under he direction of rofessor E. W. itel.

In the Silikat- orschung Insti- ut he worked on roblems both urely scientific nd technical, and ater became ead of the div- sion of glass esearch. While ere, his first roject was on he equilibria be- ween carbon di- xide and silicate nelts at high pressures, for which he re- eived the degree of Dr-Ing. from the Tech- ische Hochschule in Aachen.

His scientific work includes studies on: eactions in the solid state; equilibria be- ween carbon dioxide and oxygen with dif- erent silicates; studies on the constitution f glass and on the action of mineralizers.

His technological investigations include:

DR. WOLDEMAR WEYL

Studies of coloring materials in glass and aqueous solutions (in collaboration with E. Kreidl, E. Thümen and H. Pfeilschiffer); the dependence of color on the state of oxidation of the coloring oxide and on the association and dissociation of the solvent; and the constitution and the color of iron-manganese glasses in collaboration with W. E. S. Turner (Sheffield).

In the field of refractories, he studied the formation of magnesia-ferrite in magnesia bricks by means of x-ray methods and with J. H. Chesters, the souring of dead burned magnesite and the drying of magnesite bricks.

With H. Rudow he developed a new method for the accurate determination of traces of lead. In connection with the Fachausschuss für Fein Keramik der Dautschen Keramischen Gesellshaft (Professor Dr. W. Steger, head) this method was applied to different glazes to study the influence of composition and firing temperature on the amount of lead dissolved by different solvents.

Dr. Weyl is Associate Professor of Ceramics, in charge of instruction and research in the field of glass technology. He is giving courses in ceramic petrography, whitewares and glass to undergraduates, and advanced courses in those subjects to students of the graduate school.

Growth of Mineral Industries Art Gallery

Many artists are turning to the bustle nd roar of Pennsylvania industries in their ge-old quest for beauty. The success of he artists in portraying the beauty of in- lustry may be seen on the walls of three ooms in the School of Mineral Industries t The Pennsylvania State College where a allery of industrial paintings, the only col- ection of its kind in the world, has been rowing steadily for more than six years nder the watchful eye of Dean Edward Steidle.

Fifteen paintings have been added to the allery within the past two months, and rtists in several localities in Pennsylvania re now preparing canvases that soon will e added to the exhibit.

Dean Steidle estimates the value of the ollection of seventy-four paintings, done in il, and three lithographs at more than $25,- 000. All were presented to the School by rtists, alumni, industries, or friends of the

Pennsylvania mineral industries, both outside and inside views, form the motif of the oil paintings, all of which are the work of Pennsylvania artists. The lithographs, the work of Wilfred A. Readio, of the College of Fine Arts at Carnegie Institute of Technology, Pittsburgh, depict abandoned Colorado mining properties: "Yankee Girl," "Canyonside," and "Old Shaft."

A large canvas of a "silica brick plant" in Johnstown, one of the works of art recently added to the collection, is exhibited as a memorial to the late Harry Tredenick, for many years president of the Haws Refractories Company, Johnstown. Some time before his death, Mr. Tredenick engaged Ludwig Henning of Johnstown, to paint the picture for the Penn State gallery. The company paid for the picture after its completion and sent it to Dean Steidle with the request that it be exhibited in memory of Mr. Tredenick.

Walter Huber, Harrisburg artist, contributed a scene entitled "Tapping the Heat." This is a view in the plant of the Central Iron and Steel Company, Harrisburg.

Other recent acquisitions were painted by

Wayne Martin, of Wayne, "Red Shale," crushing and screening plant near Blooming Glen, Pa.

R. Dunkelberger, of Reading, "Tapping an Electric Arc Furnace." This was presented by G. V. Luerssen, a graduate of the college in 1915.

Godfrey F. Biehl, of Pittsburgh, "Bituminous Coal Tipple," near Heilwood.

Molly Wood Pitz, of Norristown, "A Lime Kiln," located near Philadelphia, reported to be the oldest lime kiln in Pennsylvania.

Martha Davis, of Ebensburg, "By-Product Coke Oven," at night, located near Indiana, Pa.

William Mohr, of Ridley Park, a handsome painting of the Mineral Industries Building at The Pennsylvania State College wherein the art collection is housed.

Dorothy Everett, of McKeesport, "Tapping the Heat" in a McKeesport mill.

Rose McGary, of Pittsburgh, "Welding a Steel Casting." This was painted in a mill on the Allegheny River in the Pittsburgh district.

Saverio DiMagno, of Hershey, "The Hershey Quarry," at Hershey.

A. H. Bennett, of Pittsburgh, "Rhythm of Structural Steel," showing the new bridge over the Allegheny River at Pittsburgh.

Yarnall Abbott, of Philadelphia, "Paving Block Cutters."

Gustave L. Brust, Jr., of Pittsburgh, "Brick Kiln," in western Pennsylvania.

Alumnus Wins Prize

Mr. James C. Gray, graduate of the School of Mineral Industries in the curriculum of Mining Engineering, class of 1925, recently won second prize for a paper which he presented before the Coal Division of the A.I.M.M.E. for his essay on underground mining. The subject of Mr. Gray's paper was "The Mining of a Thick Crushed Bed of Anthracite through Rock Holes from an Underlying Bed." Mr. Gray is now mine foreman at the Marvine Colliery of the Hudson Coal Company, Scranton, Pennsylvania. He was previously mine foreman of the Stillwater Colliery of the Hudson Coal Company in 1933 when that colliery was awarded "The Centennial of Safety" trophy of the Explosives Engineer and the U. S. Bureau of Mines.

Department of Mining and Geophysics

Wm. R. Chedsey, Head of the Department of Mining, attended the meeting of the Thomas S. Lowther Mining Institute at Indiana, Pennsylvania, on Saturday, October 31, and the Fifteenth Bituminous Inspection District Institute meeting at Barnesboro on November 7. At the Barnsboro Institute, he presented a brief exposition of the work being done at The Pennsylvania State College in the measurement of roof subsidence following mining. Brief mention was also made of similar work more recently started by other agencies.

Dr. H. Landsberg visited the Ernest Mine of the Rochester and Pittsburgh Coal Company, Indiana, Pennsylvania, on November 14. The company collaborates in the School's program of studies on roof subsidence by operating two convergence recorders. A new arrangement of the recorders has been tried out at that mine for the past four

Mining Society Smoker

The Penn State Mining Society held its first meeting of the year on October 1. It was conducted in part as a smoker with appropriate refreshments. There were 55 members present.

President Bray read pertinent parts of the constitution of the Society for the benefit of new members. He discussed the activities of the Society and outlined a probable program of speakers, field trips and social events for the coming school year. Professor Chedsey, head of the department of Mining Engineering, gave a historical sketch of the Society and explained its affiliation with the American Institute of Mining and Metallurgical Engineers.

Professor J. W. Stewart, faculty sponsor for the Society, read a letter from the Secretary of the American Institute of Mining and Metallurgical Engineers, explaining a recently introduced procedure by which student associate membership in the A.I.M.M.E. may be more readily obtained. He urged as many students as possible to take advantage of the improved facilities for obtaining student associate standing in the Institute. Then he introduced the speaker of the evening and the Society's new Counselor, Mr. S. M. Shallcross, General Manager of the American Lime and Stone Company, of Bellefonte, Pennsylvania.

Mr. Shallcross gave an interesting informal talk on the subject of planning one's career. He stated that one should plan his career as intelligently and as far in advance as possible, but that this planned career should be flexible enough to meet unexpectedly arising circumstances in life. He even suggested that it might be well for one who has found a previously planned career unsuited to his tastes, to abandon this career for one more adapted to his temperament. He recommended that all of us adopt a hobby in life, and by way of illustration unexpectedly produced an accordion and played several surprise selections. In particular he popularized the song "My Sweetheart's a Mule in the Mine." This latter touch instantly added to his popularity with the members of the Society, in fact practically a song fest resulted under his leadership. With such counsel and leadership as Mr. Shallcross provides, it would seem that the Penn State Mining Society will certainly excel itself this year.

Membership cards bearing the seal of the Society were printed recently as a new innovation, and these were distributed at the close of the meeting to all paid-up members. The present membership of the Society is 61, a larger number than at the corresponding time last year. The membership is still growing and all look forward to a more successful year than ever before.

Mineral Industries Experiment Station

The Rochester and Pittsburgh Coal Company Fellowship in Fuel Technology has been renewed for a second year. Mr. George A. Brady, who has been in charge of the analytical laboratory for the past five years, has been appointed to this Fellowship. Mr. Brady will be engaged in research work on the surface properties of coal.

Mr. Robert J. Grace has taken the place of Mr. George A. Brady in charge of the analytical laboratory. Mr. Grace is a graduate of The Pennsylvania State College, School of Chemistry and Physics, Class of

Power Conference. Mr. Hsaio has completed his work for the Ph.D. degree at Penn State and has returned to China to resume his duties as technologist in the National Geological Survey of China.

Dr. H. M. Krutter has been appointed to the research staff in the Department of Petroleum and Natural Gas. Dr. Krutter will conduct investigation work in air-gas recovery, a project financed jointly by The Penn Grade Crude Oil Association and The Pennsylvania State College. Dr. Krutter is a graduate of the Massachusetts Institute of Technology, receiving also his Master's and Doctor's degrees from the same institution. Prior to joining our staff he was an instructor in Physics at Purdue University.

Mr. Clifford R. Horn joined the research staff conducting research activities on secondary recovery of crude oil from the Bradford sandstone at The Pennsylvania State College on November 1. Mr. Horn was graduated from the Colorado School of Mines in May, 1933, with the degree of Petroleum Engineer. Since graduation he has had ten months' experience as a chemist in rare metals. He has spent one year in the laboratories of the Colorado School of Mines engaged in research work on mud-laden fluids. For three months he was connected with the Colorado Mineral Resources Survey and for five months with the geological department of the California Company. Mr. Horn is a member of Tau Beta Pi and the A.I.M.M.E.

Mr. Norman H. Ishler, a graduate of The Pennsylvania State College, School of Chemistry and Physics, 1936, has been appointed analyst on the Central Pennsylvania Coal Producers' Association project.

Mr. Charles C. Haworth, a graduate in Chemical Engineering, University of Washington, has been appointed Graduate Assistant in Natural Gas.

The following appointments have been made for work on the Bradford District Pennsylvania Oil Producers' Association project:

Mr. L. T. Bissey, Research Assistant, a graduate of The Pennsylvania State College, School of Chemistry and Physics, 1935;

Mr. Bennett Ellefson, Research Assistant, a graduate of St. Olaf, 1932 (A.B.), and the University of Minnesota, 1933 (M.S.);

Mr. Clifford R. Horn, Research Assistant, a graduate in Petroleum Engineering from the Colorado School of Mines, 1933;

Mr. J. S. Levine, Graduate Assistant, a graduate in Chemical Engineering, University of Texas, 1936.

Lecture on Meteors

Dr. H. H. Nininger of Denver, Colorado, who has made a life work of searching for and studying meteorites, spoke before a large audience at the College on Tuesday, November 10, on the subject of "Our Stone Pelted Planet." Dr. Nininger's address was sponsored by the School of Mineral Industries, Sigma Gamma Epsilon, the Mineral Industries fraternity, and Alpha Nu, the Astronomical Society. Dr. Nininger is director of the Nininger Laboratory and secretary, Society for Research on Meteorites, Denver, Colorado.

Dr. Nininger is credited with being the first to attack the problem of meteorites scientifically, beyond the mere matter of analyzing and classifying them. In 1923 he conceived and began carrying out a systematic survey in search of meteorites in an attempt to discover the frequency of these

to a place among the great collections of the world and is the only considerable collection which has ever been assembled from a man's field of activities. It is now valued at $150,000.

His discovery of a new meteorite crat[er] and its excavation in collaboration with the Colorado Museum of Natural History [was] a high point in his experience; the discovery of "meteorodes" was another; the gold-bearing meteorite was a third; and the most recent is the discovery of an entirely new type of meteorite which will soon be described in a publication of the Colorado Museum of Natural History. This latter institution has subsidized Dr. Nininger's work during recent years.

In closing his lecture, Dr. Nininger remarked favorably on the nucleus of the meteorite collection of the School of Mineral Industries. He remarked that while our collection was still small, it was valuable in that it contained examples of practically every known type of meteorite and occurrence. Dr. Nininger exhibited several specimens of meteorite types and encouraged the audience to take an active interest in their search for meteorites through this section of our state.

Extension Division

Enrollment in Mineral Industries Extension classes for the 1936-37 term is progressing satisfactorily. A preliminary report on the enrollment to date with exact figures from several centers yet to be obtained indicates that the total enrollment this year will approximate the figures for last year. Indications are that seven of the centers in which classes were held last year will not carry on the work for the current year. However, fifteen new centers have been opened and the enrollment in these centers will, in part, counter-balance the enrollment in the centers which dropped.

The enrollment figures for the several curricula given below show the tabulation to date.

Curriculum	*Number of centers*	*Enrollment*
Ceramics	1	17
Coal Mining	44	1365
Ferrous Metallurgy	13	1167
Petroleum & Natural Gas	14	539
TOTALS	72	3088

Because of the extra large number of centers requesting work in Coal Mining this year and because of the fact that only one man is available to organize and supervise the work in this curriculum, complete enrollment figures have not yet been obtained from a great many of the centers. A tabulation will be given in detail of the complete work of the Extension Division in a later issue of MINERAL INDUSTRIES.

The Extension Division is pleased to announce that it is cooperating with coal mining officials of the state of Tennessee in a program of education for the men of the mining industry of that state. So far this year, it has made eighteen shipments of its extension textbook Coal Mining, Volume I, to eleven localities in Tennessee for use in adult educational programs in those localities. All the textbooks used in the work of the Division of Mineral Industries Extension are prepared by members of the extension staff and are written especially to cover the adult educational needs of workers in the mineral industries. Three-year programs of training are available in Coal Mining, Ferrous Metallurgy and Petroleum