The COLORADO SCHOOL OF MINES MAGAZINE

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Football Number

The COLORADO SCHOOL OF MINES MAGAZINE

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Editorial Comment

Football Number

NOVEMBER is a festival month. Thanksgiving Day meant to the Pilgrim fathers prayers and rejoicings. The warm days of summer were past, and enough corn harvested and on hand to feed them through the long rigorous months of a New England winter.

November is, by tradition, still the month of thanksgiving. To this festival spirit the college youths have added the gaiety of their game, football. And so in this modern age, November, Thanksgiving Day and the Big Game, are synonyms in the students' dictionary of the calendar.

Golden will again migrate to Pueblo for the annual Thanksgiving "pageant". Colorado College, as in times past, will be the foe. In memory of the valiant fight put up by the Miners at Pueblo last year, this the November issue of the Magazine is called the "Football Number".

Magazines Meet

TWENTY-THREE college publications dealing with engineering are members of the Engineering College Magazines Associated. This organization recently held its tenth annual convention at Boulder, Colorado.

The Mines Magazine is not a member of this association, but a representative attended the meetings in response to an invitation from the Colorado Engineer, convention host.

The standards of the publications belonging to E. C. M. A. are high. This organization is doing much to encourage better magazines in engineering schools. Its work proves the motto: "Strength in Unity."

Changing Laws

THE United States has become a great and wealthy nation on account of the freedom that has been exercised by the Individual Citizens in the development of Natural Resources. Starting with the original 13 states, the Middle West and large sections of the West have been settled by taking up free land. All the land and mineral laws up to the passing of the Leasing Act have been to deed the land to those who develop it. All the land in the Mississippi valley including the mineral was deeded to settlers and nearly all of them became substantial and prosperous citizens. The mineral laws were largely responsible for the development of the west. The Mineral laws were written by the prospectors and early pioneers. They granted the minerals to those who developed it. Only a small fee was exacted to cover the cost of administration.

Although the original laws regarding the location of nearly all the minerals have not been changed by Congress, yet there is a growing tendency on the part of some of the Government officials to make it as difficult as possible for anyone to acquire mineral rights. These self appointed custodians of the public domain look upon all those who are spending their time and energy in developing these natural resources as grafters. Mining men know that it is no child's play to wring from Nature the mineral wealth that has been so carefully stored away.

Whether it is better for the nation that these resources be owned and developed by independent American citizens or owned by the government and leased to tenants for the maximum rental that can be exacted is a problem that must be solved in the near future.—*C. L. C., '07.*

Don't Hibernate

WINTER is near. On the crisp fall air the odor of burning leaves creeps along, reminding us to clear away the debris that may have accumulated in our own little worlds, and to get ready for the coming year.

Take an inventory, personally and professionally, and where your stock is low, make additions. If you are out of tune, discard the old and import some new ideas. Don't hibernate; the whole world is getting ready for a new year. The fellow who isn't afraid to discard useless but loved ideas and absorb better ones, is the one who will make progress unimpeded.

Sure, and winter is a fine time of year. Browning knew what he was talking about when he proclaimed "the last of life for which the first was made." There are those of us who go into seclusion, mentally and physically, as soon as the spring and summer of the year are complete and miss half the joy of living and progression that the last of life offers, lamenting the passing months and milestones.—*I. G. Hintze.*

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The September *Letter* of the National City Bank states that confusion seems to exist in the minds of many people regarding the importance of the volume of currency or money in circulation. It is not uncommon to have a decline in the volume of outstanding currency cited as a cause of business depression, or declining prices, whereas it is only a result.

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The Seventh International Petroleum Exposition just held in Tulsa was bigger and better than ever. This annual meeting gives opportunity to petroleum engineers, operators and technologists to meet each other yearly. They get to see what improvements in equipment the tool makers and the machinery manufacturers are offering.

Oil Shale

IT is very unfortunate that the present oil shale controversy has come during a political campaign. Whether or not the disturbance was started for political purposes, it is certain that at this particular time it will be treated from the political standpoint. Such a situation is not going to help us to a rational solution of the problems of the future oil shale industry.

In spite of all the charges and counter charges, the important part in the press' discussion has hardly been mentioned; namely, the question as to whether or not a dangerous precedent has been set in the handling of mineral lands of great potential value.

During the Hoover administration title has been granted on only 43,000 acres of oil shale land which had been taken up under the placer laws previous to the passage of the leasing act of 1920.

Without even knowing in what parts of the field this land lies or how it is divided, a fairly safe estimate of its present value would fall somewhere between $5.00 and $50.00 per acre. The variations would depend on the accessibility of the shale, amount of water available, haulage and living conditions, and other such factors as well as on the total amount of oil recoverable.

Economic considerations must be taken into account in estimating the average value per acre of the 800,000 acres of Colorado oil shale land. Such factors as mining, retorting, refining, transporting, and selling costs, which must be deducted, and the revenues from possible by-products, which may be added, must be figured in arriving at an estimated net return. Another extremely important factor is the difficulty of arriving at the present value of this possible future net return. If interest is figured at only the very modest rate of 3.57, money doubles every twenty years. It requires only a little over 7 per cent to cause money to double in ten years. Taking this time factor into consideration, one can readily see that these deposits must be developed in a comparatively few years if their present value is to be considered as any appreciable fraction of their future potential value.

It is true that there is public land which may be leased for oil shale operations but the regulations under the leasing act are such as to cause many people to fear that such operations would be neither pleasant nor profitable. Therefore, it is natural that an effort has been made to get title to land so that operations may be more independent.

The prudent individual buys life insurance and the prudent oil company buys oil shale land, not for profit, but for protection.

Laying aside all charges of graft and competition, the question of the oil shale fields should be carefully investigated and a procedure for the handling of these lands worked out which will permit their development by private capital and at the same time protect the interests of the public and of posterity.

—*R. A. Baxter, '23.*

"Ambassadors"

A COLUMBIAN educator, Senor German Arciniegas, who did research at New York University this past summer, made the following statement before returning to his country.

"Students of our two lands might, by frequent visits, aid each other greatly and perhaps some day begin an international organization of world-wide influence. The student 'ambassadors' might restrict themselves at first to exchanges of ideas on education, and I am sure that in this field South America has much to learn from the United States, particularly in the matter of co-education."

It is the same idea that we hold regarding Mines graduates and other engineers in foreign service—they are, or should be, good will ambassadors.

What is Education?

DR. WALLACE BUTRICK has said that education is a voluntary process. "In the very nature of the idea, one must educate himself. Education is the determined and long continued effort of a serious-minded person to train his powers of observation, thinking and reflection through gain in knowledge," states the Doctor.

Without self-direction no individual can hope to be called educated. The process does not end with graduation from a college. Professors, class grades, memorized assignments, tests and most of the accepted formality of a college course go for naught if the student does not direct himself while in school and continue to study after leaving school!

Lately there has been some talk regarding extension courses for Mines graduates. Such courses would have for their purpose the stimulation of the Mines man's self-interest in his education. They could do little more than point the way; their success would depend upon the man's determination to help himself.

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"In America the colleges largely teach students how to remember, whereas in Europe students are taught how to think."

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"The only good journalists are dead journalists, for then the historical scholar can draw history out of the newspapers they wrote. And the only good scholars are the research scientists, for the journalists cannot understand them." —*Sat. Lit. Rev.*

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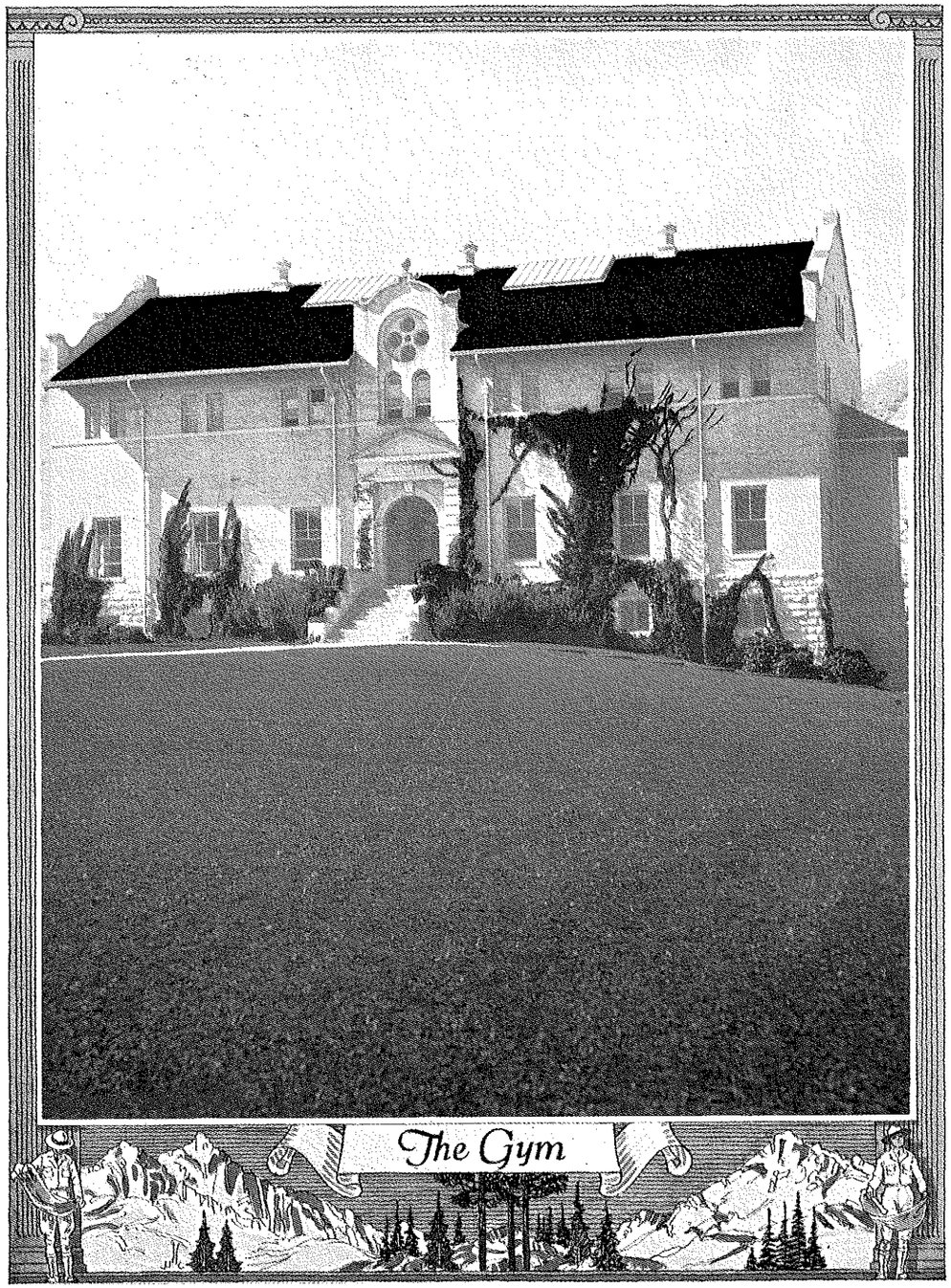
"Once a Miner always a Miner" is borne out in the fact that this fall forty-four former Miners have returned for a continuation of their engineering training. A large number of last year's students have found it necessary to stay out this year but it is safe to say that the majority of them will be on the Campus in 1931.



Seventh International Petroleum Exposition

Panorama of the Industry
Many Exhibits
Equipment Display, feature
Mines Luncheon

By George Fancher, '30*

The Seventh International Petroleum Exposition was held in Tulsa, Oklahoma, from October 4 to 11. The Exposition is the biggest event in the industry, yearly attracts oil men from all parts of the world. So great is the influx of visitors that although there are more and better hotels than is usual for a city the size of Tulsa, the latecomer must, like the Arab, bring his tent with him to find lodging. To this fact I can testify personally as I, a late comer, brought no tent.

The oil show is a complete panorama of the industry; mirrors the progress of the past year, forecasts development for the coming year, has a message for executive, producer, developer, refiner, technologist, roustabout alike, because no phase of the industry is slighted. Time spent there is time invested, which explains why many executives and wholesale delegations attend. Resulting sales run well into six, perhaps seven figures.

Many organizations take the opportunity to hold annual meetings at this time. Those doing so this year were the directors of the American Petroleum Institute, presided over by President E. B. Reeser; the general committees of this organization, divisions of marketing, refining and production; The American Institute of Mining and Metallurgical Engineers; The American Society of Mechanical Engineers, with President Charles Prenz presiding. This last mentioned organization held meetings October 6, 7 and 8 at which valuable papers on pipe line problems, mechanical subjects, refining topics, were presented by authoritative members.

The papers read, the discussion concerning them may be found in the official organ of the respective societies. Some of the more important papers will be reprinted in various technical publications.

Noteworthy among exhibits was that of the American Society of Mechanical Engineers. The expenditure of $85,000, months of toil by unselfish engineers, produced an automatic pumping station, not a toy model, but an actual working station, flexible in operation as a means of further study and research. This exhibit points the way to one more triumph of the robot. Many other examples of automatic control were on view ranging from the precision laboratory fractionating column of Walter J. Podbielniak to large pipe stills, towers, drilling devices.

Of historical interest was the replica of the famous Drake well together with drilling tools of prehistoric age. Likewise to the refiner the replica of what is reputed to be the first refinery attracted much attention. This antediluvian specimen, not as well known as the Drake well. was built according to recollections of an early employee of the infant industry. The original was erected in 1870 by William Barnsdall and associates on Oil Creek, Pennsylvania, and consisted only of a ten barrel cheese box still, wood fired, from which a long vapor pipe cooled by waters from a spring running into a trough holding the pipe, led to a tail house. The small stream of kerosene, the only product desired after the gasoline was allowed to run down the creek was run into wooden barrels. As the tail house was rather dark, it was lighted by an ordinary barn lantern swinging from a rafter. I was unable to learn whether this explains the nonexistence of the first refinery today.

Safety, in the field, shop, refinery deservedly was given much emphasis. Continuous demonstrations of current practice in safety, accident prevention and first aid were on each day's program. In addition, competitions between first aid teams of various organizations for prizes were arranged.

Equipment display is the main feature of the show, and the manufacturers deserve credit for whole hearted support of this idea. Notwithstanding this inevitable commercialism, an air of willingness to explain, to educate, to allow judgement on facts prevailed. This demonstrates the extent to which science and technology is permeating the petroleum industry.

Economics has forced this attitude, explains the show, justifies it! The idea underlying each exhibit, the various programs, the whole exposition, seemed to be one of engineering economy. This is in line with conditions prevalent in the industry and the country at large, called depression, hard times, or what would you. Factors such as over production, curtailment, restriction of industry, international trade policies, were carefully overlooked except in impromptu hotel room round robins, while officially everyone centered on "Economy." This caused optimism and hope to prevail.

So much for the Exposition in general. As official representative of the Colorado School of Mines it was my pleasure to meet many Miners, "ex's", old grads. Friday, October 10, many of us had lunch together, enjoyed brief contacts so much we wished we could have had more time together. I was impressed with the keen interest of the Alumni in the School, with the remarkable progress of many of them. Our engineers seem to be respected; many are men of achievement, holding responsible positions.

Some of the men met were Cleveland O. Moss, '02, president of the Alumni club of Tulsa; Eddie Chapman, '27; Raymond Carr, ex-'16; John G. Menke, ex-'16; H. G. Schneider, '18; Floyd Carr, '30; Earl Dickenson, ex-'18; Paul Leach, '22; George Dunn, '20; Barney Bench, '30; Ralph Curtis, '26; and Honore Dumont, '29.

Objects of my visit were to study new methods and equipment, to meet men, to develop contacts, to gather data for instruction, to ascertain the prerequisites the industry requires of embryo petroleum engineers. I was unusually successful in realizing these, I feel. Tangible evidence is the mass of performance data brought back or promised by various engineers. By the way, any loyal Alumnus can always help his department by sending in good cost and performance data on plants and equipment. It is always difficult to obtain in complete form, in sufficient amount to draw conclusions on for use in teaching, yet the value of

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*Asst. Professor of Petroleum Engineering, Colorado School of Mines.

Western Mining Industry Meets

"It is probable that we are rapidly reaching a state wherein a high tariff will be generally recognized as inimical to our future prosperity, though this may be preceded by a tariff war, after which normalcy will be reached. Effort may ever be made to generally abolish tariff protection.

"Demonetization of silver has brought the realization that high silver prices are dependent upon the foreign use of the metal, and the same is true also of copper.

"There are many factors that prevent complete stabilization of the metal mining industry. To some, complete stabilization in any industry would spell death to competition, loss of individual initiative and destruction of democracy. A stabilization between maximum and minimum figures is possible, conceivable and practicable to a large degree. Heretofore when industry has considered stabilization, the adjustment of supply to demand, it has been confronted with the possibility of violating government regulations, but the government now does not concern itself in this matter nor evince its former attitude on matters of combinations, since it realizes that undue regulation is inadvisable and that there are other matters of greater concern.

"Some mines that can produce cheaply, object to combinations that will tend to regulate their rate of production. Others whose costs are so high that only extensive price fixing at a high rate would permit continuous operation."

At El Paso, during the week of October 13, the representatives of the western mining industry. The sponsoring body was the Western Division of The American Mining Congress, but cooperating with it were the great organizations representing the technical and geological side of mining. The American Institute of Mining and Metallurgical Engineers, The West Texas Geological Society, The Mexican Society of Engineers, each met with the Congress in an effort to bring together all those forces working in behalf of the industry.

All of the major topics today engrossing western mining men were discussed at the convention. In addition, an opportunity was given to inspect some of the most interesting of the district's mines, and El Paso as host contributed much that was not listed on the program.

Brent N. Rickard, of El Paso, manager of the local smelter of the American Smelting and Refining Company, and chairman of the Board of Governors of the Western Division of the American Mining Congress, comprising the eleven western States and the western part of Texas, was in active charge of the arrangements for the conventions.

W. Val DeCamp, '08, read the first day of the convention a paper, "Management in its Responsibility to Industry." DeCamp is general manager of the United Verde Copper Company and is one of the many Mines graduates who have gone to the top in their field.

Other papers read at this session were as follows: A. C. Stoddard, assistant mine superintendent, "Development and Mining at Inspiration Consolidated Copper Company Mine"; Moses Brown, Jr., assistant superintendent of mines, "Long Hole Prospect Drilling at the Ray Mines of the Nevada Consolidated Copper Company"; J. B. Pullen, engineer, "History and Operations of the Copper Queen Branch of the Phelps Dodge Corporation"; W. V. DeCamp, of Clarkdale, Ariz., general manager of the United Verde Copper Company, "Management in its Responsibility to Industry".

Addresses delivered at the sessions of the A. I. M. E. on October 14 were made by the following: Augustus J. Monks and Norman L. Weiss, "Concentration of Oxidized Lead Ores at the San Diego Mill of the Santa Barbara Unit, Mexico"; Glen L. Allen, "Milling Practice at the San Francisco Mines of Mexico, Ltd."; Howard Willey, "Top Slicing With Filling of Slices, San Luis Potosi, Mexico"; John G. Barry, "Critical Factors Controlling Ore Deposition in Limestones in Northern Mexico"; H. H. Stout, "History and Development of Pyrometallurgy at the Copper Queen Smelter"; Frank R. Corwin and Frank S. Harloff, "The El Paso Refinery of the Nichols Copper Co."; E. R. Marble, "Natural Gas Firing at the El Paso Smelting Works"; David Cole, "Developments in Primary Crushing"; Van Dyne Howbert and Richard Bosustow, "Mining Methods and Costs at the Presidio Mine of the American Metal Company of Texas"; F. E. Gray and Mr. Howbert, "Milling Methods and Costs at the Presidio Mine".

Dr. G. M. Butler, '02, spoke at the morning session, October 15. Doctor Butler explained the aims and objects of the American Association of Engineers.

Doctor Butler is dean of the mining school at the University of Arizona. He is one of the old time graduates of the Colorado School of Mines. His Alma Mater conferred the honorary degree of doctor of science upon him in 1922 in recognition of his efforts to further the mining industry and the aims of engineering education.

Other speakers at this session were as follows: Dr. Bybee, "General Geologic Features of West Texas and New Mexico"; E. L. Porch, Jr., "Sulphur Deposits in West Texas and New Mexico"; Paul Weaver, "Potash Deposits in West Texas and New Mexico"; W. R. Nelson, chief engineer, the Radiore Company of Los Angeles, "Geophysical Methods and Results"; Alberto Terrones Benitez, acting Governor of the State of Durango, Mexico "Mineral Problems in Durango".

The papers read at the closing session of the convention were: I. J. Stauber, of Pastura, New Mexico, "A Sandstone Copper Deposit"; Ira L. Wright, manager, "Methods for Determining Metallurgical Efficiency and Results at the Selective Flotation Mill of the Black Hawk Consolidated Mines Company at Silver City, New Mexico"; J. T. Matson and C. Hoag, "Milling Practice at the Pecos Mine of the American Metal Company of New Mexico"; H. A. Clark, General Manager, Calumet and Arizona Mining Co., "Mining Operations".

DeCamp's Paper

W. V. DeCamp, general manager of the United Verde Copper company, and a graduate of the Colorado School of Mines, suggested steps looking toward stabilization of the metal mining industry in a paper read before the Western Division of the American Mining Congress at El Paso, October 16.

Mr. DeCamp suggested the American Mining Congress as the logical organization to undertake a study necessary for any progress along the line of stabilization. He stated that stability of the metal industry is not possible through legislation but by education of each operator to the seriousness of the problem. "Stabilization lies with the individual producers and the degree of sanity, wisdom and fairness they are willing to exhibit for the benefit of the industry as a whole," said Mr. DeCamp. "Should the operators fail in this, the workers whom they may carelessly set aside when not needed, may take the matter into their hands, which would lead the producers along paths that end in strict legislative action and to a degree of control of their

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An Investigation of the Maximum Size of Floatibility of Sphalerite and Galena

By Robert S. Burton, '29

Preliminary

It has often been said that flotation should be carried on at a mineral size as large as possible, assuming first that the mineral is sufficiently freed from gangue. No one has ever determined what that size is under the conditions of practical flotation.

Present day flotation is expensive but has so many advantages that some 54,000,000 tons of ore are treated annually by this process.

Any development which reduces the cost of flotation would be important, both because of the saving effect in ores now being floated, and because of the additional tonnages which would be treated by flotation.

As an example, consider a company which concentrates by flotation 50,000 tons of ore a day, the ore running one per cent copper. A saving of one cent a ton in treatment would save $500 a day or $180,000 a year.

If it were possible to save only one cent a ton in the cost of treating all the ore floated in the year in the United States, a clear gain of $540,000 each year would be effected, which would make a rather attractive dividend.

When it becomes known that one-half or more of the cost of flotation is in grinding, an investigation of this phase seems to be worth while.

Rittenger's Law of crushing which though only approximate, is the best available, says that the work done in crushing a given piece of mineral is inversely proportional to the square of the diameter of the resulting particles. According to this law, starting with a given weight of 28 mesh ore, Tyler Standard sieve size, assume grinding to 35 mesh requires one unit of work; then grinding to 48 mesh will take four units; grinding to 65 mesh will take nine units; grinding to 100 mesh will take sixteen units; grinding to 150 mesh will take twenty-five units; grinding to 200 mesh will take thirty-six units; and the work done in making the near-colloidal materials in the minus 200 mesh pulp can only be guessed at. From this it is possible to see the amount of work wasted by grinding ore finer than is necessary for flotation, and why it was felt to be worth while to determine the most economical size at which galena and sphalerite float, and if possible to show why this is true.

The work of A. W. Fahrenwald[1] is significant in this connection. He states as the factors controlling the size of floatability—(1) The degrees of oil-mineral, oil-water, and air-water adsorption which determine the force with which the particle is held to the bubble; (2) The shape of the particle; (3) Its specific gravity; (4) The cleanness of its surface which influences the degrees of adsorption (1) and (5) The swirl of the pulp.

[1]—A. W. Fahrenwald, "Size of Mineral Particle in Relation to Flotation Concentration". Idaho State Bureau of Mines and Geology, Pamphlet No. 21, Oct. 1921.

This is a thesis submitted to the Board of Trustees, the President and the Faculty of the Colorado School of Mines as a partial fulfillment of the requirements for the degree of engineer of mines. It was submitted May 10, 1929, by Robert S. Burton, and is published here in answer to numerous demands received by the Mines' Library for the data it contains. Reprints are available.

"Of course maximum flotation efficiency is to be obtained by treating the largest particle that can be floated by its first attachment to a bubble or number of bubbles; when the mineral particle is of such size, however, that it is dropped and caught many times by the rising bubbles before it is entangled in the froth and finally removed from the machine, finer grinding would result in greater recovery and higher efficiency. The agitation and swirl of the pulp will influence greatly the size of particle floatable under given conditions—the size of the bubble is important; the more numerous and finer the bubbles the more efficient will be the flotation."

Dr. A. S. Adams[2] by means of an air bubble, without oil and in distilled water, showed that the load which the bubble is capable of carrying is very close to the total surface energy of the bubble, and states that the reason 20 mesh particles are not floated in practice is that imperfect dispersion in commercial machines allows such particles to settle out so that relatively few bubbles reach them.

In addition to this, the oil-air surface tension is much lower than the water-air tension, so that it is not to be expected that as large particles as are theoretically possible will be floated in practice.

Procedure

Inasmuch as work was done on both sphalerite and galena, the procedure in experiments on each mineral will be considered separately.

Sphalerite

The ore used was from the Tri-State district and was a lead free sphalerite ore with a flint and calcite gangue. It was found that the sphalerite was entirely free from the gangue after being ground to pass through 14 mesh screen, Tyler standard screen size.

The preliminary crushing was done in a jaw crusher and in rolls until the ore was all minus 3 mesh. 2500 grams of ore were taken for each test unless otherwise stated, ground wet in a dilution of 3 to 1 in a laboratory rod mill and floated in a laboratory type Fahrenwald Sub A flotation machine at a dilution of 1 to 4.

Reagents were made up in 10 per cent solutions, and added to the pulp in the machine by 1 cc and 5 cc pipettes. The concentrate and tail after every test were filtered, dried and screened 20 minutes in a Tyler Ro-Tap machine. Each product was then weighed and assayed for zinc.

The first test run was to determine the length of grind necessary in order to have sufficiently large material present in the pulp, and to determine at what size chats or attached particles were broken up.

1100 grams of ore were taken, 100 grams split out for a head sample, and the remainder ground for 10 minutes in the rod mill with 250 cc. of water.

[2]—Dr. A. S. Adams, "A Hypothesis Concerning the Phenomenon of Flotation", Thesis at Colo. School of Mines, May 1, 1927.

Fig No 1
Cumulative Percent on Screen Analysis of Ore After Grinding

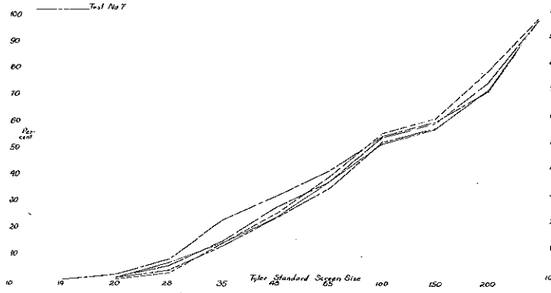


Fig No 5
Recovery

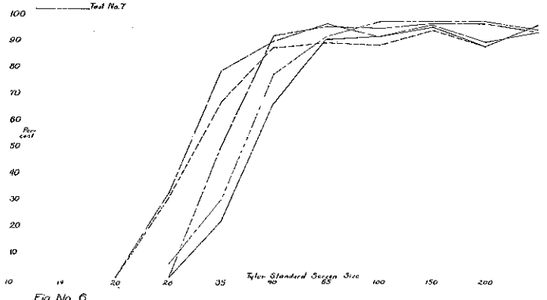


Fig. No 2.
Cumulative Percent of Screen Analysis of Concentrate

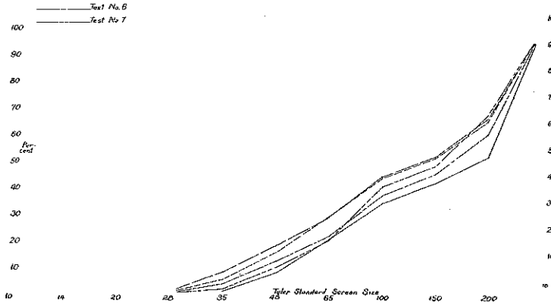


Fig. No 6
Average Curves

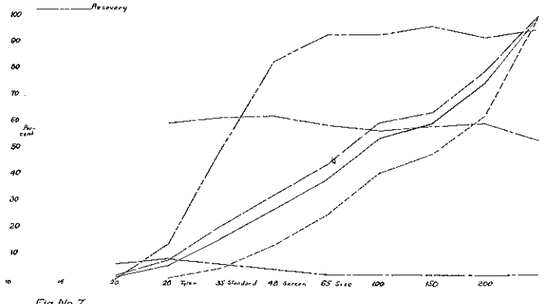


Fig. No 3
Cumulative Percent of Screen Analysis on Tail

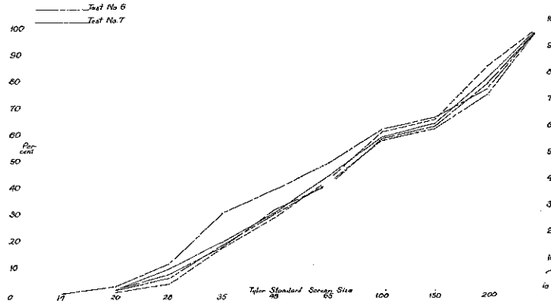


Fig No. 7
Cumulative Percent of Screen Analysis on Tail

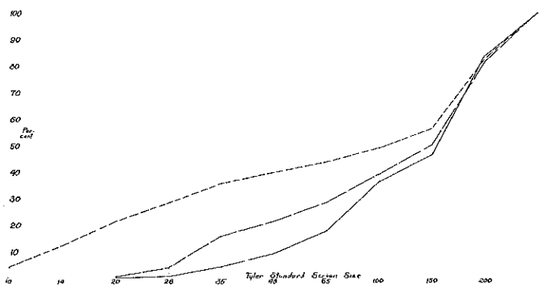


Fig. No 4
Grade of Concentrate and Tail

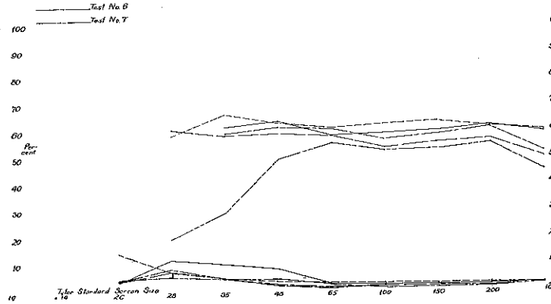
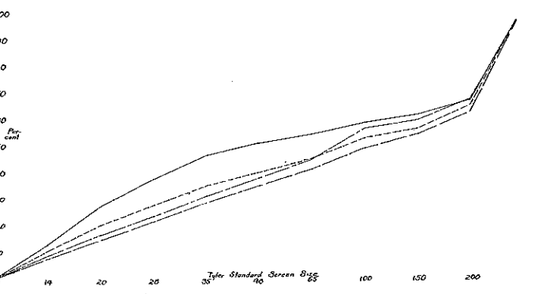


Fig. No 8
Cumulative Percent of Screen Analysis on Tail



The pulp was dried, screened and weighed; with results as shown in Table I.

TABLE I—*Results of Drying, Screening and Weighing Pulp.*

Mesh thru	on	Grams	Per cent Weight	Cumulative Per cent Weight
3	10			
10	14		0.1	0.1
14	20	13	1.3	1.4
20	28	16	1.6	3.0
28	35	49	4.9	7.9
35	48	40	4.0	11.9
48	65	23	2.3	14.2
65	100	322	32.2	46.4
100	150	204	20.4	66.8
150	200	259	25.9	92.7
200		37	3.7	96.4

The second test was made to see if it were possible to use a small batch flotation machine but results were so unsatisfactory that it was decided to use a 2500 gram batch machine.

In test No. 7 there were traces left in the machine from previous oxide ore tests, of thicarbanilid, cresylic acid, Cleveland Cliffs, and Barrett oils No's 635-636 and sodium sulphide, altho the cell had been cleaned; and as a result large pieces of quartz were in the concentrate.

In all the tests, the time of grinding was ten minutes, other conditions were as tabulated below and the results obtained are tabulated and shown on the graphs on following pages.

TABLE II—*Test Conditions.*

Test No.	Lbs/ton copper sulphate	Lbs/ton K ethyl zanthate	Lbs/ton pine oil
3	1.75	.79	.32
4	2.80	1.27	.20
5	1.99	.64	.14
6	2.80	1.03	.07
7	2.80	1.03	.07

TABLE III—*Test Number Three.*

Cum.% on head	Mesh thru	on	Concentrate Gms.	Cum.%	%Zn.	Gms.Zn.	Tail Gms.Wt.	Cum.%	%Zn.	Gm. Zn.	% recov.
		10									
	10	14									
.9	14	20					22	1.4	3.2	0.7	
6.5	20	28					123	9.2	11.8	14.5	
13.9	28	35	7	1.0	61.6	4.3	157	19.1	10.0	15.7	21.5
23.9	35	48	45	8.0	63.7	28.7	179	30.4	8.1	14.5	66.5
37.2	48	65	80	20.4	58.1	46.5	215	44.0	2.3	4.9	90.5
51.5	65	100	88	34.1	59.0	51.9	230	58.6	2.0	4.6	91.9
57.2	100	150	49	41.7	59.9	29.4	76	63.4	1.9	1.4	95.5
72.2	150	200	64	51.6	61.7	39.5	271	80.6	2.0	5.4	88.0
100.0	200		311	99.9	59.2	184.0	307	100.0	2.3	7.1	96.3

TABLE IV—*Test Number Four.*

Mesh Thru	on	Concentrate Gms.	Cum.%	%Zn.	Gms.Zn.	Tail Gms.	Cum.%	%Zn.	Gms. Zn.	% recov.	Cum.% head
	10										
10	14										
14	20					6	.3	14.2	.9		0.2
20	28	3	0.4	58.4	1.7	55	3.5	7.0	3.8	30.9	2.6
28	35	34	5.3	66.3	22.5	234	17.0	4.8	11.2	66.8	13.7
35	48	71	15.6	62.9	44.7	201	28.6	3.2	6.4	87.5	25.0
48	65	94	29.1	61.1	57.4	246	42.8	2.8	6.9	89.4	39.0
65	100	101	43.8	62.4	63.1	302	60.3	2.7	8.2	88.5	55.7
100	150	50	51.1	63.1	31.5	79	64.9	2.5	2.0	94.1	61.1
150	200	96	65.0	61.2	58.7	349	85.1	2.3	8.0	88.0	79.5
200		240	99.8	59.7	143.4	256	99.9	2.3	5.8	96.1	99.9

TABLE V—*Test Number Five.*

Mesh Thru	on	Concentrate Gms.	Cum.%	%Zn.	Gms.Zn.	Tail Gms.	Cum.%	%Zn.	Gm. Zn.	recov.	Cum.% head
	10										
10	14					1					
14	20					28	1.6	3.6	1.0		1.1
20	28	6	0.9	60.6	3.6	99	7.1	7.7	7.6	32.1	5.3
28	35	51	8.2	58.2	29.7	182	17.3	4.5	8.2	78.4	14.7
35	48	70	18.3	58.8	41.2	255	31.6	1.8	4.6	89.9	27.8
48	65	74	28.9	58.0	42.9	157	40.4	1.0	1.6	96.5	37.1
65	100	107	44.3	53.6	57.4	313	58.0	1.7	5.3	91.6	54.0
100	150	53	51.9	55.5	29.4	77	62.3	1.6	1.2	96.1	59.3
150	200	99	66.1	56.6	56.1	291	78.6	2.2	6.4	89.8	75.0
200		236	100.0	49.9	117.8	378	100.8	2.1	7.9	93.8	99.8

TABLE VI—*Test Number Six.*

Mesh Thru	on	Concentrate Gms.	Cum.%	%Zn.	Gms.Zn.	Tail Gms.	Cum.%	%Zn.	Gms.Zn.	Recov.	Cum.% head
	10										
10	14					2	0.1				0.1
14	20					49	2.9	4.0	2.0		2.1
20	28	1	0.2			143	11.1	8.2	11.7		8.0
28	35	25	3.8	59.0	14.7	333	30.2	4.4	14.7	50.0	22.8
35	48	59	12.3	61.2	36.1	152	38.9	2.2	3.2	91.9	31.8
48	65	66	21.9	60.6	40.0	170	48.7	1.2	2.0	95.3	41.2
65	100	106	37.3	56.8	60.3	222	61.5	1.5	3.3	94.8	54.7
100	150	55	45.2	58.5	32.2	73	65.7	1.6	1.2	96.5	59.9
150	200	105	60.4	60.9	64.0	190	76.6	1.1	2.1	96.7	72.0
200		274	100.0	51.9	142.3	418	100.1	2.4	10.1	93.5	100.1

TABLE VII—*Test Number Seven.*

Mesh Thru	on	Concentrate Gms.	Cum.%	%Zn.	Gms.Zn.	Tail Gms.	Cum.%	%Zn.	Gms.Zn.	Recov.	Cum.% head
	10										
10	14										
14	20					19	1.2	4.5	0.8		0.8
20	28	1	0.1	19.8	0.2	70	5.7	5.1	3.6	5.3	3.9
28	35	13	2.0	29.1	3.8	193	18.0	4.6	8.9	29.9	13.0
35	48	55	10.0	49.2	27.1	186	29.9	4.3	8.0	77.2	23.7
48	65	70	20.2	55.1	38.6	176	41.1	2.1	3.7	91.3	34.6
65	100	141	40.7	52.3	73.8	256	57.4	0.8	2.0	97.3	52.2
100	150	53	48.4	53.0	28.1	66	61.6	1.0	0.7	97.6	57.5
150	200	134	67.9	55.0	73.8	198	74.3	0.9	1.8	97.6	72.2
200		220	99.9	45.0	99.0	405	100.1	1.3	5.3	94.8	99.9

TABLE VIII—*Averages.*

Mesh Thru	on	Concentrate Gms.	Cum.%	%Zn.	Gms.Zn.	Tail Gms.	Cum.%	%Zn.	Gms.Zn.	Recov.	Cum.% head
	10										
10	14										
14	20					25	1.5	5.9	1.1		1.0
20	28	2	0.3	59.0	1.1	98	7.3	7.9	8.2	13.7	5.3
28	35	26	4.2	61.2	15.0	219	20.3	5.7	11.7	49.3	15.6
35	48	60	13.0	61.9	35.6	195	31.9	3.9	7.3	82.6	26.4
48	65	73	24.3	58.6	45.1	193	43.4	1.9	3.8	92.6	37.8
65	100	109	40.2	56.4	61.3	265	59.2	1.7	4.7	92.8	53.6
100	150	52	47.8	58.0	30.1	74	63.6	1.7	1.3	95.9	59.0
150	200	98	62.3	59.1	58.4	259	79.1	1.7	4.7	92.0	75.0
200		236	100.0	53.1	137.3	353	100.2	2.1	7.2	94.9	99.9

GALENA

The same apparatus was used for the test on galena as for the previous ones on sphalerite. The reagents used were potassium ethyl zanthate, and pine oil.

The ore contained pyrite and sphalerite, so that a high grade product and high recoveries were not possible without the use of depressing agents. In order to lessen the number of unknown variables, it was decided not to use depressing agents. Further as there was neither time nor opportunity to investigate this phase of the problem, a compromise procedure was decided upon. It was found that the pyrite and sphalerite did not rise in the froth until a

portion of the galena had been floated off, so that the froth was taken off only so long as it appeared to be relatively high in lead. The results, then, do not show commercial recoveries, but do show the relative floatability of different sizes of galena.

The ore was low in grade, leading to experimental error in weighing the small amount of concentrate obtained.

It was found that the galena being soft, was reduced in size very rapidly in the rod mill, while the chert gangue was very refractory.

In tests No's 11, 12, 13 and 14, therefore, the ore was given a very short grind and the plus 10 mesh material, which was largely barren gangue was screened out and rejected.

2500 grams of ore were used in test No. 8; 2000 grams in all the others.

Because of the difficulty of obtaining good results with the lead ore, two tests, No's 15 and 16, were run on a pure lead jig concentrate.

The material was given a one minute grind in the rod mill and then floated, dried, screened, and the products weighed. Since both the tail and froth were pure galena, it was not necessary to assay them. 2000 grams were used in test No. 15 and 1000 grams in test No. 16.

It appeared desirable to know what size lead was dispersed in the pulp during flotation, so 1000 grams of galena were ground, and placed in the machine with the usual pulp dilution. Two 100 cc. samples were then taken by means of a pipette inserted into the pulp. These samples were dried, screened and the products found to weigh as shown below.

Mesh	Sample No. 1	Sample No. 2
28	10	15
35	15	25
48	50	60
65	90	105
—65	4000	4100

TABLE IX—*The Difficulty of Dispersing the Larger Mineral Sizes in Commercial Machines.*

Test	Pine Oil Lbs/ton	K ethyl Zanthate Lbs/ton	Minutes of grind
8	.11	.24	10
9	.10	.30	5
10	.10	.05	7
11	.15	.10	2
12	.15	.10	3½
13	.15	.10	3½
14	.15	.10	3½
15	.15	.10	1
16	.20	.20	¾

TABLE X—*Test Number Eight.*

Mesh Thru	Mesh on	Concentrate Gms.	Concentrate Cum. %	Concentrate % Pb.	Concentrate Gms. Pb.	Tail Gms.	Tail Cum. %	Recov.
	10							
10	14					1		
14	20					2	0.1	
20	28					13	0.7	
28	35					76	4.3	
35	48					101	9.1	
48	65	6	3.8	67.0	4.0	183	17.8	31.2
65	100	14	12.5	75.6	10.6	389	36.3	36.2
100	150	13	20.6	77.2	10.0	215	46.5	82.7
150	200	19	32.5	72.1	13.7	781	83.7	66.3
200		108	100.0	62.2	67.2	338	99.8	91.4

Fig. No. 9
Cumulative Percent of Screen Analysis on Concentrate
Test No. 8
Test No. 9
Test No. 10

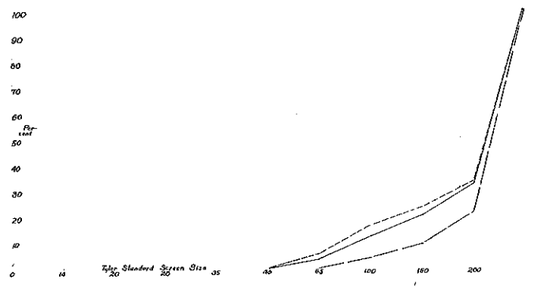


Fig. No. 10
Cumulative Percent of Screen Analysis on Concentrate
Test No. 11
Test No. 12
Test No. 13
Test No. 14

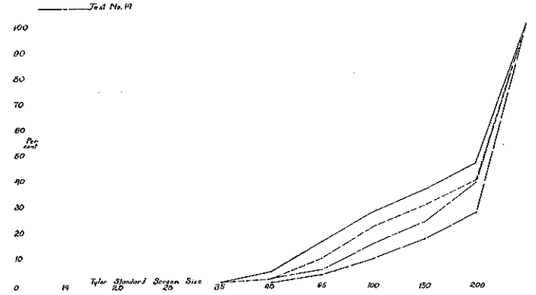


Fig. No. 11
Grade of Products
Test No. 8, Concentrate
Test No. 9, Concentrate
Test No. 10, Concentrate
Average Tail

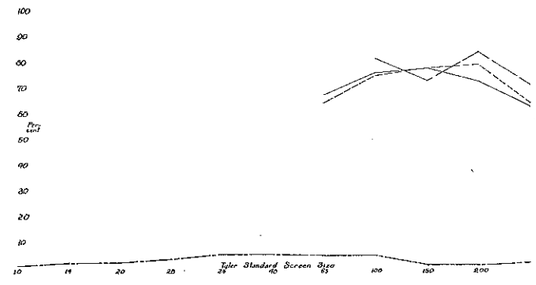


Fig. No. 12
Grade of Products
Test No. 11, Concentrate
Test No. 12, Concentrate
Test No. 13, Concentrate
Test No. 14, Concentrate
Average Tail

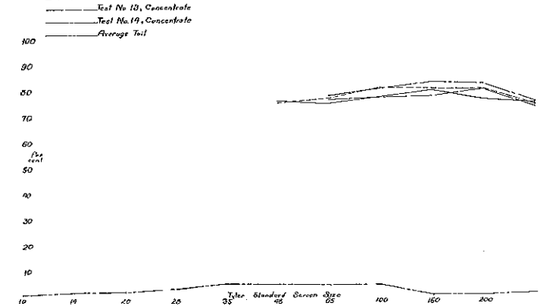


Fig. No. 13
Recovery
Test No. 8
Test No. 9
Test No. 10

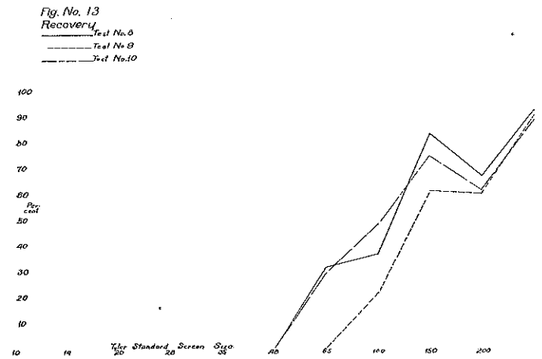


Fig. No. 14
Recovery
Test No. 11
Test No. 12
Test No. 13
Test No. 14

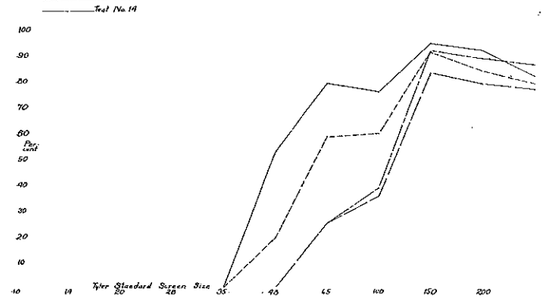


Fig. No. 15
Flotation of Pure Galena
Test No. 15
Test No. 16

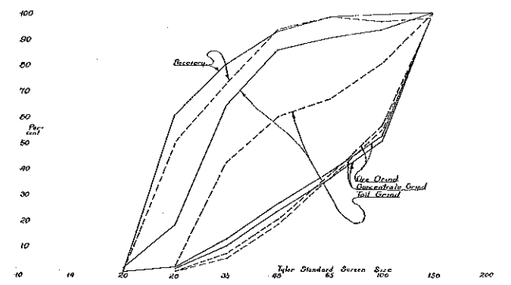


TABLE XI—*Test Number Nine.*

Mesh Thru	Mesh on	Concentrate Gms.	Concentrate Cum. %	Concentrate % Pb.	Concentrate Gms. Pb.	Tail Gms.	Tail Cum. %	Recov.
	10					77	4.2	
10	14					148	12.3	
14	20					169	21.6	
20	28					124	28.4	
28	35					137	35.9	
35	48					73	39.9	
48	65	6	5.9	64.0	3.8	69	43.7	39.2
65	100	11	16.7	74.3	8.2	92	48.8	47.9
100	150	7	23.6	77.2	5.4	136	56.3	74.0
150	200	10	33.4	78.8	7.9	479	82.7	60.8
200		68	100.1	63.6	43.2	314	100.0	87.7

TABLE XII—*Test Number Ten.*

Mesh Thru	Mesh on	Concentrate Gms.	Concentrate Cum. %	Concentrate % Pb.	Concentrate Gms. Pb.	Tail Gms.	Tail Cum. %	Recov.
	10					1		
10	14					9	0.5	
14	20					64	4.1	
20	28					211	16.0	
28	35					100	21.6	
35	48					122	28.5	
48	65					186	39.0	
65	100	3	4.1	81.0	2.4	195	50.0	21.2
100	150	4	9.5	72.3	2.9	565	81.8	60.4
150	200	9	21.7	83.3	7.5	322	99.9	59.5
200		58	100.1	70.9	41.2			89.1

TABLE XIII—*Test Number Eleven.*

Mesh Thru	Mesh on	Concentrate Gms.	Concentrate Cum. %	Concentrate % Pb.	Concentrate Gms. Pb.	Tail Gms.	Tail Cum. %	Recov.
	10					771		
10	14					129	13.1	
14	20					141	27.4	
20	28					99	37.5	
28	35					85	46.1	
35	48	3	4.4	76.1	2.3	42	50.4	52.3
48	65	8	16.0	75.5	6.0	34	53.8	78.9
65	100	8	27.6	77.8	6.2	41	58.0	75.6
100	150	6	35.8	80.0	4.8	27	60.7	94.1
150	200	7	46.0	76.7	5.4	55	66.3	91.5
200		37	99.7	75.1	27.8	334	100.2	81.6

Note: Plus ten mesh tail rejected and not considered in calculation.

TABLE XIV—*Test Number Twelve.*

Mesh Thru	Mesh on	Concentrate Gms.	Concentrate Cum. %	Concentrate % Pb.	Concentrate Gms. Pb.	Tail Gms.	Tail Cum. %	Recov.
	10					474		
10	14					146	10.7	
14	20					127	20.1	
20	28					101	27.5	
28	35					99	34.8	
35	48	1	1.4	75.5	0.8	65	39.6	19.5
48	65	6	9.5	77.3	4.6	68	44.6	58.2
65	100	9	21.7	81.1	7.3	103	52.2	59.8
100	150	6	29.8	80.9	4.9	45	55.5	90.8
150	200	7	39.3	80.7	5.6	121	64.4	83.6
200		45	100.1	74.7	33.6	483	100.0	78.5

Note: Plus ten mesh tail rejected and not considered in calculation.

TABLE XV—*Test Number Thirteen.*

Mesh Thru	Mesh on	Concentrate Gms.	Concentrate Cum. %	Concentrate % Pb.	Concentrate Gms. Pb.	Tail Gms.	Tail Cum. %	Recov.
	10					436		
10	14					118	7.7	
14	20					109	14.8	
20	28					99	21.3	
28	35					112	28.6	
35	48					89	34.4	
48	65	2	3.0	76.7	1.5	94	40.6	25.0
65	100	4	9.0	77.2	3.1	117	48.3	35.6
100	150	5	16.5	77.9	3.9	79	53.5	82.9
150	200	7	26.9	80.4	5.6	128	61.9	78.8
200		49	100.1	78.3	36.1	583	100.1	76.4

Note: Plus ten mesh tail rejected and not considered in calculations.

DISCUSSION

Sphalerite

Figures No's 1, 2, 3, 4, and 5 were plotted from the data obtained from tests No's. 3, 4, 5, 6, and 7. In figure 5 it will be noted that for screen sizes larger than 65 mesh, the curves do not check very closely, although having the same general trend. This is because the products were weighed only to the nearest gram, and due to the small amount of zinc in the sizes above 65 mesh, an error of a fraction of a gram in weighing the concentrate would materially affect the calculated recovery. For this reason,

TABLE XVI—*Test Number Fourteen.*

Mesh Thru	Mesh on	Concentrate Gms.	Concentrate Cum.%	Concentrate %Pb.	Concentrate Gms.Pb.	Tail Gms.	Tail Cum.%	Recov.
	10					511		
10	14					123	8.9	
14	20					106	16.6	
20	28					96	23.5	
28	35					102	30.9	
35	48	1	1.7			89	37.4	
48	65	2	5.0	78.4	1.5	94	44.2	25.0
65	100	6	15.0	80.7	4.8	159	55.8	38.7
100	150	5	23.3	83.1	4.2	43	58.9	91.4
150	200	9	38.3	82.7	7.4	106	66.6	88.2
200		37	100.0	76.0	28.1	457	99.9	75.9

Note: Plus ten mesh rejected and not considered in calculations.

it was felt to be permissible to average this portion with the rest of the data to obtain the average curves shown in figure 6.

It will be noticed that in figure 6 the curves for cumulative percent of head concentrate and tail are parallel, within the limits of experimental error, except that the concentrate curve gradually flattens as it reaches the larger sizes of mineral.

This seems to indicate that the weight of any given size of sphalerite that will float is proportional to the amount of that size in the pulp the percentage falling off, however, as the maximum possible size floatable is approached. Stated another way, the amount floated is a function of the amount present, and of the ease of floating.

The recovery curve is rather interesting in that it shows that it is possible to float 28 mesh sphalerite, but a commercial recovery is not obtained until the sphalerite is ground to 65 mesh. This was to be expected from theoretical consideration as mentioned in preliminary discussion. Since there were no attached particles, the grade of concentrate would be expected to be practically a straight line, as it is.

The grade of tail curve rises between 20 and 28 mesh, then drops between 28 and 65 mesh, and is practically level from 65 mesh to minus 200 mesh, showing that maximum extraction is at sizes smaller than 65 mesh, and that the sphalerite, being soft, tends to be concentrated into the smaller sizes by grinding.

Galena

As can be seen from the data, a satisfactory procedure was not evolved until the last few tests, namely, No's. 12, 13 and 14.

The difficulty was in grinding the gangue to a size the flotation machine could handle, without grinding the galena to very small sizes. This is exactly the same difficulty that confronts commercial plants. The wasteful grinding of gangue after the minerals are freed is the cause of high grinding costs. In this work, the difficulty was removed by screening after a short grind, rejecting the oversize and floating the undersize in tests No's. 11, 12, 13, and 14.

In making tests No's. 8, 9, and 10, the ore was ground longer with consequent overgrinding of the galena.

The difference in the results of the two procedures is clearly shown in figures No. 11 and 12; and figures No. 15 and 16.

In test No. 11, the time of grinding was 2 minutes as compared to 3½ minutes in tests No. 12, 13, and 14 and there was a correspondingly larger amount of plus ten mesh screened out. The shorter grind left more galena in the larger sizes, as shown by the higher recovery and weight of these sizes in No. 11, as compared to No's. 12, 13 and 14.

It will be noticed that test No. 9 had a 5 minute grind while No. 10 had 7 minutes and No. 8 had 10 minutes. The recovery and weight of concentrate of No. 9 are seen to be greater than of the other two tests.

CONCLUSIONS

1. Mineral can be floated at sizes larger than is done in most present day plants. The cardinal principle of ore dressing is, of course, that concentration cannot be effected without freeing the minerals from the gangue, but modern practice seems to have overstepped the mark with the result that perhaps 80% of the ore is ground to minus 200 mesh in order to break up a few percent of refractory material.

2. In order to reduce grinding costs, methods or flow sheets will have to be devised for flotation to act on the mineral as soon as it has been ground to a floatable size.

The method now used at Climax, Colo., of a brief preliminary grind and rough flotation followed by a regrind and cleaning of the froth indicates the trend future development will have to take.

3. Classification is one of the difficulties standing in the way of decreased grinding costs. Since classifiers separate the pulp on the basis of settling rates, the small mineral is sent back for regrinding and the large gangue goes into the overflow, which is exactly the opposite of desirable. The mineral should be ground to a size that can be floated, and then floated, not reground.

4. The size of mineral floatable is proportional to the grade of the head. High grade ores yield larger sized pieces in concentrate than low grade ores, because there is so much greater chance of some large particles being attached by bubbles.

The matter of dispersion is important in floating the larger mineral particles. Present-day machines are ineffective in keeping large mineral pieces dispersed.

ACKNOWLEDGMENTS

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The thanks of the writer are also due to the St. Joseph Lead Co. who furnished the ores which were used for the work.

TABLE XVII—*Test Number Fifteen.*

Mesh Thru	Mesh on	Froth Gms.	Froth Cum.%	Tail Gms.	Tail Cum.%	Recov.	Cum.%
	10						
10	14						
14	20			2	1.9		.1
20	28	26	1.2	17	18.4	60.4	2 0
28	35	188	10.1	47	64.1	80.0	12.6
35	48	288	23.8	22	85.5	92.9	26.6
48	65	262	36.2	5	90.4	98.2	38.7
65	100	301	50.5	3	93.3	99.1	52.4
100		1047	100.1	7	100.1	99.5	100.0

TABLE XVIII—*Test Number Sixteen.*

Mesh Thru	Mesh on	Froth Gms.	Froth Cum.%	Tail Gms.	Tail Cum.%	Recov.	Cum.% of Head
	14						
14	20						
20	28	1	0.1	1	2.2	50.0	0.2
28	35	48	5.4	18	42.2	72.7	7.2
35	48	118	18.5	8	60.0	93.7	20.5
48	65	161	36.4	3	66.7	98.2	37.8
65	100	167	54.9	6	80.0	96.6	56.1
100		406	99.9	9	100.0	97.8	100.0

Anomalies of Vertical Intensity

By GEORGE B. SOMERS, '30

Correlation of the anomalies of vertical intensity of the earth's magnetic field with the regional geology of North America

CHAPTER III—INTERPRETATION, CONTINUED

GEORGIA[24]

Geologically this state can be divided roughly into three sections, namely, the northwest corner which consists of Paleozoic sediments, the northern half less the northwest corner where igneous and metamorphic rocks predominate in the mountains, and the southern half or Coastal Plain where Mesozoic, Tertiary and Recent formations are found. In this Coastal Plain area a structure contour map shows that the regional dip of the sedimentaries is to the southeast.

The magnetic interpretation is somewhat difficult. The mountainous area, or second one described above comprises both "highs" and "lows". A comparison with the geologic map in Professional Paper No. 71 of the United States Geological Survey indicates that the "lows" coincide with the Pre-Cambrian rocks and the "highs" with the Post-Cambrian intrusives. Whether this effect is accidental, or is actually the case, the writer was unable to determine from either the government map or state maps furnished by the Geological Department of Georgia. The effect may also be due to a difference in the composition of the rocks or to the location of the various stations, it is impossible to say which from available data.

Considering the northwest corner, the effect near the mountains is "low", corresponding to the adjacent Pre-Cambrian rocks. The "high" in the extreme north west corner is too small to be an indication of conditions.

In the Coastal Plain section "highs" are found near the mountains and "lows" near the southeastern corner which indicates the Florida type of anomaly that reveals the southeastern dip of the strata directly. There is, however, a "high" that approximately covers the area between longitude 82° to 85° and latitude 31° to 31°30′, and extends into Florida at two points. Comparing this with the structure map of this region it can be seen that the "high" corresponds to a local anticlinal structure that is superimposed on the regional one.

IDAHO[25]

Stations in Idaho were few and far between as a glance at the United States Coast and Geodetic Survey map will show. By drawing the isonomalic lines before the geology was studied some peculiar effects were obtained. For example the extreme "high" by the D of Idaho is from a single station in a basalt area. This was connected by isonomalic lines with another "high" station near the Montana boundary. There is no geologic connection apparently between these two places. Likewise the same difficulty is found near H where one station near the H, with a positive anomalie of 3 gamma, caused the isonomalics to be drawn in a northwest-southeast direction half way across the state.

If the above is taken into consideration it will be seen that the area occupied by the Idaho batholith is negative, which agrees with similar intrusives in Colorado, Wyoming, New Mexico, and other states. It is probably due to the location of the magnetic stations in valleys.

Tertiary lavas found in the southern part of the state and also along the western boundary give large anomalies both positive and negative, with the former more common than the latter.

Since basaltic areas normally appear to be magnetically "high", the "low" portions may be due to reversed polarity caused by movement, the location of the stations in valleys below the local magnetic poles or to the absence of lava at that point. The anomalies in either case are due to local polarity and have no significance in regard to structure.

The "low" just south of D, however, is from three stations, two in Idaho that occur in the Idaho batholith, and one in Oregon. It is evident that these lines, as explained above, should not have been connected in this manner.

There are so few stations in Idaho and so few areas where magnetometer surveys would be of value that it was considered unnecessary to redraw the isonomalic lines in the state at this time.

ILLINOIS[26]

A comparison of the structural map of Illinois, given in Mr. Moulton's publication, with the isonomalic map gives very unsatisfactory results. "Highs" which cannot be correlated with structure are also reported from eastern Illinois[27] as the results of magnetometer work.

The structure map based on the approximate horizon of No. 2 coal, shows the La Salle and the Duquoin anticlines and two low areas, one by the N of Illinois on the isonomalic map, and one in the southern part between the I and the Indiana boundary. The general dip of the formation is from northwest to southeast, the La Salle anticline being a plunging one superimposed on the regional structure.

The La Salle anticline, which extends from La Salle county in the north to Wabash county in the southeast is marked by "lows" at its southern end and a "high" at the northern one with a minor high about the center. This seems to indicate the plunging effect. However, to the east of this anticline in the syncline near the Indiana boundary we find extreme "highs" to be the rule.

The Duquoin anticline which extends from Fayette county southward to Jackson county, is marked by a decided "high" but so also are the two structural lows in Wayne and Shelby counties mentioned above. "Highs" also occur along the western half of the state where the structure is rising, which is just the reverse of the conditions found in eastern Illinois.

It can be seen from the above statements of the magnetic conditions found over certain structural features that little correlation can be made from the data available. Several

24.—McCallie, S. W. State Geologist. Personal communication and maps.
25.—Laney, F. B. Head. Dept. of Geology, University of Idaho, Moscow, Idaho. Water Supply Paper No. 489. U. S. Geol. Survey (Distribution of Tertiary lavas, p. 281).
Journal of Geology, Vol. 36 (1928) p. 675. (Idaho Batholith).
Bulletin No. 199. U. S. Geol. Survey (Tertiary lavas, map pg. 13.

26.—Moulton, Gail F. Geologist in Charge, Petroleum Section, Illinois State Geological Survey. Personal communication.
Moulton, Gail F. Carbon Ratios and Petroleum in Illinois. Report of Investigations No. 4. Illinois State Geological Survey. 1925.
27.—Oral communication by Dr. C. A. Heiland.

assumptions or speculations in regard to these anomalous conditions are possible and will be considered here in detail since the same conditions are found in adjoining states under possibly similar circumstances.

(1) It is noticeable that these anomalous effects occur in Iowa, Illinois, Indiana and northern Ohio or in other words in states covered with the terminal moraine of the Pleistocene ice sheet. Anomalous magnetic conditions however are much less pronounced in Minnesota, Wisconsin and Michigan where the glacial till is thinner. It should also be noted that glacial drift has little or no effect in North Dakota, eastern South Dakota and Nebraska or in New York State. This leads then to the conclusion that the magnetic anomalies in Iowa, Illinois, Indiana and Ohio are due to local effects in the glacial till which came partly from the iron formations of northern United States and southern Canada. In New York and the Dakotas the glacial drift which was derived from ordinary types of rocks, has little or no effect.

According to Dr. Heiland[28] most European geophysicists do not believe that glacial till produces magnetic anomalies. It is interesting to note therefore that results in this country appear to check that belief except in those states where the glacial material may have been brought from iron formations.

(2) The crystalline basement rocks may be the cause due to their surface structure not coinciding with that of the overlying sedimentaries.

(3) The crystalline basement rocks may be the cause but the effects be due to irregular concentration of magnetite.

(4) The anomalous effects may be due to local causes in the sedimentaries such as:

(a) erosion of beds containing magnetite
(b) various geological conditions existing during deposition
(c) irregular thickness of the magnetic bed.

Of these different possibilities the writer inclines to Glacial Drift from Iron Formations Theory as being the one which most nearly satisfies all conditions. The acceptance of the theory does not mean that magnetometer work will not prove satisfactory in this state but does imply that care must be used in interpreting results inasmuch as there may be many local effects not related to structure. These effects merely proved too strong to attempt to correlate regional structure by means of stations many miles apart.

Indiana[29]

Structurally, based on the upper surface of the Trenton limestone of Ordovician age, this state may be divided into three parts as follows. Extending from the northwest to the southeast corners of the state is a structural high with a sag a short distance northwest of the central point. The southern end of this high, called the Southeastern geanticline is the Northwestern arm of the Cincinnati geanticline. To the northeast the Trenton limestone dips down 1500 feet, and to the southwest 4500 feet to the borders of the state.

Comparing this pronounced structure with the magnetic anomalies shows apparently no connection between the two, since magnetic "highs" and "lows" occur indiscriminately over structural highs and lows. In all probability therefore, the anomalies in this state are due to the same causes as those in Illinois. The writer believes the most probable of these to be local effects in glacial drift due to magnetic materials brought down from the iron formations to the north.

Iowa[30]

Although the structural contour map, based on the top of the Saint Peter sandstone, found in the Annual Report of the Iowa Geological Survey, Volume XXXIII, Plate I is very regular and shows on the whole a structure dipping from north to south, the magnetic map is highly irregular and at no place appears to conform with the structure. The structure map also shows a northeast-southwest syncline in the southwestern corner of the state, a minor depression in the southeast corner, and an anticline in the approximate center of the state. No indication of any of these structures is, however, shown by the isonomalics.

The writer is, therefore, inclined to the belief that the anomalies are due to local rather than to regional causes produced probably by magnetic minerals brought by the glacier from iron formations to the north during the recent ice ages. This and also other possible causes for the irregularities were discussed fully under Illinois. The same deductions and conclusions made for that state will serve for this one.

Kansas[31]

Although good results have been obtained in Kansas with magnetometer surveys, the isonomalic map accompanying this thesis gives far less regional information than it does for most of the other states outside of the glacial drift area. A close inspection, however, of both isonomalics and geologic structure brings forth a number of interesting, but as far as the state is concerned unfortunate points which will be discussed later.

Structural data was obtained largely through the courtesy of J. W. Ockerman. The isonomalic map accompanying this thesis was then compared with the isonomalic map of L. Sparagen[31a] and found to check closely when the difference in isonomalic intervals was considered. A somewhat different interpretation was, however, placed upon some of the results obtained. Additional magnetic data was also obtained from Bulletin No. 13, of the Kansas Geological Survey.

The surface formations in Kansas are all sedimentary and range in age from Mississippian in the southeast corner to Tertiary in the west. The regional dip of the strata is to the northwest away from the Ozark uplift. There are a number of buried granite ridges which were probably covered by the waters of the Pennsylvanian Sea.

The interesting geological and magnetic features of the state are as follows:

(1) The Chautauqua Arch in southeastern Kansas which is well shown by magnetic "highs".

(2) An anticline in Shawnee and Osage counties in the eastern part. There is only one station which appears on this anticline, that one being a short distance northwest of the last S of Kansas. It is evident therefore that this anticline is too small in comparison with the number of available stations to be outlined on the map.

(3) The "Granite Ridge" which extends from Marshall and Nemaha counties in the north, southwestward to Sumner and Cowley counties in the southern part. This is one of the most interesting features of the correlation. It is a well known structure which plunges from north to south, and has been located both by drilling and by magnetometer surveys. The station map shows that only two

[28]—Oral communication.
[29]—Logan, W. N. State Geologist. Personal communication.
Logan, W. N. Petroleum Industry in Indiana in 1923. Trans. A.I.M.M.E. pp. 1-6. March, 1924.
Logan, W. N. Some Features of the Upper Surface of the Trenton Limestone in Indiana. Proc. Ind. Acad. Sci. Vol. 38, 1928 (1929).
[30]—Lees, James H. Assistant State Geologist. Personal communication.
[31]—Ockerman, J. W. Geologist. Geological Survey of Kansas. Personal communication.
Kansas Geological Survey Bulletin No. 13. The Granite Ridge of Kansas.
Sparagen, L. Series on the Magnetometer in Kansas Oil and Gas Journal, Oct. 11, Oct. 18, Oct. 25, 1928.

stations in northern Kansas are on the ridge, and that both of these give positive anomalies where the ridge comes within a few hundred feet of the surface. South of that point the stations accidentally occur on both sides of the ridge but not actually on it. At that point i.e., south of the last A of Kansas, we find a "low" which is probably due as much to the stations being off the ridge as it is to the greater depth of the ridge at that point.

(4) The Bluff City anticline from Harper to Butler county in the south. This anticline appears as a "low", but whether this is due to the anticline being negative or to stations being located to one side of the axis the writer does not know. The former is indicated.

(5) The Abilene anticline from Kingman to Marshall county in the east central part of the state. This structure is roughly outlined by a line of magnetic "highs".

(6) The Darton Arch in west central Kansas is shown by a "high" except for its nose which points east.* This appears as a "low". This anomalie may be due either to the eastward dip of the nose or to the fact that the location of stations does not show the high point of the structure.

(7) The Salina basin in the north central part is roughly shown by a magnetic "low".

(8) The three anticlines in northwestern Kansas which extend from Decatur to Lane county, Phillips to Ellis county and Osborne to Rush county are all in a magnetically high area. Only one station, however, seems to be right on an anticline and that one causes the extreme "high" just north of the K A of Kansas.

(9) An anticline in the southwestern part from Hamilton to Grant county is not indicated by available stations.

It can be seen from the above summary that the United States Coast and Geodetic Survey's stations, while no doubt excellently chosen for their work, were unfortunately situated for revealing regional structure. It is regretted that such is the case in a state in which the magnetometer works as satisfactorily as it does here. Nevertheless the point is well brought out by studying the results in other states as well as in this one that sufficient stations must be chosen to show true structure and not some purely local effect. The above information, though, poor as it is, indicates that both positive and negative anomalies may show structural highs in this state.

Kentucky[32]

A number of interesting points can be brought out in correlating the results from this state. To do so the state may be divided for convenience into six divisions. These are as follows:

(1) The Cincinnati Arch is undoubtedly the most important regional structure in the state. Its axis which extends in a northeast-southwest direction is shown by a "low" at its northern end, and a "high" in the southern part. This paradoxical situation was explained by cross section diagrams (after Jillson) which were found in Emmons[32] pg. 234-5. From these diagrams it could be seen that though the arch sloped downward more or less regularly to the east and west, that considered from north to south there was a sudden downwarping about two fifths of the distance from the Ohio to the Cumberland river. These diagrams also showed that many sedimentary beds had been eroded from the structurally higher part to the north and that these appeared again to the south where the basement rock was relatively much lower although the surface elevation remained approximately uniform.

Considering the isonomalic map it will be observed that the northern geologically high part is "low" while the south or low part is magnetically high. The writer is not familiar enough with the stratigraphy of Kentucky to explain this phenomenon. Referring the reader to Colorado, the explanation seems to lie in the presence of a magnetic sedimentary bed which has been eroded from the northern part of the arch. It may, however, be due to a difference in the basement rock.

(2) The western Kentucky geosyncline is only shown by one "low" area marked be the E of Kentucky. It is quite probable, however, that it would have shown up further to the east and west had there been more stations. Little, therefore, can be inferred about this structure.

(3) An anticline just south of the geosyncline mentioned in (2) was shown on the cross section map but could not be located elsewhere. It appears as a "low" just south of the first K of Kentucky, but since its exact location is not known it will not be considered further.

(4) All of the oil and gas pools shown in 1926 appear on the map in areas marked by magnetic "highs".

(5) The mountainous region along the Virginia and West Virginia border, is characterized by both positive and negative anomalies which seem to be due to local rather than to regional causes.

(6) The Ozark structural axis which appears in Kentucky as the Rough Creek uplift and the Campton anticline was not shown on the map sent me by Dr. Jillson. It was found on a map after Gardner[33], Siebenthal and others but was only shown roughly. It appears, however, except at one point in the eastern part to follow a line of magnetic "highs".

Louisiana[34]

The state of Louisiana lies entirely within the Gulf Coastal Plain. Its surface formations range in age from Tertiary to Recent.

The chief structural features are the Sabine Uplift in the northwestern part and the Monroe uplift in the north. Both of these uplifts are shown by magnetic "highs".

In all sections of the Gulf Coastal Plain the magnetic "highs" in general appear to coincide with the geologic highs, according to the Florida type. For this reason it is interesting to note that the salt dome area in the southern part is almost entirely a "high". There is also a promising "high" which extends from a short distance east of the L O of Louisiana eastward into Mississippi which may possibly represent a structural high.

Maine[35]

The geology of Maine is very complex as can be seen from the following quotation from Dr. E. H. Perkins letter.

"The rocks of the state have been deformed several times; Pre-Cambrian, Devonian, and Carboniferous. During these movements, especially during the Appalachian Revolution the rocks were folded and thrust over each other. Igneous intrusions of Pre-Cambrian, Devonian, and Carboniferous ages have added to the complexity. I believe that during Triassic and Jurassic time there was considerable block faulting. Finally, the Pleistocene glacier

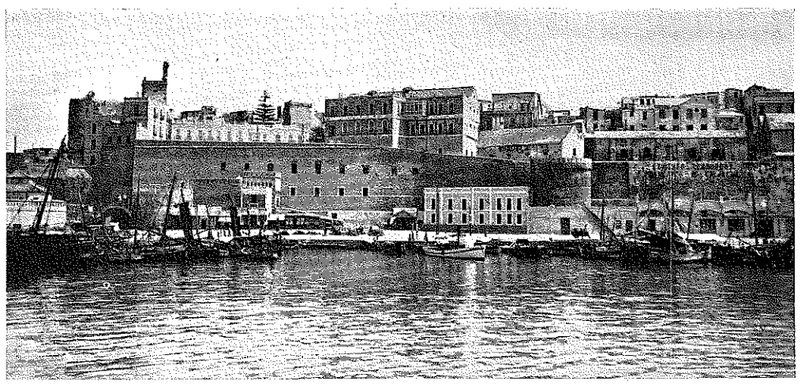
*Ladner, A. L. (Texas Co.) in an oral communication reports that the Darton arch has no magnetic effect.
[32]—Jillson, W. R. State Geologist. Personal communication.
Jillson, W. R. New Oil Pools of Kentucky, p. 342, Series VI, Kentucky Geological Survey 1924-6.
Jillson, W. R. Geology and Mineral Resources of Kentucky. Series VI, Kentucky Geological Survey 1928.
Emmons, W. H. Geology of Petroleum, p. 234-5, 1921.
[33]—Emmon, W. H. Geology of Petroleum, p. 201, 1921.
[34]—Emmons, W. H. Geology of Petroleum pp. 349, 369.
Ingham, W. Structural map after Spooner, W. C. (see Texas).
Sparagen, L. Series on the Magnetometer in Louisiana. Oil and Gas Journal, April 4, April 18, 1929.
[35]—Perkins, Edward H. Head of Dept. of Geol. Colby College, Waterville, Maine. Personal communication.

(Continued on page 40)

Glimpses of Spanish Morocco

The quaint city of Melilla
Business at leisure
No good brooms

By J. A. Riley, '23



The old Moorish section of the City of Melilla. Fishing boats in the harbor.

MELILLA, a city of 40,000 people, is about midway between Ceuta and Oran on the southern shores of the Mediterranean, which at this point is about 110 miles wide. Situated on the neck of a small peninsula, the point of which is called *Cabo Tres Forcas,* that juts northward into the Sea, it commands a due-east view of the ever-widening Mediterranean. Naturally, having sailed south from Spain to reach Africa, one expects to look back north over the water. That one looks east in place of north from the harbor or city is extremely confusing and makes it difficult to orient ones self for an unusually long time.

The harbor comprises a nearly finished municipal dock and break-water combined, and a privately owned ore-loading dock slightly to the south. Both extend east from the land and between them is calm water when the wind does not come from the east—and a *levante*, as an east wind is called, is the worst of all the winds that blow. Several times ships have had very narrow escapes in the harbor because of the unexpected and unannounced arrival of a hard blow from this quarter. Just three years ago March, three ships were lost within the harbor—being unable to make their safe departure. Harbors here being what they are makes them only a place to unload vessels or load them; not a place of safety. However, between six and eight hundred ships call here each year. Most of them call for iron ore, of which the port ships some 1,000,000 long tons annually. This production is divided between one large and one small producer in the proportion of about eight to two.

The most interesting hour in the harbor is just after day breaks and the fishing boats come in to port in a marine parade. With their engines chugging away—those that have them—with the added load of several strung out behind that don't have them; all their brilliant gasoline fishing lights still going full; and the yells and hub-bub always attendant upon the event, they make quite a picture.

Shortly after the daily mail boat from Malaga comes in and the port then settles down to the daily routine of loading and unloading ships from all along the African Coast from Tangiers to Algiers, and from ports of Spain and France. They are all small ships and use the dock, but the larger ships, when cargo demands their stopping here, use the outer harbor, discharging into lighters in the usual small-port manner.

The history of Melilla and the country immediately surrounding undoubtedly goes back to the time of Carthage. The coast was thoroughly scoured during those times and the position of the town makes it very unlikely that its location was missed. That any settlement was made here at that time is not likely yet not impossible to suppose. Some twenty-five miles westward on the coast, at a small village called *"Afrau"*, the Romans have left unmistakable proof that they visited here even to the extent of partially exploiting some small deposits of iron. The slag piles and their smelters—smelters made in the sides of hills in the solid rock—still are to be seen. The location of Melilla being so much more in evidence from the sea, it is reasonable to suppose that, at least in the time of the Roman Empire, this location was known. Particularly as at the point of *Cabo Tres Forcas* there are evidences of iron right at the sea. This location is held by one of the operating companies here as a possible site for future operations.

Little of importance has brought this territory into prominence since then. The Portuguese landed not far from Melilla at one time but were driven out by the Moors, who at that time also were making their successful invasion of the Spanish Peninsula in Europe. A rugged, uninviting, semi-barren land, it has not lent itself to any extent to exploration or exploitation of its mineral deposits. Its modern history really dates only from the first years of the twentieth century, and the section is probably best known from the war between the Spanish and the Moors which lasted from 1921 to 1926 when *"Abdel-Crim"*, the Moorish Chieftain, carried on a guerilla warfare against the French and Spanish and was finally subjugated by their combined forces. His chief headquarters were near the present town of *"Sidi-Dris"* on the Mediterranean near the *Islas Alhucemas,* about thirty-five miles west of Melilla.*

Between the dock and the ever-present Spanish city plaza, of which Melilla boasts one, of course, is a row of one story eating houses as picturesque as can be seen anywhere. At once reminiscent of New York's lower Third Avenue and Coney Island's Bowery, they present all but the steaming corn-on-the-cob and the hot roast beef sandwiches. In their places are heaps of cooked cold shrimp in the shell, greasy shoe-string potatoes, fried devil-fish and sardines, a little salad of lettuce and olive oil, tomatoes, fruit, some cheap red wine, and on each small, uncovered, wooden table the ever-present *botijo,* the bottle of earthenware from which water is drunk. This bottle has a small spout, a holding ring, and an air vent on the top. The ring is grasped in the right hand, the bottle elevated by means of this ring and the left hand on the bottom of the bottle and then tipped until the water flows to the mouth from the spout which remains about six inches above the back-tilted head. The process is now complete and the drink is yours—provided!—you can hold your throat open allowing the water to enter without the necessity of swallowing! In this case you have quenched your thirst. Otherwise you have had a bath.

Both Moors and Spaniards—chiefly those who work near the dock—eat here at these little shacks. And if one does not mind the smell, it is quite a worth-while sight to watch. Sitting around the little tables, either inside or around the tables placed on the side-walks in imitation of the Cafes farther uptown, they eat their piece of fish and dry, hard bread and perhaps an orange. Eating with them is a rite and they accomplish the ritual with all the time-wasting and apparent luxurious ease they have learned from the better classes. Across the street is the State Department of Sanitation and Fumigation. It seems to mean little to them and less to those who eat there.

Starting at the base of the breakwater, and nearly hidden by these little eating houses, the old Moorish town extends westward, a little north of the present Spanish part, about three city blocks to just beyond the plaza. The trend of traffic so thoroughly avoids this old town that one may easily miss it. But it should be sought out and explored. Melilla takes so much from Africa, and so much from the Military, and so much from Spain that little is left, or rather acquired, to give it character or individuality of its own. So many influences have left it devoid of anything truly typical of the constituent parts. But here behind the breakwater is a little spot of extreme interest. The best view Melilla affords of the Moors trading and selling. Crooked streets wind aimlessly around; glad to exist at all perhaps, for certainly streets seem to be the last thought—the step-child—of the Moors planning. Both sides of the streets are lined with small stalls that are seldom more than ten feet square, in which sits a Moor. Kindly greeting a friend, business seems to be the least of his concerns. He is content to see the world go by his door, if only one or two will stop to buy. He is a good merchant and probably few who really intend to buy get away without a sale accomplished. His chief goods are cloth, of which both men and women use great quantities in their wearing apparel, shoes, leather goods, a small candle-holding Moorish lamp, perfumes, and trinkets without end. Their prices are things to be played with. In addition to being what he thinks he can get from the particular customer, one has also to consider that many of his goods are bought in the French Territory for French francs. A French franc is worth about a third of a Spanish *peseta,* but that is not considered. He buys for francs, adds his profit, and sells for that number of *pesetas.* A profit he determines and a profit the exchange gives him. Quite often one half of the asking price will buy the goods. One thing is very certain: though the kindly old man in the stall drops his price after due persuasion on your part, he has made a profit with which he is thoroughly satisfied.

Climb the hills near by and take a look at Melilla—This is what you see.

The rest of Melilla is very new—1909 really marks the beginning of its history. As a result of its newness and Military occupancy, it is surprisingly clean for a Spanish city. Its chief street, *"Calle Alfonso XII"*, though quite short, is wide and well paved. On it are stores of all sorts from which one may buy most of todays necessities. At six o'clock it is closed to traffic and is taken over by the people for their evening *paseo,* lasting well on to ten o'clock, when dinner is eaten. The other streets of the city are clean also and paved with well-laid cobbles. All the streets are watered daily, and generally speaking Melilla is a decent place to have to live. I say, "have to live" advisedly, for an American, with American cities to choose from, would not live in Melilla by preference. Compact as it is, it is hard to believe, on judgment based on a view from within, that the city harbors 40,000 people. But a view of it from the surrounding hills changes that doubt at once to a conviction.

Honestly Melilla has little excuse to exist and does so under several very real disadvantages. There is, of course, the Military, of which Melilla houses the second largest garrison in Morocco. Not creative in any way, it adds little to the city's well-being except in its function as a police force. The drinking water is very bad, the climate abominable with its wind and extreme heat in summer, and the harbor facilities little enough. In spite of this latter there are two iron producing companies that ship from the port—ship when the weather is good and wait for good weather when it's bad. These are really the only capital producing operations related to the city in any way. Deducting, then, the Military and the few people occupied within Melilla in the offices of the iron companies, there must be some 20,000 people who live either on the buying power of this same Military or on Melilla's only other function; that of a trading post between Spain and the Moors who live in the country surrounding the city. Strangely, Melilla is a city of Spain—actually a part of Spain though geographically separated from it. Within the physical

All Spanish towns have "Plazas". This is the one boasted of in Melilla.

*See "Adventuring in French Morocco" "Explosives Engineer", Sept. '25. By George Baekland.

limits of the city all is Spanish. Spanish postage stamps are used, customs duties are recognized by spanish customs stamps, and to all practical purposes one is in Spain. For the ground on which Melilla stands is Spanish owned—the territory surrounding is merely under the protection of Spain. In Morocco, Melilla shares with Ceuta the advantages of being a free port. The city, in the form of a municipal tax, levies a very small tax against imports, but this serves merely to pay the expenses of the personnel that must be maintained to examine all incoming goods, which examination must be made to preclude the possibility of entrance of arms and ammunition to the Moors. Any people without arms are not to be greatly feared, but Spain realizes what a great cost resulted and how nearly impossible it was to subdue these people once that no care is spared in keeping the Moors as they now are—absolutely disarmed.

While Melilla is virtually a free port of entrance, one must pass the Moorish customs to enter Morocco with goods of any kind. A tax of 5 per cent is levied against nearly everything that enters, and to this tax is also added a tax against and in proportion to the weight. On each road from the city is a customs house in charge of both Spanish and Moorish inspectors where all vehicles are stopped and searched. Duty is paid on the spot and the vehicle proceeds. The customs house closes at 4:00 p. m. except for the passage of passenger vehicles and is then only watched over by the Moorish customs officers—naturally a Spaniard has a little more trouble "getting away with something" after that hour. There is decidedly no love lost between these two factions in Morocco, though, of course, they are on the surface very peaceful. About nine in the morning is the most interesting time to pass by these customs houses. Sometimes for a quarter mile the auto trucks, horse-drawn trucks, burro trains, and various other means of transportation are lined up waiting to declare their goods and proceed. Time means little; some of the last to arrive spend half a day getting through, and the proceeding offers a very good cross-section picture of Moroccoan life.

Not far from Melilla is produced a fairly large amount of broomstraw. But it is not used to make brooms! From it the natives make rope and baskets. As a result, one may purchase very good baskets, terrible rope, and, if you want a broom, it will have to be one of palmetta grass!

EDITOR'S NOTE: This is the second travel article by J. A. Riley. An interesting description of the customs of the people in this Mediterranean country will be published in the December Magazine.

Old Ballot Recalls Memories

The election just past has set some of the Mines' grads to reminiscing. An old ballot used in 1891 was recently unearthed in the vaults at the Jefferson county court house.

Compared with the blanket-like ballot of today it is extremely small—only 7½x11½ inches.

The Democratic candidates are printed on one side of the ballot, under the emblem of a crowing rooster. On the other side are the Republican candidates, headed by the American eagle.

Among the Democratic candidates is listed the name of Dr. Paul Meyer for coroner. Doctor Meyer at that time was on the School of Mines faculty. He is one of the only two honorary members of the Mines' Alumni Association.

William B. Milliken was also on the ballot as Republican candidate for county surveyor. "Billy" was then a student at Golden, and was graduated in 1893.

Miners Came Back for 1930 Homecoming

The 1930 homecoming is now history. Many Alumni returned for the celebration, and although the outcome of the game with Teachers was disappointing, all went away satisfied with the efforts of the program committee and the day's entertainment.

A great many of the grads failed to "spot" the register at the Integral Club, and so their names were missed. About half a hundred names were recorded, however, and here they are: A. J. Weinig, '08; Max Scheble, '30; J. H. Steele, '00; R. Higgins, '17; C. A. Filteau, '07; Russell H. Volk, '26; Frank J. Wiebelt, '16; Al Wyner, '25; C. Lorimer Colburn, '07; Fred C. Carstarphen, '05; Warren C. Prosser, '07; E. S. Geary, '12; Arthur W. Buell, '08; R. J. McGlone, '27; V. C. Benderoff, '27; C. E. McWhorter, '24; J. D. Tolman, ex-'27; Wayne H. Denning, '26; Philip A. Ray, '29; Charles L. Harrington, '12; H. L. Minister, '16; F. J. Laverty, '25; W. L. Jude, '25; A. H. Bebee, '15; J. Harlan Johnson, '23; Charles N. Bronstein, '13; Morris K. Barrett, '24; Henry C. Keyes, '24; Donald Dyrenforth, '12; C. J. Garvin, '93; J. M. Tippett, '97; John Robertson, '22; W. H. Williams, '17; V. C. Benderoff, '27; Byron B. Boatright, '22; F. M. Fairbairn, '23; W. B. Milliken, '93; W. T. Graham, ex-'26; C. M. Glasgow, '10; A. J. Dexter, '05; C. C. Malmstrom, '00; T. C. Ellis, '06; Dave Dodge, '15; R. S. Adams, '27; W. G. Lofgren, '28; Fred C. Steinhauer, '99; H. H. Pratley, '22; Wm. P. Simpson, '01; Frank C. Bowman, '01; F. E. Briber, '16; Mrs. McArthur; R. H. Sayre; and Dr. M. F. Coolbaugh.

Students met the Alumni at the Integral and escorted them to the several fraternity houses where they were luncheon guests. Everyone assembled at the field early for the burro races and other special events. Then the game.

During the half Blue Key performed a trick of sawing a bear in two parts, to produce two homely Teachers.

The Kappa Kappa Psi, presented a German band which provided a novel satire and rendition of famous musical scores.

The main attraction during the half was the polo game between Theta Tau and Sigma Gamma Epsilon engineering fraternities. The latter team was victorious by the score of 6-3. This victory was the first for Sigma Gamma Epsilon, and their name is to be inscribed on the silver loving cup.

Following the game, part of the Alumni joined in the entertainment and dinner provided at the Armory, while others took part in the open house frivolities at the various fraternities.

About fifty attended the dinner given in the Armory dining hall. The principal talk was given by John E. Field. The toastmaster of the evening was Jimmie Steele, '00.

Carlton Bowman, son of Frank Bowman, '01, sang several numbers. He and Mrs. Bowman also rendered a duet. Scotty Whitman also sang several Scotch ballads.

The "M" club dance concluded the evening. A lively crowd was present and the affair was well attended. Tony Farraro's band furnished the music for the occasion. The hall was decorated in Mines' Blue and White.

The winner of the cup for homecoming decorations was announced during the latter part of the evening. Kappa Sigma was chosen as having the most attractive decorating scheme.

Principles of the Hydro-metallurgy and Electrodeposition of the Metals

IX. Chapter on Metal Recovery

By THOMAS P. CAMPBELL*

So far we have been considering the principles governing the methods by which ores and concentrates may be prepared for leaching, the leaching processes, and the methods of separation and purification of the leach pulps and solutions. All of which has been preliminary to the main point of the argument, to wit, the recovery of the main metal, either as such, or as one of its compounds.

In taking up this step in the general scheme of hydro-metallurgical operations, it is convenient to list the means employed in metal recovery as:

1. Metal replacement.
2. Chemical precipitation of a metal compound,
   (a) Salting out.
   (b) Formation of an insoluble salt, acid, or base.
   (c) Hydrolysis.
3. Physical precipitation,
   (a) Thermal decomposition,
   (b) Evaporation,—fractional crystallization.
4. Amalgamation.
5. Electrodeposition.

Or, in even broader terms, we may effect metal recovery from solution by:

1. Chemical means, (1) and (2).
2. Physical means, (3).
3. Physicochemical means, (4) and (5).

In point of antiquity, amalgamation (as in the Patio Process and stamp-milling), and fractional crystallization (as in salt and caustic soda extraction and purification) should come first. However, in present order of importance metal replacement and electrodeposition hold high rank.

Amalgamation is not, strictly speaking, recovery from solution, but rather a recovery from suspension. The process as used today consists simply in allowing comminuted ore of "free milling" grade to come in contact with mercury, or an amalgam of mercury and sodium. Depending upon the intimacy of this contact, more or less of the free gold and silver in the ore will form an amalgam (alloy, solid) with the mercury. "The fundamental requirements in plate amalgamation are: (1) that the precious metals shall be free and have clean, metallic surfaces; (2) that they shall be flowed over the plate in a pulp sufficiently fluid to permit metallic particles to sink readily; (3) that the velocity of flow be sufficiently low that the precious metal particles can sink to the plate surface, and yet high enough that other constituents of the pulp cannot remain permanently at rest thereon; (4) that the plate surface be clean and bright; and (5) that the amalgam be sufficiently soft (fluid) to permit it to spread over the metal particles. Bright metallic surfaces are usually obtained by grinding. Pulps normally contain 10 to 20 per cent. solids." (Taggart, op. cit., p. 960) The area of plates required, where amalgamation is chiefly relied upon for recovery, is 3 to 4 sq. ft. per ton of ore per 24 hours. When the amalgam has become sufficiently "loaded" with the precious metals, the plates are steamed and scraped to remove the amalgam.

*Associate Professor of Metallurgy, Colorado School of Mines.

"Intensive amalgamation" methods, such as those involving the use of a small direct current through the plates, milling in salt water, grinding with mercury, centrifuging the pulp with mercury, etc., are seldom sufficiently effective to justify the added expense. If ordinary apron-plate amalgamation is not sufficient, cyanidation would probably show better recoveries at lower cost than could be obtained by any "intensive" method. The final recovery of the rare metals is effected by first separating the excess of mercury (by straining through chamois), and then distilling off the mercury from the concentrated amalgam, leaving the gold and silver behind. It should be noted that the gold and silver never existed in true solution; and that ores containing the noble metals in compound forms, or too finely interlocked with other minerals, are not amenable to amalgamation. However, amalgamation is still used to a large extent as a preliminary to cyanidation, not only because amalgamation is a cheap process, but also because coarse, free-milling particles of Au and Ag dissolve very slowly in the dilute solutions employed in cyanidation.

Chemical precipitation methods are used, for the most part, in purification processes (vide supra) and in the recovery of those metals which cannot be separated by metal replacement or by electrodeposition. The details of the many processes in practice are too numerous and too highly specialized for treatment here. However, we may cite a few examples:

TUNGSTEN occurs in nature usually as some sort of an iron-manganese tungstate. The common method of extraction is to form a sodium tungstate*, by roasting; leach with hot water; separate and clarify the tungstate solution; and then purify the sodium tungstate by fractional crystallization. When this process has reached its economic limit, the (relatively) pure tungstate is redissolved and the solution treated with hot HCl solution. This precipitates tungstic acid (H_2WO_4), which may then be calcined to the oxide, WO_3. Another method involves removal of As, P, SiO_2, etc., by addition of $MgCl_2$, concentration of the W as calcium tungstate, $CaWO_4$, by addition of $CaCl_2$, and finally the production of H_2WO_4 by digestion with hot, dilute HCl.

VANADIUM is another metal which must be recovered as part of an anion (acid) group. Again, the extraction involves the formation of an impure alkali vanadate, the separation and purification of the solution, and the precipitation of a vanadic acid. Here, however, the conditions attending the acid precipitation play an important role. Under favorable conditions, up to 92% of the V may be precipitated by addition of H_2SO_4 until the solution is about 1/20N. In practice, the precipitation is a combination of salting out of the unstable metavanadate, and the acid decomposition of the orthovanadate. The sodium vanadate solutions are saturated with NaCl at or near the boiling point; then HCl (or H_2SO_4) is added, and the re-

*—Details of this and similar processes will be given in Part II of this work.

sulting precipitate contains a considerable amount of $NaVO_3$. The ores, concentrates, and precipitation products are sold on the basis of their "pentoxide" (V_2O_5) content.

The preparation of pure Al_2O_3 for production of Al, by fused-salt electrolysis, furnishes a good example of hydrolysis. The impure bauxite ore is treated, thermally, to form sodium aluminate ($NaAlO_2$). This is dissolved in water, the pulp separated, the solution purified, by various means, and the Al is then precipitated as $Al(OH)_3$ by bringing the solution to, or near, neutrality with CO_2. The hydrolysis is catalized by the addition of freshly precipitated $Al(OH)_3$. Agitation for long periods, under these conditions, will bring about a 70% recovery of the Al.

The principles underlying the reactions utilized in the above examples, are, for the most part, derived from elementary inorganic chemistry. Once again, these processes may be regarded as representing applications of the operations of qualitative and quantitative analysis. In most cases, it is helpful to write out the equation corresponding to the reaction in question, since this will usually indicate the conditions necessary for the industrial application.

For example, any hydrolysis may be looked upon as the reverse of neutralization—

$$Na_2Al_2O_4+4H_2O=2NaOH+2Al(OH)_3.$$

Sodium aluminate is the salt of a strong base with a weak acid; the reaction requires the addition of water, and from the thermal values involved, it is probable that the reaction is endothermic. Hence, dilution, agitation, and a high temperature would favor the process, while any excess NaOH would tend to bring about a reverse reaction. The catalytic value of the initial addition of $Al(OH)_3$ seems to depend upon the fact that $Al(OH)_3$ can exist in two modifications, having different physical and energy characteristics; the transition from one form to the other, as hydrolysis proceeds, allows the reaction to go. The function of the catalyst then appears to be that of a starter or promotor for the main reaction. The limit to dilution,—and therefore to recovery,—is economic, for the most part, being dependent on the coast of concentration (by evaporation) of the NaOH liquor for the next leach, cost of equipment, labor, etc., for handling large quantities of solution, etc., etc.,—not to mention the power cost for agitation and interest on metal tied up.

Fractional crystallization,—as well as the common, garden variety of concentration by evaporation,—is one of the oldest processes known. The production of salt by evaporation of brines in shallow pools was probably man's earliest attempt at chemical engineering. Fractional crystallization,—the separation of one crystal species from an impure mother liquor,—doubtless came later. In fact, it is only within the last century that the basic principles of this art have been even vaguely appreciated and applied.

Evaporation implies two, and only two, essential conditions[58]: first, an external source of heat to supply the sensible heat (specific heat of solution plus latent heat of vaporization of the volatile liquid) required to bring about vaporization of the solvent liquid; and, second, removal of the vapor thus formed from the free surface of the solution. The heat may be supplied either as direct heat *within* the body of the solution, or as indirect heat, through the walls of a suitable solid container. The vapor may be removed by means of some inert gas, acting as a scavenger, or simply as undiluted vapor, through convection, or by suction. The whole process may be carried out at atmospheric pressure, in open vessels; or under vacuum or pressure in enclosed vessels.

For the vast majority of cases met with in metallurgical practice, evaporation, as leading up to fractional crystallization, is carried out in open pans, or in multiple-effect evaporators, or in a combination of both. For simple evaporation, for straight crystallization,—as in the recovery of hydrated zinc sulfate from the products of a sulphatizing roast,—spray evaporators have been found to be very efficient.

In dealing with multiple-effect evaporators, there is a wide-spread impression that evaporation under vacuum requires less energy than does pressure or atmospheric evaporation. True, less heat is required to bring the solution to the point of ebullition; but on the other hand, the latent heat of vaporization increases with decrease in boiling point[59], so that the net gain is little or nothing. However, evaporation under vacuum leads to acceleration of evaporation in general, and to the use of efficient, compact apparatus, in particular.

The general principle of multiple effect evaporation may be illustrated by Fig. 16. Neglecting the raising of boiling-point by solutes, we may assume that saturated exhaust

[58]—Walker, Lewis & McAdams, op. cit., Ch. XIII.
Liddell, Handbook of Chem. Eng., Ch. XI.

[59]—W. K. Lewis, & H. C. Weber, Jour. Ind. Eng. Chem., vol. 14, No. 7, 485 (1922), give a useful approximation for variation of heat of vaporization with boiling-point, and with composition.

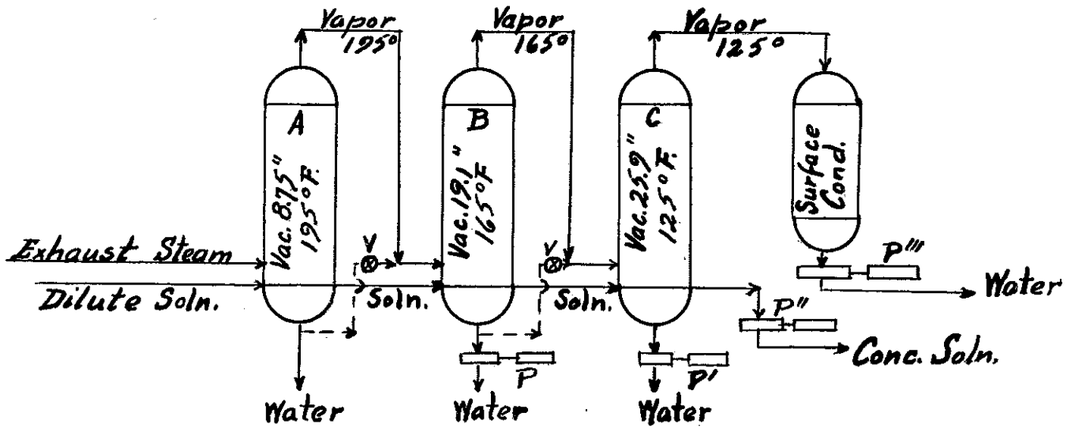


FIGURE 16—*Multiple Effect Evaporation.*

steam at 4.2 lbs. gauge (18.9 lbs. abs.) enters the heating coils of effect A. The solution to be concentrated also enters A, after being preheated to 195°F, in the "liquor space." In the type of effect here considered, the heating coils, or space, is separate from the liquor space. The exhaust steam will have a temperature of 225°, and the pressure in the liquor space will be 8.75 in. of vacuum (10.4 lbs. abs. at normal barometer). Thus the water in A will boil at 195°, and furnish steam to the heating coils of B at the same temperature. It should be noted that the vapor from the liquor space of A becomes the heating steam of B, and so on; the condensed steam in the heating space of A, B, etc., is then drawn off separately, except as noted otherwise below.

The liquor space in B will have a vacuum of 19.1 in., and at this pressure the boiling point in B is 165°. The vapor from B passes to the heating coils of C; and in the liquor space of C, the vacuum is 25.9 in., with a boiling point of 125°. Vapor from C, at 125°, then passes to the surface condenser. Since the condensed water in the heating space of A is above atmospheric pressure, it can run out under gravity. But in B and C, the condensed water is under vacuum; hence in these two effects the condensate must be removed by pumps P, and P′, while pump P‴ takes the final condensate from the surface condenser.

Part of the sensible heat lost in the condensates from the heating spaces of A and B may be recovered by allowing some or all of the A and B condensate to enter the liquor spaces of B and C, respectively, by means of the expansion valves, V. Due to diminished pressure, the condensate will flash into steam in the liquor spaces.

This arrangement of effects is called "parallel flow", since liquor and heating steam flow in the same direction. Obviously, instead of using a separate heating space in each effect, the vapor from the previous effect could be introduced directly into the liquor space of the next effect. In any event, theoretically, one pound of initial steam should bring about the evaporation of one pound of water in each effect. In practice this is not true, the actual evaporative capacity of a given number of effects operated in series varying widely with the conditions imposed. The actual conditions for a given installation can best be predicted by means of a heat balance, such as was illustrated in the chapter on roasting. In general, the capacity of one or more effects in series is directly proportional to the effective temperature difference between the steam supplied and the boiling solution in the last effect.

Finally, taking into account the fact that the boiling point of any solvent is raised by the presence of a solute (solid), it follows that the total number of effects is limited by the total temperature drop available to force heat through the heating surface (and this is the difference between the steam supply temperature and that of the condenser cooling water) *less* the total boiling point raising in all effects.

In metallurgical work, multiple effect evaporation is usually carried to such a point that the least soluble solute is on the verge of crystallization. The final stage,—that of actual crystallization,—is then obtained in open pans or kettles, where the progress of events may be watched.

Fractional crystallization,—the separation of one crystalline, pure solid, from a solution containing two or more molecular species,—depends upon two properties of solids: first, difference in solubility, and second the tendency of all solids to crystallize in a pure form. Hence, the process of fractional crystallization is founded upon a knowledge of the solubilities at various temperatures of the substances in solution. If a given substance is to be separated in as pure

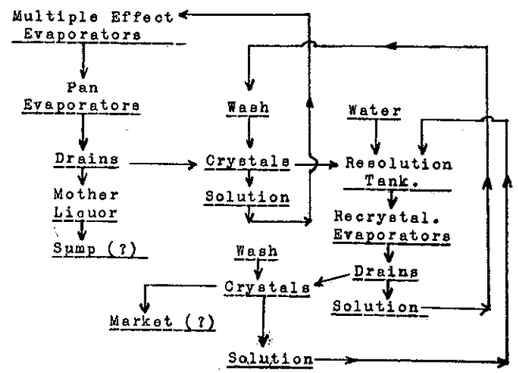


FIGURE 17—*Flow Sheet of Evaporation and Fractional Crystallization Plant.*

a condition as possible, the concentration of the solution, and the cooling effect during crystallization, should be regulated so that a certain amount of the substance will remain in solution. The crystals may then be separated from the mother liquor on drain boards, by settling and decantation, or by other suitable means. Some of the mother liquor will, of course, cling to the crystal surfaces, and this may be removed by washing with cold water. This wash water may be fed back to the evaporator system. Final washing and drying is often advantageously carried out in centrifuges. For high purity it is usually necessary to redissolve the first crystals in fresh water, or in the wash water from a secondary washing, to form a nearly saturated solution. Then recrystallization is effected by a second evaporation, the excess liquor from this stage being used as wash water in the first stage. A schematic layout is shown in Figure 17.

Turning now to the case of thermal decomposition, the outstanding example is that of the leaching solutions employing copper-ammonium carbonate.[60] Ammoniacal solutions of ammonium carbonate react with CuO, probably, in the sense of the following equation:

$$CuO+2NH_4OH+(NH_4)_2CO_3=Cu(NH_3)_4CO_3+3H_2O.$$

A similar reaction occurs with ZnO. In the case of finely dispersed metallic Cu (as in Cu-bearing sands, etc.) this leach is especially effective in that metallic Cu is not readily attacked by cold, dilute H_2SO_4. In practice, the leaching agent used for metallic Cu is $Cu(NH_3)_4CO_3$: in contact with the fine Cu, this cupric salt is reduced to the cuprous state, $Cu_2(NH_3)_4CO_3$. When live steam is blown into this cuprous solution, CuO is precipitated and the solution is oxidized again to the cupric state. In the case of the zinc solution, NH_3 is expelled by heating the solution in a still, and a basic zinc carbonate is precipitated. This product, after separation from the solution, is dried and calcined to drive off water and CO_2. The vapor products of distillation and calcination are recovered in suitable absorption and scrubbing apparatus, so that the solvent is regenerated.[61] Cast iron vessels, pipes, etc., may be used throughout; and, in fact, both the chemistry and technology of this, and similar, processes are so simple as to require no detailed attention here.

[60]—Benedict & Kenny, Tr. A. I. M. & M. E., Feb. 1924, E. & M. J. 104, 43 (1917).

[61]—Bretherton & Wilson, U. S. Pat. No. 1,204,043 (1916).
Gordon & Keith, U. S. Pat. No. 1,464,036 (1923).

A Mines Man Seeks his Chest of Gold in Central America

EDITOR'S NOTE: The following is a letter to Doctor Underhill, Associate Professor of Mining at the Colorado School of Mines. Kurt O. Linn, an ex-Mines man, is the author of the letter, and his pleasant style will be appreciated.

THE LETTER

About a year or so ago I wrote you a letter from down here. If you got that letter, you never answered it; or if you did answer it, I never got the reply, and so the result remains about the same. But patience is one of the Tropic's virtues, and after some six months or so I forgot all about the matter.

Last week, however, I ran across a last year's Mines Catalog, in one of the toughest little outposts of this Valley. I can't imagine how it got there. The tendency for evil to spread out is really remarkable. From a sense of duty I stole the catalog and brought it home with me. I'm glad that I did, because it turned out to be mighty interesting reading, after all these years. The fellow who got up the catalog was undeniably clever. At first it was hard to recognize the old stand thru the rosy haze, and I was almost led to believe for a time that somebody must have died and left the place a lot of money.

But further study revealed that the place must still be much the same, in spite of what the printer could do. Many of the same names in the Faculty list, a number of the veteran students, and the same buildings, climate, and scenery.

Some change has been made in the Math department, it seems. They were the "scoundrels" who altered my career for me, and forced me out into the world to try to make a living. From the start I was never in sympathy with their system; I wanted it simplified, so that the general run of students could understand it. Things shouldn't be going on in a school in practically a clandestine fashion. Then there was their miserable conundrum system. I suggested that they abandon it, because it was unsuited to the dignity of a college, which should deal with facts, not guesses and suppositions. Problems like: "If A and B stand at opposite poles of the Earth, and C on the equator of Jupiter, at what angle of variation will the left link of the Moon appear to these three parties?" are alright, theoretically, but you've got to admit that such a situation will arise less than once in a Geological period. But enough of those good old days.

I've been here a year now, and according to every piece of fictional authority I ought to be about ready to shove off with that chest full of money. I have the chest picked out already—just a small one—and presently I ought to be able to begin filling it. Joking aside, Doctor, Central America doesn't present such a bad career, particularly if a fellow isn't cursed unordinarily with ambition from the start, and doesn't have to waste three or four months getting the ambition out of his system in order to begin.

Money isn't so hard to get, and is very easy to save down here. It isn't all beer and skittles either; you grow old faster, there are a thousand little annoyances, and here in the Aguan Valley it's a constant lookout for your life; but pretty soon you get used to these things. Time passes almost too quickly, because it's a country where time means so little. Time is not punctuated here by expected events, and when you're not waiting for anything to happen, you might as well forget about time.

There's one thing which stands in need of great reform here—the Judiciary system. Justice isn't any more predictable here than it is in the States. Why, not so long ago, I was sitting in a cantina over in Sava—a little rough house in the United Fruit Company's concession—and presently a couple of fellows came along and sat down at the same table. They ordered beer tossed off a couple of mugs, liked it and ordered more. After a time their conversation turned into politics. I should have left then, while they were still disclosing friendly blue-prints of the subject. But I didn't, and soon the discussion warmed into an argument, thence into personalities, and the first thing I knew a mug of beer sloshed over into my face.

The one gentleman had undoubtedly meant this courtesy for his friend, but that made no difference; because, while I was still wiping the beer out of my eyes, some firm hands removed me from the place, and about five seconds later I was marching down the street to the Chartel, escorted officially by the night patrol, and being informed over and over again by a crusty little sub-commandante that disorderly conduct wasn't going to be tolerated in Sava as long as he was in charge.

I'm moving down into Costa Rica later on in the year, but intend to come to the States first. Very likely I'll be in Colorado for a week or so, and then I'll look you up. So, with best regards.

Russell J. Farrar Dies

News of the death of Russell J. Farrar, honor graduate of the Class of 1910, has just been received in Golden. Farrar died at Fort Bayard, New Mexico, August 21, 1929, after a four year fight against tuberculosis contracted during his service in France.

After graduating from Mines, Farrar went to Mexico where he followed his profession of mining engineer. Returning to the United States, he became associated with the Gold Hunter Mine at Mullan, Idaho. From here he went to Arizona, where he entered the employ of the Copper Creek Mining Company. When war was declared, he enlisted in the army and was sent to France with the 340th Machine Gun Battalion, 89th Division. Farrar's division was sent into Germany as part of the Army of Occupation and he did not return to the United States until May, 1919. While in the service he received his commission as a Lieutenant.

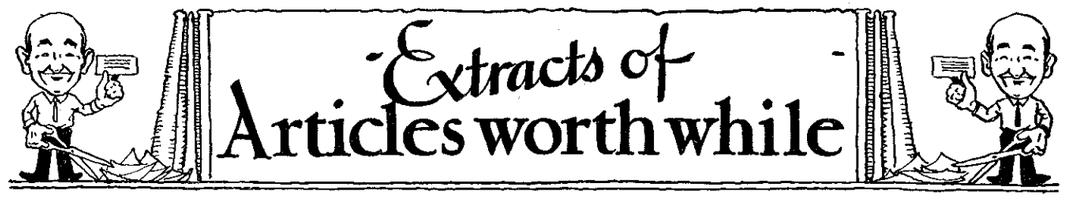
Upon his return to civilian life, Farrar reentered the employ of the Gold Hunter Mines at Mullan and remained there until 1925 when his health broke.

The American Legion had charge of his funeral services which were held in Salem, Oregon, August 27, 1929. Surviving him are his mother, Mrs. Isabelle C. Farrar, and a sister, Mrs. R. N. Kellogg, both of Portland, Oregon.

Alumnus Makes Broadcast Possible

A broadcast over K. F. E. L., Denver, of a Mines program on Friday night before homecoming day was made possible by J. H. Winchell. Winchell is a true Mines supporter, and is one of the many Alumni who stand ready to give help to any Mines' project. Winchell turned over the regular broadcasting hour of the Puritan Pie company, of which he is proprietor, to the Miners.

The program presented by the Mines men at this time was one of music, and a short talk by Fred C. Carstarphen, '05. The Colorado School of Mines' Band and the School quartet contributed the musical numbers.



Style Manual for Engineering Authors and Editors: The American Society of Mechanical Engineers, 29 West 39th Street, New York City. This manual has been revised, August 1930, and is an excellent guide to style for authors of technical articles. Matters of style taken up are taken up under the following heads: Permissible Abbreviations, the Hyphen and Compound Words, Use of Italics, Spelling, Capitalization, Punctuation, Mathematics and Formulas, Tables, Illustrations, and so forth.—*Br.*

Concentration and Cyanidation at Flin Flon Pilot Mill: S. P. Lowe in Canadian Mining and Metallurgical Bulletin, September 1930. Reprints available. A description of the Flin Flon experimental and laboratory mills. Flotation tests, and so forth.—*Br.*

The Museum of Science and Industry: Waldemar Kaempffert. Published as a bulletin, reprinted from Scientific Monthly, June 1929. An interesting description of the institution founded by Julius Rosenwald "to reveal the technical ascent of man." Well illustrated and entertaining as well as instructive.—*Br.*

Ore Deposits of Magmatic Origin: Paul Niggli. Translated from German by H. C. Boydell. Thos. Murray & Co., London; D. Van Nostrand Co., New York. 93 pp., illus. $3.50.

The value of this book to the serious student of ore deposits is far beyond the price despite the few pages. Boydell has done a distinct service in making available in excellent readable English the views of Professor Niggli of Zurich University. The work is, as indicated by the title, a careful consideration of one group of ore deposits only and with a breadth of view not always found among students.

Chapter headings include: The physical chemistry of ore-generating magmas, the minero-chemical classification of ore deposits derived from the magma, the association of magmatic ore deposits, and conclusions.

Several good tables are given.

A valuable contribution is a discussion of the geographical distribution of the ores on the basis of magmatic provinces.

—*J. H. J.*

Tin: C. L. Mantell. The Chemical Catalog Co., Inc., 419 Fourth Ave., N. Y. 366 pp. $7.00. A monograph which should prove of great value to those engaged in the tin industry, as well as to chemists and lay readers.

Economic Resources and Industries of the World: Isaac Lippincott. D. Appleton & Co., New York. 1929. 656 pp. $5.00. We have yet to see a more complete survey of the world's economic resources. This book should be invaluable to the business man as well as to students of economics.

Millions in Mergers: H. A. Toulmin, Jr. B. C. Forbes Pub. Co., New York. 1929. 323 pp. $3.50. A comprehensive survey history of merger trends, discussing the effects of mergers on prices, labor and executive initiative. The author tells when companies should and should not merge and what makes mergers pay. Of timely interest.

An Audit of America: E. E. Hunt. McGraw-Hill Book Co., Inc., (370 Seventh Ave., N. Y. C.) 1930. 203 pp. A summary and interpretation of "Recent Economic Changes," descriptive of the levels on which the American people live, as explained by the recent changes in manufacturing, construction, transportation, marketing, labor. management, agriculture, and finance.

Prometheus, U. S. A. By Ernest Greenwood. Harper & Bros., New York. 1929. 213 pp. $2.50. An interesting development of the history and uses of fire from early mythology thru the present day. The book includes a thoro treatment of the problem of domestic heating, the relations between the oil and electric power industries, and the problem of oil conservation. A fascinating work and one of value both to the lay reader and those particularly interested in industrial and domestic uses of oil.

With Mines Men in Print

Fred C. Carstarphen, '05, has an article in the September number of the *Engineering and Mining World*. Mr. Carstarphen compares the costs of truck and cableway transportation. This article should give valuable information to engineers confronted with the problem of transporting materials any great distance.

J. Harlan Johnson, associate professor of geology at the Colorado School of Mines, has an article in the June issue of the *Bulletin of the American Association of Petroleum Geologists*. Professor Johnson has written this time upon the unconformity in the Colorado group in eastern Colorado. This article is available in reprint form.

Edwin H. Crabtree, '27, is the author of an article in the September Mining and Metallurgy. Mr. Crabtree discusses some problems of milling costs in this paper. It is available in reprint form.

Dr. F. M. Van Tuyl, professor of geology at the Colorado School of Mines, is joint author with Q. D. Singewald, former member of the Mines faculty, of the article, "Discoloration of Sediments by Bacteria". This appeared in the May issue of the *A. A. P. G. Bulletin*.

Jack P. Bonardi, '21, announces that he has available a number of reprints, with compliments of the author, of two articles: *World Progress in Mining* and *African Copper Deposits*. These articles appeared in the May and June numbers of the Colorado School of *Mines Magazine*. Address requests to author, care of Mine and Smelter Supply Co., New York City.—*Br.*

The metal-mining industry continues to manifest great interest in the series of papers on milling methods and costs at representative operations in the different districts being published by the United States Bureau of Mines, Department of Commerce. Each paper is prepared by an official of the particular company, who acts as a consulting engineer of the Bureau of Mines. Among this series is a paper by a Mines Alumnus:

Information Circular 6353, "Milling Practice at the White Bird Concentrator, Canam Metals Corporation, Picher, Okla.," by Edwin H. Crabtree, Jr., '27.

Athletics

Sprains and Bruises

By Charlie Whaurse

The Alumni came out to school homecoming day to see Mines beat Teachers; and some of them went home disappointed, others never found out the difference until the next morning.

Reports have it that their banquet at the Armory was a grand success. As yet I have heard no reports on the things done by those rebellious ones who joined in the parties at the several frat houses instead of attending the banquet as all law abiding Alumni should have done. (Law abiding now-a-days is interpreted everywhere as "keeping the 18th amendment"—in letter and not in spirit.)

Homecoming day proved one thing to me, and that is that these Mines grads get their fun where they find it. It just goes to prove my contention that the whole afair should be staged in Monterrey.

When I read the Alumni Magazine, I sometimes wonder how the red and yellow, the green and orange, the blue and all the other colors hold out. News has to be colored, I guess, in order to be interesting. Well, it must be admitted that the Mag *is* interesting!

The election is over and we can all use our radios again. As my old maid aunt says: "You've made your bed, now you'll have to lie in it." The voters have turned the country over to the Democrats, and now I guess we are scheduled for a business depression. Anyhow, Dave Johnston was elected to the Colorado legislature. The result should be a general improvement in athletics in that legislative body.

The lady who lives next door to me was saying the other day that what this country needs is more education and less football. This is decidedly confusing to me. It seems like all the one and the same thing.

Denver Freshmen Defeat Orediggers

The frosh football team played the Pioneer first year men. The Mines men proved no match for the Denver yearlings, the final score being 54 to 0 in favor of Denver. The D. U. frosh used the same style of play that their varsity uses, the Howard Jones system, and it proved too much for the Orediggers. The Miners put up a good scrap, but could make little headway.

A large number of Miners turned out to support the frosh in their first game, and their cheering attracted considerable attention.

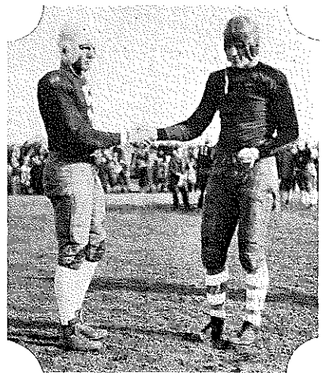
Rice Out of Game

The proverbial jinx seems to be following the Mines team this year through the medium of injuries.

Following the Denver University game, in which Don Peaker was rather painfully injured, Ed Rice, popular veteran halfback, was suddenly stricken with acute appendicitis which necessitated the immediate summoning of a doctor.

After an examination, it was decided that Ed should discontinue football for the remainder of the season, or risk the possibility of sudden strain, causing greater complications.

When Two Great Athletes Shook Hands



On to Pueblo Thanksgiving

Alumni who attended the Mines-Colorado College game last Thanksgiving Day at Pueblo will remember the great duel staged between Dutch Clark and Floyd Carr. Some of the prettiest running ever witnessed on the football field was done that day. Above is a picture of Clark and Carr shaking hands before the November battle at Pueblo.

Again this year, the Miners and the Tigers will meet at Pueblo. Another special train will be chartered by the Mines fans. Alumni who wish to get seats on this special will get in touch with Ken Dickey, president of the Mines student body. A big day is being planned, and a lot of hot stuff will be ready for the Tiger.

Mines had the ball on the Tigers' two, three and four yard lines last year, but they could not punch it over. The final score of the game was only thirteen to nothing, but the thirteen was on the wrong side of the book. That 13 will bring bad luck to Colorado College this year. The Miners are on the spot to win and not to lose this year's Thanksgiving affair. Come on down to Pueblo and help put spirit into the team.

Officials Are Criticized

Everyone is riding the officials on the gridiron these days. There surely must be some cause for this derision or so many would not be joining in. As a matter of fact, an official can, if he so desires, call a foul on some player on every play. In such a game as football, where there is a great deal of personal contact, no set of rules can eliminate "unnecessary roughness." It is up to officials to enforce the rules that are made with a certain amount of discretion, realizing that perfect enforcement is an impossibility.

Such discretion is too often exercised when the ball is in the middle of the field; but whenever a team nears its opponents' goal line, the penalties begin to pile up. Any one of the four officials can see a foul at any time, yet these fouls, unless flagrant breaches of the rules, go unpenalized until a team gets into a favorable position to score—or does score.

The worst thing an official can do is to be lenient in midfield and then call back a touchdown when there is the least doubt of some infraction of a rule.

Yet, if the foul should be unquestionably evident, the score ought to be nullified by the officials. Such a case was the touchdown made by Bond in the Mines-University game, and called back by the referee because a Mines man made an illegal block. There was no question but what a foul was committed in this instance.

Moving pictures of the Yale-Army game revealed that an Army touchdown was illegal because a team mate pushed his halfback over the goal. The score was counted. However, it seems evident that if moving pictures were necessary to detect the foul, the referee was justified in permitting the touchdown.

Without the pictures it would have been difficult to prove that the Army player did push his mate over the line, just as it is quite difficult to distinguish between an illegal and a legal block, unless the blocker plainly falls across the back of the blocked man's legs. (Called clipping). Holding with the hands is the easiest of all fouls to detect, but every vicious block made in an open field from an angle shades into a "clip." The blocked man has but to turn slightly to throw the blocker across the back of his legs. The official who wishes to "over-officiate" a game can call three out of every five of such blocks clipping.

Monterrey Section

Another one of the series of ads which the Monterrey Section is running in the Magazine appears on the Chapter News page.

The Spanish may be translated: "On to Monterrey for that good old Mines bust in May after Commencement!"

Mines 7—Boulder 36

A fighting Oredigger eleven rated but a poor underdog because of its previous showing, turned on Boulder to score a touchdown and play better football than the 36-7 score would indicate in the annual game October 18.

The Mines line, although heavily outweighed, put up a stubborn fight which caused Boulder to resort to an aerial attack. State could not gain around either end. At the center Colorado had no better success, as Burrell backed by Bond, threw the Boulder backs for loss after loss.

Mines offense was weak, but had its bright spots in Eads kicking and the pass combination, Eads to Peaker.

Mines 0—Teachers 7

Mines lost a desperately fought game with Colorado Teachers, October 25. It was the Miners' homecoming, and the score was 7 to 0.

Teachers scored early in the third quarter. Lefty Eads later ran 60 yards to a touchdown for Mines, but the officials nullified the score and penalized the Miners 25 yards on a charge of clipping. There was some question as to whether the penalty was justified, in as much as the man claiming to have been clipped never fell to the ground. However, after a long "conference" of officials in the middle of the field, they decided that Mines did not deserve the touchdown.

The game was pretty well even all the way through, Teachers making about 17 first downs to Mines' 14.

Mines 13—Western State 0

Mines had little difficulty in downing Western State College November 1. The second and third string men saw action, and about the only man to play the entire game was Burrell.

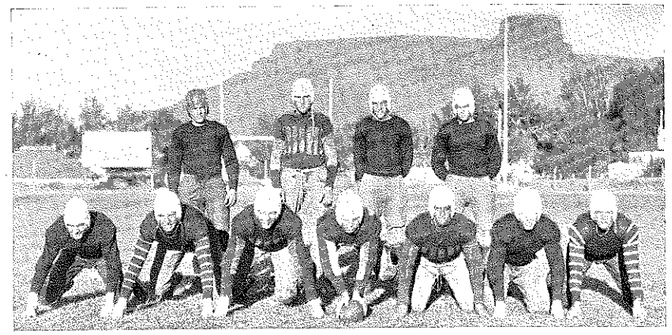
This boy Burrell, now that we have mentioned him, is about the best defensive player on the Orediggers' squad. He plays center, and on the offense, never makes a bad pass. Burley, as he is called on the campus, was mentioned for all-conference last year. He stands a good chance to make it this season!

Well, back to the game with Western State. The Miners blew a chance to score in the first two minutes of play when they failed to plunge the ball over the goal line from one yard back. This encouraged the Western Staters, and they put up a strong defense for the remainder of the first half.

The score stood 0 to 0 at the beginning of the third quarter, but it was not long before Peaker intercepted a pass, and on the next play ran for a touchdown. This put Mines seven points ahead. In the remaining minutes of this period, Eads ran 75 yards for another touchdown, but it was called back.

Eads repeated in the last quarter. This time it was a 50 yard run to the final stripe. Again the referee called it back—this time for off-side. Eads, several plays later, again ran for a touchdown, this time from his own fifteen yard line. An 85 yard run is nothing to be sneezed at. This score was counted, making the total for Mines, 13; and for Western State, 0.

THE 1930 OREDIGGER LINE-UP



Line: Manhart, Preston, Pressett, Burrell, Martin, Bond, Adams
Backfield: Rice, Michaelson, Bonnett, Eads

Burrell, Pressett, and Preston played a bang-up defensive game. All three of these men were tackling the Western backs behind the line of scrimmage at all times. And although Peaker and Eads shone on the offense, it should be stated that the three linemen named were the real stars of the game. Bonnett did some splendid line plunging.

Mines made over twice as many first downs as Western. The Golden boys outplayed their opponents in every department of the game, in fact.

Basketball Prospects

Pre-season basketball is showing great form with three letter men and a number of promising recruits out. Clyde Turnbull is running true to form in the center position with Benedict and Morris showing great shape at the guard positions.

Men from last year's squad who are fighting for positions are Gardner, Hovey and Kenworthy, and among the newcomers to the squad there are Townsend, Elkings, Quine, Hylton, Lebar, O'Neill, Obrukt, J. Zadra and R. Zadra. Most of these men have had a great deal of experience in high school and should give plenty of competition to the regulars.

Professor Signer has been putting these men through some pretty stiff practices so that they will be in condition to start right in with those out for football and develop a real team.

Eads Gets Prize for First Touchdown

Clyde Gregory, Golden jeweler presented Lefty Eads with a Conklin pen and pencil set for having scored the first touchdown of the 1930 season. Eads scored in the Mines-Boulder game.

In presenting this set Gregory has again carried out his custom of awarding a prize to the player making the first touchdown. The first prize went to "Red" Wells who scored the first touchdown in the 13 to 12 victory over Denver in 1928.

Changes in Line-up

The above picture shows the Mines team as lined up for the Denver game. Since then several changes have been made.

Rice has been forced out of the game with an attack of appendicitis. In his place Coach Allen has been using Peaker, Harris and Spalding.

Michaelson has been returned to the line, changing places with Bond.

Woodburn, Putz and Rump have been relieving the guards. Rump, playing his first varsity football in the Boulder game, was a consistent tackler, and will be heard of in the remaining games.

Alternating with the tackles shown here are Austin and Robison. Austin is a new man, and puts up a good fight.

Fallis and Wilkerson are the reserve ends. Fallis is a sophomore, and is steadily improving.

Burrell at center has been outstanding on defense. His work is consistently good, and he is responsible for many opponent plays going astray.

Miniature Football Now

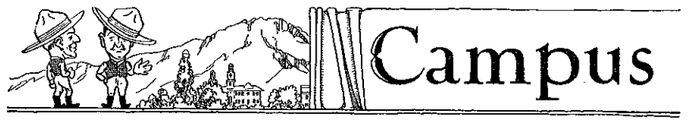
Miniature football is the latest on the Mines' campus. Every day, youngsters from all over Golden gather in front of Stratton Hall and have the time of their lives playing their particular brand of football.

There are more than eleven on each side but that bothers nobody. The uniforms are like Joseph's coat, and only a couple of the tiny gridiron heroes possess helmets. Occasionally little sister is allowed the special treat of playing center.

The punts are usually grounders but they get there just the same; and when a little man is tackled he knows he's been hit.

No soprano quarterback could possibly be heard through the din they make but what does that matter. The signal is somewhere between "one" and "ten" and the players can almost guess when it is going to be called.

Football material for the '40's and all winners.



Fraternity News

Frat House Managers Meet

President Coolbaugh recently met with the fraternity house managers to discuss the heating problems of the fraternities. The first subject brought before the meeting was that of insulating houses. Since insulating materials have become so cheap he highly recommends that the fraternities consider this. Uniform heat resulting in the saving of a great deal on fuel bills is the chief advantage of insulation, it was pointed out. Properly insulated houses seldom vary from one to two degrees in various parts of the house. There is also an advantage in keeping the upper floors of a house cool in the summer.

Examples were cited where some companies were not getting but sixty percent as much work from their employes in the heat of the summer as they do under average conditions. That refrigeration will soon be very popular due to the present success in insulation.

A. T. O. Mothers Club Benefit

The A. T. O. Mothers club gave a benefit bridge party at the A. T. O. house November 7. The proceeds of the party were given toward furnishing the new house.

S. P. E. Honors Pledges

The Sig Ep boys with their lovers strolled out to Cherry Hills where their annual pledge dance was given in honor of their new men and faculty members.

The hall was elaborately decorated to suit the occasion and the rhythm was furnished by Tony Ferraro and his Boys. The programs were of a special feature portraying a log of a ship, the ship being the good ship Sigma Phi Epsilon, on its annual cruise into the uncharted waters of the whoopee sea.

Faculty Members Pledged

Alpha Tau Omega fraternity announces the pledging of Professor J. Harlan Johnson. Professor Johnson obtained his B.S. degree from the South Dakota School of Mines, and his M.S. from this school. He is prominent throughout the country in geological circles.

The Sigma Alpha Fraternity announces the pledging of Frederick Mangold, instructor in English, on October 17. Mr. Mangold, after completing his preliminary education at East high school in Denver, went to Princeton, where he took his B.S. degree. While there he was elected to Phi Beta Kappa, honorary scholastic fraternity. Before coming to Mines, Mr. Mangold taught at the University of Louisiana.

Betas Hold Pledge Dance

The annual pledge dance of the Mines chapter of Beta Theta Pi was given in the chapter house last Friday evening. The affair was formal, and a house party climaxed the dance. Music for the occasion was furnished by Hume Everett and his orchestra. The house was decorated in futuristic style. Dinner was served at eight-thirty, and dancing was enjoyed from ten to two. Attractive favors consisting of silver dresser compacts were presented.

Sigma Nu Homecoming Party

The Sigma Nu's were host to a number of guests at a dinner party following Homecoming game. Following the dinner, everyone attended the "M" club dance. Alumni guests included "Walt" Lofgren, '28; George Fancher, '29, and "Herb" Winchell.

Phi Lambda House Party

The Phi Lambda Alpha fraternity entertained at dinner following the Homecoming game. The dinner was held at the fraternity house on Thirteenth street. The following alumni were guests: Harlan Johnson, '23, and "Doc" Adams, '28.

A. T. O. Homecoming Affair

Alpha Tau Omega entertained at a dinner and a dance over the week-end of homecoming in their new home. Alumni guests included: W. A. Waldschmidt, "Rut" Volk, "Red" Brewer, and "Herb" Reno.

R. O. T. C. Happenings

The indoor rifle range was opened November 3 for voluntary practice on Mondays, Tuesdays, Thursdays and Fridays from 1:00 to 5:00 p. m. The intramural rifle match will be held during the week of December 15.

As has been done in the past, the Military Department will present a cup to the winning team. The A. T. O. fraternity won the cup last year with the Betas a very close second.

The Military Department is conducting a conference Course Troop School for a Reserve Officers at the Colorado School of Mines. These are held from 4:00 to 6:00 p. m. the second and fourth Tuesdays of each month in room 342. The course as outlined provides for the solving of one problem in troop leadership each month, and one lecture each month on military subjects of general interest. All members of the faculty and members of the Senior class invited to the lectures.

The next meeting of class will be held on November 4. On November 18, there will be a lecture given on "Camp Sanitation." There are twenty-seven Reserve Officers on the campus. This course fills a distinct need, and offers the reserve officer a convenient way of keeping up his active training.

Band Prospects Good

Prospects for the Band look unusually good this fall. First rehearsals were held the second week of school, and a gratifying number of men, both from the upperclassmen and frosh, turned out. The new material is very promising, and a successful season is predicted for this organization.

Under the leadership of Professor Bellis, the Mines band has won recognition all over the state. Not only does the Band play at rallies, football games, and all school functions, but it has appeared in Denver on many occasions. During the winter, concerts are given in Guggenheim on Sunday afternoons.

Kappa Kappa Psi, the honorary band fraternity, is going to attempt this fall to obtain more cooperation between the student body and the band. This fraternity has had a charter at Mines for a number of years.

Mines R. O. T. C. Rated Excellent By War Department

The Military department reports that the annual school inspection of the R. O. T. C. unit and that the camp equalled the high standard set by Mines in years past. The unit received the rating of "Excellent" as a result of the inspection.

The Military camp which opened immediately following the close of school was exceptionally successful from the view point of both the Military department and the students attending. Sixty-nine men from Mines and one from the Missouri School of Mines reported on the opening date.

While at Fort Logan the men made an enviable record in infantry drill and engineering construction work which will be hard to equal by succeeding camps.

While on the Rifle Range, practically every man qualified with the rifle and pistol.

For the coming school year, Captain Frank M. S. Johnson will be the new Professor of Military Science and Tactics and reported for duty at the school September 1, after a two weeks tour of duty in the R. O. T. C. office in the 8th Corps Area Headquarters. Prior to that he was stationed in the U. S. District Engineers office at Rock Island, Ill. Captain Johnson has seen service in France and since the war has been stationed at various posts in the U. S. and has served a tour in Panama.

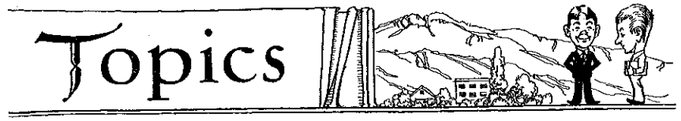
Dixon Manages Annual Second Year

At the first meeting of the Student Publication Board, Philip C. Dixon was elected Business Manager of the Prospector to take the place of J. Dennis Sullivan. Sullivan was elected to the position last spring, but did not return to school this fall.

Dixon was the manager of the annual last year and with this experience a well-managed Prospector seems assured this year.

The Student Publication Board is comparatively a new institution; it was provided for under the new constitution adopted by the student council last year. It consists of the Director of Publications, who is an ex-officio member, two faculty members, appointed by the President of the faculty, and four student members, appointed by the president of the student council subject to the approval of the student council. Before last year, the Oredigger and the Prospector were in no way under the supervision of the student body.

The faculty members for this year are Doctor W. W. Howe, Coach George Allen and C. H. C. Braden, Director of Publications. The Student Council at its first meeting held this school year approved the selection of Davidson, Burrell and Switzsavage as the new student members of the board. Frank Hayward was appointed last year.



Tax on Kissing May Be Building Solution

A report from the International News Service states that a Kissing Tax is urged to pay the War Debt of Germany. Backers of this plan estimate that the annual revenue from this source would amount to about 20 million dollars. Now here is an idea for an amusement tax or something of that nature for the benefit of Mines. In as much as the general tax situation in this state prevents our getting any money for building appropriations, perhaps we could get a luxury tax of this sort thru the legislature and get some revenue therefrom. In doing so all of the Coeds from Boulder, Aggies, Denver and Colorado College would cause the male end of those schools, and 90 per cent of the kissing population of Mines, to dig deep for a new Chemistry Building and Gymnasium.

Of course this tax could be limited to just straight kissing but if an additional tax were placed on hugs and the like the amount would probably get us five or six new buildings.

This being around election time, perhaps some of the candidates who have the best interests of Mines at heart would insert this plank in their political platform. Of course the plan would have to be so disguised to pull wool over the representatives and senators eyes who have thus far blocked any appropriations of that sort. It could be done in a very legitimate manner and the Oredigger will leave no stone unturned in pulling for such a bill.

All of the heavy osculators of this campus should be heartily in favor of this plan as it will give them better quarters in which to day dream and give birth to new ideas in the gentle art of kissing. A suitable slogan for this campaign would be "Kiss and the Miners get buildings, don't and they freeze in the air. Kiss like you meant it and liked it and the boys will have buildings to spare."—*Oredigger.*

Mines Local of S. P. E. E.

A Colorado School of Mines branch of the Society for the Promotion of Engineering Education was formed October 22, at Guggenheim hall. The Constitution and By-Laws were read and accepted. Professor Robert A. Baxter was elected president and Professor I. A. Palmer, vice-president.

The Mines faculty boast another father. Prof. and Mrs. Carl O. Wittig have announced the birth of a son, Carl Gustav, October 10, eight and a quarter pounds.

Counting the total red grades, for the first period 1930, in the senior class, 95 per cent of them were above passing. This is good work but it is as it should be. The junior class as a whole passed 88 per cent of their courses. The sophomore class passed 82 per cent and the freshman class 84 per cent.

Geophysics Department Has New Office

The Geophysics offices in the basement of Guggenheim were remodeled during the summer and are now being occupied by the staff. According to the new layout the staff may easily enter and leave the offices without interrupting the Geology lecture classes. It also affords Dr. C. A. Heiland, head of the Department, a quiet office for his studies. Dr. Heiland is pleased with the results and announces that the place is open to visitors.

Frosh Row Their Own

Boat races at the big eastern colleges are ordinary affairs compared with the "boatless" boat race the freshmen at Mines have annually.

Pledges from the several fraternities gathered on the lawn in front of Stratton Hall for this contest, Thursday, October 30. Coached by upper classmen, the Frosh were seated on the ground in rowing formation, close together, with hands grasping ankles immediately behind them. When the signal was given, they propelled themselves backward, steady by jerks, with a humping, hitching motion, urged on by self-appointed coxswains.

The Sigma Alpha Epsilon crew, exhibiting perfect coordination, were the winners.

New Society Organized

Members of the faculty met recently for the purpose of organizing a local society for the promotion of the study of engineering.

At present this has no direct bearing on the national society of S. P. E. E. To become a member of this organization the local must receive sanction from the national organization as a local branch. If the local proves a success negotiations to become a branch of the national will be taken up.

The organization of the local is, at present, temporary, there is no responsibility to the national chapter until the local becomes one of the branches of S. P. E. E.

At the first meeting Professor Baxter was elected chairman and a committee for the purpose of outlining an active program was appointed.

What the Dames Are Doing

Miners' wives and mothers started the 1930-31 season of the Dames' club on September 22 with a welcoming party for new members. The affair was held at Mrs. Roscoe Morton's, 807 16th Street, Golden, with Mrs. Paul Stroud, Mrs. Alice Moore, Mrs. John Terry, Mrs. A. J. Hintze, and Mrs. Morton as hostesses. Forty guests were present.

In between games and bridge, those attending were told of the national organization of Dames club which is designed to meet the social needs of wives of students and mothers of students in residence while their sons are studying for a degree. The club has seventeen chapters throughout the United States.

Constantinople was the subject of an informal talk, October 13, by Mrs. Jervis Fulmer, wife of the former head of the chemistry department of Robert College, Constantinople, who is now on the Mines faculty. Mrs. Fulmer illustrated her talk with many interesting pieces of Turkish art.

A portion of this meeting was devoted to the business of organizing an Alumnae section of Dames to keep in touch with former members whose husbands or sons have graduated. The local chapter of Dames is also starting a memory book to contain souvenirs of its parties and meetings, thus making a pictorial record of Dames' doings at Mines.

A little girl party was the Hallowe'en festivity for the matrons composing Dames. Very short dresses and long curls were seen again. Two dignified Dames arrived on roller skates. Kid games, all the way from Farmer in the Dell to pinning the tail on the cat, were played. Some of the Dames would do well to make a study of felines to ascertain the exact resting place for their tails, for the guests stuck the cat's prolongation in his mouth, on his tummy, and some in their blindfolded eagerness put the tail on the door.

Cider and doughnuts augmented by a private stock of lollipops, were on the refreshment list. Mrs. Ross Wilson, Mrs. A. S. Adams, Mrs. Fred Nye, and Mrs. John Bowsher were the engineers for the party.

A kitchenette cupboard has been installed in the club room and now Dames can play house at their meetings.

Former members of the local chapter are asked to get in touch with Mrs. L. J. Dempsey, 1017 12th Street, Golden, and give her news about themselves.

Officers for the year are: Mrs. A. J. Hintze, president; Mrs. Mary Wilson, vice-president; Mrs. L. J. Dempsey, recording secretary.

News from the Chapters

Tulsa Section

The regular monthly meeting for the month of October, of the Oklahoma Section of the Alumni Association was held at the Tulsan Athletic Club on Saturday night, October 18. A chicken dinner followed by bridge and dancing, with music furnished by a Victrola and a radio, was enjoyed by ten members of the Oklahoma Section and their ladies.

Later in the evening, when the radio commenced to perform as all radios will do, Jerry Westby very ably supplied the piano music for the rest of the evening.

This meeting had been postponed a week due to conflict with the International Petroleum Exposition which was in progress at the time usually scheduled for our meetings. From now on we expect to continue our schedule of last year, of a dinner dance the second Saturday of each month, held at the Tulsan Athletic Club and the regular Friday noon lunches at Bishop's Third Street Waffle House in Tulsa.

We wish to extend an invitation to all Alumni who may be in the vicinity to attend these meetings whenever possible to do so.

The following Mines men were in Tulsa for the International Petroleum Exposition, October 4 to 11:

Tom Allan, '18, Russell, Kansas; Lee K. Worth, '17, Ft. Worth, Texas; Thomas L. Regan, '28, Wichita Falls, Texas; Field M. Davis, '28, Wink, Texas; Wilmer G. Wilson, ex-'28, Shreveport, La.; M. C. Sheble, Jr., '30, McAlester, Okla.; J. W. Baldwin, '21, Bartlesville, Okla.; F. A. Lichtenheld, '20, Bartlesville, Okla.; E. L. Caster, '25, Shreveport, La.; H. C. Price, '13, Bartlesville, Okla.; A. M. Peairs, ex-'24, Dallas, Texas; John Evans, '23, Amarillo, Texas; John M. Weller, '26, Oklahoma City, Okla.; E. V. H. Bauserman, '25, Dallas, Texas; Floyd Carr, '30, Seminole, Okla.; Niel Whitmore, '29, Burbank, Okla.; J. G. Menke, ex-'18, Wichita Falls, Texas; Geo. M. Fancher, '30, Golden, Colorado.

New York Section

The 94th regular meeting of the New York Section of the Colorado School of Mines Alumni Association was held at the Fraternities Club, 22 East 38th St., New York City, on Friday, October 10, 1930. Dinner was served at 6:30 P. M.

The following men were present:

Bilisoly, J. M., '23, 247 Park Ave., N. Y. C.; Downes, F. A., '13, 247 Park Ave., N. Y. C.; Frondel, Clifford, '29, 5th St., Bayside, L. I.; Hallett, R. L., '05, 105 York St., Brooklyn, N. Y.; McKinless. F. V., '23, 11 Broadway, N. Y. C.; McKinless, R., '25, 7 Marlette Pl., White Plains, N. Y.; Paul, R. B., '02, 160 Front St., N. Y. C.; Ramsey, E. R., '12, 247 Park Ave., N. Y. C.; Sopris, R. F., '26, 2 Rector St., N. Y. C.; Taylor, L. S., '26, 247 Park Ave., N. Y. C.; Wells, R. W., '29, 11 Broadway, N. Y. C.; Wolf, H. J., '03, 230 Park Ave., N. Y. C.

Following the dinner President Wolf called the meeting to order. The reading of the minutes of the previous meeting and of the Treasurer's report were dispensed with.

President Wolf spoke of the untimely death of S. M. Soupcoff who attended our last meeting when he was in excellent spirits and apparently in good health. The only details we have is that Sam died very unexpectedly of heart failure.

We also learn with the greatest regret of the death of Frank J. Rheinhard.

The speaker of the evening was R. L. Hallett who gave an interesting talk on non-ferrous metals with particular stress upon the relation between stocks on hand and unit prices. His discussion was clearly illustrated by charts covering the period from 1913 to date. The analysis covered the source and the market for the metals, particularly Cu, Zn, Pb and Sn and their effect upon the general economic conditions of the U. S. and of the entire world.

With a vote of thanks to Mr. Hallett for his instructive talk the meeting was adjourned at 9:30 P. M.

Houston Section

The regular monthly luncheon of the Houston Section of the Colorado School of Mines Alumni Association was held at the Rice Hotel on Saturday, October 11.

The following men were present:

C. H. Stewart, '25; Geo. Lemaire, '26; A. L. Ladner, '27; E. R. Locke, '28; R. K. Tracy, '28; Geo. Waggoner, '28; R. P. Clarke, Ex-'26; Tom Pulver, '30.

Ladner gave a splendid talk on the various methods of geophysical prospecting in use at the present time, which was very interesting to all of the fellows present and created quite a discussion, especially between the geologists and geophysicists.

This was the first talk of this nature which has been given at the regular monthly luncheons in this Chapter, and intentions are to continue with these short talks on various subjects each month.

Alumni Letters

Rhodes Comments on Campbell Articles

Dos Estrellas, Michoacan, Mexico,

My dear Colburn:

You may be surprised to hear from me but I want to make a few observations, which I think are in order, on the article by associate professor of metallurgy, Thomas B. Campbell, which appears in the July 1930 issue.

Referring to his remarks on "unimolecular reaction" and the differential equation representing the same where "a" is called the dissolving power of the solution, I think this latter expression needs modification. Since the differential equation as written is a direct function of the concentration of one of the reacting substances at any time "t" except the gold which is in the solid phase, that substance most easily handled is the cyanide although the oxygen would serve the same purpose. If instead of "dissolving power", equivalent amount of substance were substituted, the solution of the problem would be free from that vagueness which "dissolving power" gives to it.

On the other hand, if the strengths of the cyanide solution at any time "t" are used, the problem resolves itself at once into a simple manipulation of solution concentrations. We can also use the actual amounts of cyanide in solution at any time "t". For this case the 5 tons of solution contain 1 pound of cyanide or 16 av. ounces. This is the quantity "a" or amount when "t" is equal to 0. The differential equation is so written that the velocity of the reaction at any instant is proportional to the concentration or amount of salt untransformed. x is the amount of salt transformed at time "t". At the end of 24 hours x equals $0.49 \times (480/437.5)$ or 0.5375 av. ounces gold corresponding to 0.5375/2 or 0.26875 av. ounces of NaCn. At the end of 24 hours we have

$24 = K(\log 16 - \log (16 - 0.2687))$; from which $K = 3261$.

When $x = (1.43 \times 1.097)/2$ or 0.78435 av. ounces of NaCN transformed,

$t = 3261 (\log 16 - \log (16 - 0.78435))$ or 71.25 hours.

The handling of the problem in the above manner avoids the necessity of one having to imagine that 1 av. pound of NaCN has a dissolving power of 29.166 troy ounces of gold, although these are equivalent amounts according to the reaction as written.

This problem brings up another point worthy of mention, namely, the mixture of av. ounces and troy ounces, av. pounds and troy pounds. To any one accustomed to working with the metric system, this mixture is an abomination and shows further the indifference or aversion of the American public to a superior system. Perhaps ten percent are familiar and see the inherent advantages but it has taken not less than twenty years to hammer this in. A pertinent question would be how long would it take to convert ninety percent of the American public to the metric system? Perhaps at first thought a simple proportion x/90; 20/10, where x equals 180 years would appeal to most people. However the thing does not work that way for the reason that while the mobile minds dissolve easily into the apparent advantages of the metric system, the more refractory minds dissolve at an ever decreasing rate. If "a" equals the percent of public opinion at the beginning, and x equals the percent transformed to the metric system at any time "t", then the velocity of public opinion toward the metric system, would be represented as

$V = dx/dt = k(a - x)$, and

$t = K (\log a - \log (a - x))$.

If a equals 100 and x equals 10 at the end of 20 years, then

$K = 20/(\log 100 - \log (100 - 10))$, or 437. and to convert 90% of public opinion to the metric system

$t = 437(\log 100 - \log (100 - 90))$

$= 437$ years, and at this rate one would not have to stretch his imagination much to see that an infinite time would be required to convert 100 percent. Fortunately *nature* steps in and eliminates the more refractory minds without them having anything to say about the matter, so that taking this into account another equation could be written which would reduce the time to approximately 100 years or perhaps less.

Kindly pass this on to the editor of the Magazine.

Yours sincerely,
W. B. RHODES.

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Bakersfield, Calif.,

My dear Mr. Colburn:

I wish to thank you for your kindness in attempting to get back issues of the Colorado School of Mines Magazine for me.

It was not the series of Hydrometallurgical articles which I desired, although they are intensely interesting, but copies of the magazine itself. A friend sent me a copy and after reading it from cover to cover I realized how very much I was missing by not being a subscriber.

With kindest regards, I remain,
EROS M. SAVAGE, Ex-'22.

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Shawnee, Okla.,
Box 413,

Dear Colburn:

I certainly enjoy the Magazine. The news and technical articles have been a pleasure as well as a benefit. I wouldn't think of missing a single issue.

There are quite a number of Mines men in this locality at present and more showing up all of the time. We hope to have a "round up" in the near future and have a real old time session.

I had hopes of paying you a visit but the Scotchman uncovered too many points of interest in the Grand Canyon which he excavated in search for a nickel that found its way in a gopher hole.

Yours truly,
MYRON C. KIESS, '25.

Dear Mr. Colburn:—

Just a line to tell you that at the present time I am located in the southeast corner of Colorado. My new address is Springfield. Still with the Shell Petroleum and doing surface geology.

Having spent about three months in Oklahoma, previous to this assignment, I frequently saw *Arnold Bunte*, '26, and *John Weller*, '26. Upon one occasion, I saw *Arthur Austin*, '29, the brother of one of my class mates. They all seemed to be doing well with their respective companies.

I want to take this chance of sending best wishes to all the Alumni, especially the class of '27.

Most sincerely yours,
(Signed) V. C. BENDEROFF, '27.
Chicago,

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Dear Braden:

Please accept my sincere apology for my neglect in answering your letter of August 21. As you know, a new job demands a great deal of extra time to establish the necessary routine to handle the work with dispatch. This has been my situation.

For your "personal" information *I do not have to apologize to anyone here for my education received at Mines.* As an example, in spite of the fact that I was graduated in mining engineering, so much confidence in my general training has been expressed that I have been called upon to prepare an outline for the necessary exhibits in both "Metal Working" and "Iron and Steel." These outlines were presented to the directors of the National Association of Tool Makers and the president of the Illinois Steel company, respectively. Their reports on my efforts were quite flattering.

As for possible articles, the Indianapolis Star (the managing editor is a friend of my folks) has made me a tentative offer for a series of five articles of a popular nature for their Sunday editions on the subject of "The Romance of Mining." (Wouldn't that word "romance" make the boys get a little drunk.) If they are published I shall forward them, with the Star's permission, to you for use in the Mag.

Yours truly,
"MIKE" MERCER, '30.

Personal Notes

Clayton "Fuzz" Kerr, '30, and Mrs. Kerr returned the middle of October from Gallup City, Montana. While in Montana "Fuzz" went to call on *Edward McGlone,* '23, who is assistant foreman for the Anaconda Copper Mining company at Butte; *Hale Strock,* '22, who is with the fire-filling department of the same company; and *Frank Lee,* '27, another Anaconda man who lives at 504 Caledonia Street, Apt. "H", Butte.

Fred Roth, '27, who spent a portion of his September vacation visiting at Mines was back again the fifteenth of October on his way to the Fort Morgan oil fields for his company, the Midwest Refining.

Eugene M. Howell, '30, narrowly escaped injury in a collision between the bus in which he was riding and a private automobile near Oklahoma City, October 8. The bus rolled down a ten-foot enbankment and six people were injured. Howell is with the Continental Oil company.

Dudley Rankin, '23. spent Saturday and Sunday October 11 and 12, in Golden visiting friends and relatives. He was en route to his home in Casper after attending a conference of employees of the Standard Oil company of Indiana at Hammond, Ind.

Arch Sproul, '26, has returned from South America and is now at Pittsburgh, Pennsylvania, headquarters for the Vanadium Corporation of America, the company for which he has been working since his graduation.

J. Harlan Johnson, '23, and Mrs. Johnson were on the list of Golden alumni who entertained visiting Miners during homecoming. They had as luncheon guests October 25, Mr. and Mrs. Fred Carstarphen, '05; Mr. and Mrs. John Wilson, '23; Ward Graham, ex-'26; and Mr. and Mrs. W. A. Waldschmidt. Mr. Waldschmidt is associate professor in the geology department at Mines.

William Huleatt, '21, made a visit to the Climax Molybdenum company property and the Fairplay country in October.

M. E. Bunger, '09, has been appointed one of the designing engineers for the Boulder dam. He received his appointment from the U. S. Reclamation service.

Erik U. Garpner, '27, with the geophysics department of the Gypsy Oil company, Tulsa, Oklahoma, stayed over for a short visit at Mines after homecoming.

C. Z. Leonard, '29, geologist for The Texas Company, has sent in a change of address c/o The St. Louis Hotel, Perry, Okla.

Sidney W. French, '08, consulting engineer, has moved from Sherman, California to Torrance, California, where his mailing address is box 966.

Manuel F. Quiroga, '24, is working for the "Compania Carbonifera Consolidada de Coahuila, S. A." He is assistant to the Superintendent and the responsible engineer of the mines; he is very well known in this region as a coal miner as he has six years of experience in the mining camps of that region. His address is Palau, Coahuila, Mexico.

George Pasquella, '24, who is in the Geophysical Department of the Dixie Oil Company, has been transferred from Muskegon, Michigan, to their Tulsa office, Philcade Building.

Edgar R. Locke, '28, Sales Engineer for Ingersoll-Rand Company, has been transferred from Los Angeles to Houston and is now making his home at 510 Sul-Ross.

A. M. Peairs, '23, associated with Foster Wheeler Corporation, with offices in Republic Bank Building, Dallas, was in Houston and Corpus Christi recently on business.

Carl F. Beilharz, '25, geologist for The Pure Oil company, has been transferred from El Dorado, Arkansas, to Chickasha, Okla., where his address is 820 Florida Avenue.

George Ordonez, '29, who has been with the Lago Petroleum company in Maracaibo, Venezuela, since his graduation, has returned to Mines this fall and is living at the Phi Lambda Alpha house.

Guy C. Riddell, chairman of the Committee on Rare Metals and Minerals, A. I. M. E., who has been located at Rye, N. Y., recently left for Russia on some research work where his address is Moscow, U. S. S. R., Ilinka, Nkrki, S. S. S. R.

Arnold S. Bunte, '26, Core Drill Geologist for the Shell Petroleum Corporation, is now located in Chickasha, Oklahoma. His post office box number is 745.

A. S. MacArthur, '27, sailed from New York October 15 for Venezuela where he will be shift boss for the Gold Fields American Development company.

Roy B. Munroe, '29, who is connected with the Kansas City Gas company, attended the American Gas Association's 12th annual convention in Atlantic City, October 13 to 17.

S. Power Warren, '13, was mentioned in the October issue as being on the staff of Queen's University, Kingston, Ontario. This was incorrect. "Pi" is studying at Queen's, which has 2,000 students, and plans to get his master's degree on this year's leave of absence. He is also making a study of the complex ores prevalent in that part of Canada. His address is 574 Johnston Street, Kingston, Ontario, Canada.

F. J. Wiebelt, '16, who is taking graduate work at Mines, and his family are at the Kellums apartments, 921 19th street, Golden, for the winter.

Raymond Whetsel, '16, who is with the Cities Service company in Paris, France, expects to be located permanently in Europe. Mrs. Whetsel, her mother, and the Whetsel's three daughters, are sailing in November to join him and spend the winter in southern Spain.

Paul Lewis. '29, who has been at Artesia, New Mexico, is one of the many Mines men who have been transferred by their companies to the Fort Morgan oil fields that have just opened up.

Donald Bailey, '21, is with the Title Guarantee and Trust company of Los Angeles. The Baileys are at home at 1114 Maple, South Pasadena, Calif.

Robert Brummett, '26, who is with the engineering department of the City of Los Angeles, visited at Mines at the beginning of school.

Theodore D. Benjovsky, '09, of Salida, Colorado, was another Alumni visitor. He is with the Federal Lead Co.

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Prof. Juan Korvûjin, head of the geophysics department of the National university of Mexico, visited the department at Mines the first of October.

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The latest registrant at Mines is Wang Tsung Ho, a former student at the Fuchien Christian university, the University of Yen Ching, and the University of the Philippines. Mr. Wang hails from Punan, Amoy, China.

BIRTHS

Another potential Miner made his appearance at the home of Mr. and Mrs. Marvin Marsh, Middletown, Ohio, recently. "Soupy" is with the American Rolling Mills company.

A son arrived at the home of Mr. and Mrs. F. W. White, at Ingleside, Texas, Tuesday morning, October 21. Dad White is with the Cumber Oil company and has been since his graduation in 1928 from Mines.

Cards were received recently announcing the arrival of Mary Ann Baroch on October 24 at Bagdad, Arizona. Mary Ann's father is Charles T. Baroch, '23, Mill Superintendent and Metallurgist for the Bagdad Copper Corporation.

At home, with dad and mother, Mr. and Mrs. C. A. "Slick" Weintz, since October 6—Miss Patricia Ellen Weintz. Miss Ellen was born at Livingston, Montana. "Slick" is a geologist with the Midwest Refining company and has his headquarters in Casper. He was named "Typical Miner" in the 1927 Prospector.

Alumni Register During Summer

The Alumni Register shows that the following Mines men called at Alumni Office during the summer:

Date		*Name* *Class*	*Address*
June	3	L. L. Middlekamp, '05	Houston, Texas
	9	Charles T. Baroch, '23	Bagdad, Arizona
	10	H. E. Merryman, '95	Montrose, Colorado
	11	George B. Kelly, '27	San Antonio, Texas
		J. L. White, '09	Denver, Colorado
	13	T. D. Benjovsky, '09	Salida, Colorado
	14	Hugh A. Wallis, '29	Maracaibo, Venezuela
	16	B. A. Miller, '26	Pittsburgh, Penna.
	20	Harry Fiske, '21	Los Angeles, Calif.
	21	Joseph M. Bradley, '01	Arvada, Colorado
	23	C. A. Lehnertz, '24	Golden, Colorado
	26	J. W. Pearce, '14	Chicago, Illinois
		L. J. Hartzell, '95	Butte, Montana
	30	W. F. Koch, '11	Salt Lake City, Utah
July	15	E. G. Dallmus, '28	Great Falls, Montana
	17	Paul S. Lewis, '29	Golden, Colorado
	18	Al S. Wyner, '25	Ajo, Arizona
		Edmund C. Bitzer, '29	Youngstown, Ohio
	19	Norman Whitmore, '26	Los Angeles, Calif.
	24	G. N. Pfeiffer, '05	Herrin, Illinois
	25	Hollis J. Joy, Jr., '25	Gilman, Colorado
		R. H. Clough, '22	Colorado Springs, Colo.
	29	C. T. duRell, '95	Washington, D. C.
	30	D. C. Frobes, '24	St. Louis, Mo.
		C. D. Frobes, '24	Rivermines, Mo.
August	1	E. W. Ginet, '28	Casper, Wyoming
	2	E. F. Bladholm, '29	Los Angeles, Calif.
		R. Kenneth Burgess, '28	Golden, Colorado
	6	B. B. LaFollette, '22	Gilman, Colorado
	12	E. B. Blickenstaff, '25	Milford, Utah
	19	P. D. Grommon, '07	Berthoud, Colorado
		Geo. P. Robinson, '04	Monterrey, Mexico
		H. A. Dumont, '29	Wheatridge, Colorado
	21	H. C. Armington, '07	Los Angeles, Calif.
	25	S. L. Goodale, '03	Pittsburgh, Penna.
	26	John H. Abbott, '28	Glendale, Calif.
		J. D. Bullock, '24	Lindsay, Okla.
	29	A. S. MacArthur, '27	Butte, Montana
Sept.	2	H. W. Lawrence, '23	West Stockbridge, Mass.
	5	Geo. C. Weaver, '26	Kremmling, Colorado
	5	F. R. Blume, Ex-'30	Emerson, Nebraska
	8	J. McBrian, '23	Shawnee, Oklahoma
	10	E. H. Crabtree, '27	Picher, Oklahoma
	13	D. H. Mullen, '25	Dividend, Utah
	25	S. M. Kobey, '29	Laredo, Texas
	27	R. L. Boeke, Ex-'29	Nucla, Colorado
	30	Frank Sistermans, '23	Los Angeles, Calif.

Anomalies of Vertical Intensity

(Continued from page 23)

covered the surface with a mantle of drift. . . .

"There seem to be, however, certain major anticlines, or upthrust blocks containing Pre-Cambrian rocks. Between these there are basins, synclines, or down faulted blocks containing Cambrian, Silurian, Devonian and Carboniferous (?) sediments . . ."

Very little in the way of correlation can apparently be offered in this state, chiefly on account of the highly metamorphosed condition of the rocks. At only three points does there seem to be any connection between the geology and the isonomalics. These are the magnetic "highs" in the southwest and southeast corners which correspond with granitic outcrops, and the "high" in the northeast corner which coincides with "Mars Hill", a resistant mass of Devonian (?) conglomerate which dominates the topography of the country for a distance of forty or fifty miles. The isonomalics show no trace whatever of the anticlines and synclines, mentioned by Dr. Perkins, which extend in a northeast direction across the state.

One peculiar feature of note is this. In a general way the magnetic "high" in the western part coincides with topographic highs while the "lows" in the east match topographic lows. The question brought forth is this—is there a possibility that due to the complexity of the geology that the isonomalics reflect topographic rather than geologic structure. It was observed in Colorado that the valleys of the Front Range had a lower magnetic intensity than the ridges. Under certain conditions therefore the possibility is present that the topography might have a stronger magnetic effect than the geology. Is such the case here? The writer does not know and has not the means at his disposal to find out.

Maryland[36]

Structurally, it is possible to divide Maryland into two general sections, first the area about Chesapeake Bay, and second, the remainder of the state. The strata of the first section range in age from Cretaceous to Recent, and have a regional dip to the southeast. The second section, which contains chiefly rocks of Paleozoic and Pre-Cambrian age is complexly warped into a series of northeast-southwest folds. The geology of this latter portion of the state is not revealed on the isonomalic map, hence the first section only will be considered.

The northern end of Chesapeake Bay appears as a magnetic "high" while the southern part is "low". This corresponds with the Florida type of magnetic effect in indicating directly the regional dip of the strata in this region. There is, however, a "high" area near the southern part of Chesapeake Bay which extends from Virginia, across Maryland, into Delaware. The cause of this "high" is unknown but it may be due to local structural effects or to unknown basement conditions.

Massachusetts[37]

No special structural data was available from this state. Furthermore, although the area seemed to be amply covered with stations there is little or no connection between the anomalies and either the regional geology or topography. No interpretation will, therefore, be attempted.

[36]—Mathews, Edward B. State Geologist. Personal communication.
[37]—Hutchins, Everett N. Senior Civil Engineer. Dept. of Public Words, Boston.

Michigan[38]

Michigan can best be described by considering the upper and lower peninsulas separately.

Lower Peninsula—This area is structurally a large basin, the center of which is approximately the same as the geographic center of the peninsula. Rocks, of Devonian age, are found along the northern shore and also in the southeast and southwest corners. Inside of these outcrops, in regular order, are found Mississippian Pennsylvanian, and Permian formations, the latter occupying the center of the area. This peninsula is also covered by a certain amount of glacial drift.

Oil and gas have been found at a number of points but thus far chiefly in the southern part. There are a number of known structures but all are too small in size to appear on this map even though the stations are spaced relatively close together, much closer in fact than those of the western states.

Structural contour maps of the southern part of the peninsula are available[38], and from the similarity of the geologic structure can easily be assumed for the northern part.

Magnetically the results shown are only fair but promising. In general, the central part of the basin is predominately "high", with "lows" appearing in the areas of Devonian strata. There are other "lows" in the center of the peninsula but the "highs" are much more extensive. The writer believes that this area may be of the Colorado type in that the "highs" may be due to magnetic effects of the sedimentaries which in this case are of later Paleozoic age. Furthermore, the magnetic effects, of local structure, should, as in Colorado, on the whole be positive. There is little on which to base this belief except the fact that most of the oil areas coincide with magnetic "highs", and that one which occurs in a magnetic "low" is not well represented by stations. It might therefore actually be a high or it might be that the magnetic bed had been eroded from above this structure. One can easily observe that the Mason, Muskegon and Saginaw county structures are all on "highs".

The "lows" in the center of the peninsula may be due to local structures or polarity, or to the effect of varying basement rock, the writer was unable to find sufficient data to determine which. The irregularities may also be caused by local effects in the glacial drift as was discussed under Illinois. This being on account of the fact that the drift came from iron bearing formations to the north. The question will naturally arise, why should the drift effects be sufficient in Illinois, Iowa, Indiana, and Ohio to practically eliminate regional effects, when states such as Michigan which were also covered by the glacier do not seem to suffer so much from the same cause. The answer is probably that the drift was thicker at the end of the ice sheet, therefore states covered by the terminal moraine should have the strongest anomalies from glacial drift. This would account for the lesser effect of the drift in Michigan, Wisconsin and Minnesota than in Illinois, Iowa, Indiana and northern Ohio.

Upper Peninsula—This part of Michigan is made up largely of Pre-Cambrian and lower Paleozoic rocks, the latter being in the eastern part. Here are found the large copper and iron deposits and consequently large magnetic anomalies, both positive and negative. While stations in this area are relatively closely spaced the effects produced appear to be due more to local than to regional causes. It is noticeable, however, that the lower Paleozoic rocks in the eastern part register "low" the same as do the Devonian ones of the Lower Peninsula.

It is regretted that so little information can be given from the data available in regard to a state which is receiving so much attention with the magnetometer as Michigan is at present. Nevertheless the indications are that magnetometer work in this state can be successfully carried out.

[38]—Newcombe, R. B. Geologist. Michigan Geological Survey. Personal communication and maps.
Newcombe, R. B. Correlating Geological Markers in Michigan Section. Michigan Academy of Science, Arts and Letters. Vol. X 1928.
Smith, R. A. Production and Value of Mineral Products in Michigan for 1924, 1925 and 1926 with a report on Oil and Gas Development, Publication 37. Geologic Series 31, Geological Survey of Michigan.

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Western Mining Industry Meets

(Continued from page 14)

operations that would be drastic and fatal to the future of all industry and a bar to the extension of foreign trade which is so vital to the general situation. Those engaged in metal mining have long realized the alarming results that follow the peaks and depressions in the industry and have sought a solution. The country is confronted with a general surplus in all lines of industry. A solution for the surplus is not possible within our own borders, but we must look to the foreign trade to take care of these surpluses. We are involved in an international rather than a national problem. Many firms and industries long ago recognized the need for expanding markets and have not only developed extensive foreign trade but have established manufacturing plants in foreign countries with a view of adapting our machine methods to the cheaper and yet potentially efficient labor available.

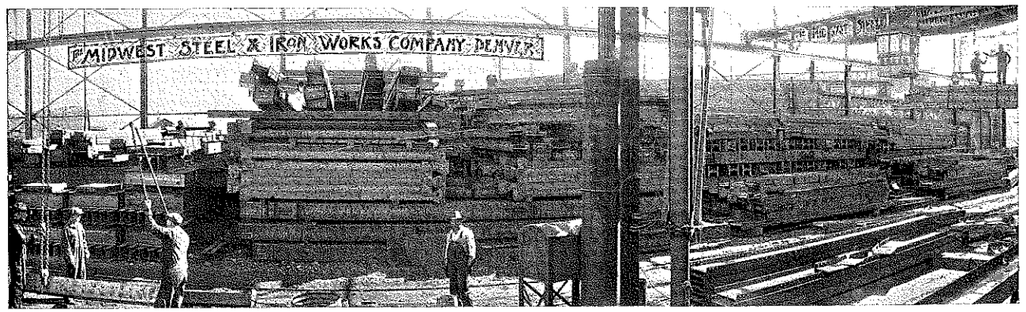
Mr. R. Von Zwerger, a German mining engineer who is making a tour of all the important mining districts of the west, was a visitor at the school on Tuesday, September 9. He was particularly interested in the geophysical work, having been engaged in that line for the Ohio Oil Company in Louisiana and Arkansas. He was accompanied by Mr. H. Mowitz.

One of my fraternity brothers failed in all the courses he was taking.

He telegraphed to a sympathetic mother, "Failed in all subjects. Prepare Papa."

Mother telegraphed back: "Papa prepared. Prepare yourself."—*Colby White Mule.*

ALBERT G. FISH, *Pres. & Treas.* IRA C. BOWER, *Sec.*



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Petroleum Exposition

(Continued from page 13)

such material to the student is inestimable. It is his nearest, quickest approach to experience.

Another tangible proof of the success of my visit will be the donations of representative equipment by progressive companies to the petroleum engineering department. These gifts, many of them valuable, range from fittings and valves for use in class instruction as exhibits in our museum, to orifice meters, filter presses, apparatus for actual use in our laboratories. The presentation of such gifts to the department is the highest type of advertising and progressive companies are quick to sense this, to take advantage of it. As these gifts arrive in Golden they will be announced in this organ with due credit to each donor.

I heard many comments from exhibitors, Alumni, technical men alike concerning the eminence of the School of Mines in engineering, its progressiveness in sending a representative to cover the Exposition. Personally, I feel my visit was worth while from all angles, and I shall always recall with genuine pleasure the Seventh Annual International Petroleum Exposition.

Love Taps

"Man, oh, man, wha' you bin doin'? Bettah stop dat football."

"Football? Wha' yo' get tha' way? Ah's jes been in a lovah's quarrel."

"You mean to say Mirandy done all dat?"

"No, brother; it was Mirandy's other feller!"

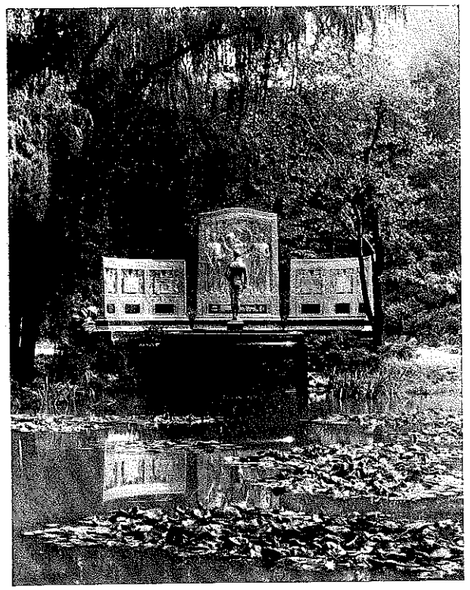
—*Notre Dame Juggler.*

Westinghouse Memorial

The nation's leaders of industry, business, and scientific research paid homage to the late George Westinghouse, inventor of the air brake and an industrial leader, in the dedication of a memorial to him in Schenley Park, Pittsburgh.

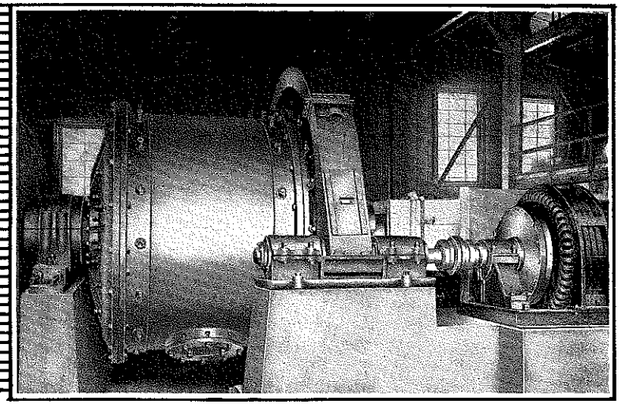
The memorial may be considered one of the most significant contributions to American art and a remarkably unique work in both architectural and artistic spheres. It represents the combined efforts of Henry Hornbostel, architect; Daniel Chester French, sculptor; Paul Fjelde, sculptor; Massaniello Piccirilli; and other talented artists who were associated with them; and is an outstanding achievement in interpreting American culture.

The setting of the memorial was chosen to obtain the greatest beauty and simplicity. It is a wooded glen through which flows a pretty brook into a lily pond. There is an abundance of trees and shrubbery, and the finest growth of rhododendron in Pennsylvania adds beauty to the locale. Two years of culture have contributed to the natural beauty of this spot in Schenley Park, one of the largest units in the City of Pittsburgh's public parks system.



A front view of the Westinghouse Memorial showing its beautiful setting. The right-hand panel of the Memorial depicts three of Mr. Westinghouse's most notable achievements: the illumination of the Chicago World's Fair, the air brake, and the modern railway signaling system. The panel at the left of the central group shows graphically three more accomplishments of the great inventor; alternating-current railroad electrification; the steam turbine, introduced into America by Mr. Westinghouse; and the hydro-electric plant at Niagara Falls. The center-piece of the Memorial is a ten-foot figure representative of American Youth, a sculptural triumph of Daniel Chester French.

Results Count



BASED upon the results obtained from Marcy Ball Mill installations at Walker, Andes, and Inspiration, the International Smelting Company has chosen the Marcy Mill for its new flotation unit at Tooele, Utah.

This mill is grinding half inch lead-silver ore and reducing it in "one easy step" to feed suitable for selective flotation.

This particular mill, a Marcy No. 86, has detachable heads, manholes in the shell, new type spiral shell liners—all essential to high capacity, low power consumption, and reduced grinding costs.

Let our engineers analyze your milling problems and show you representative installations. Ask for Bulletin No. 69, which is chock-full of interesting information on Marcy Ball Mills.

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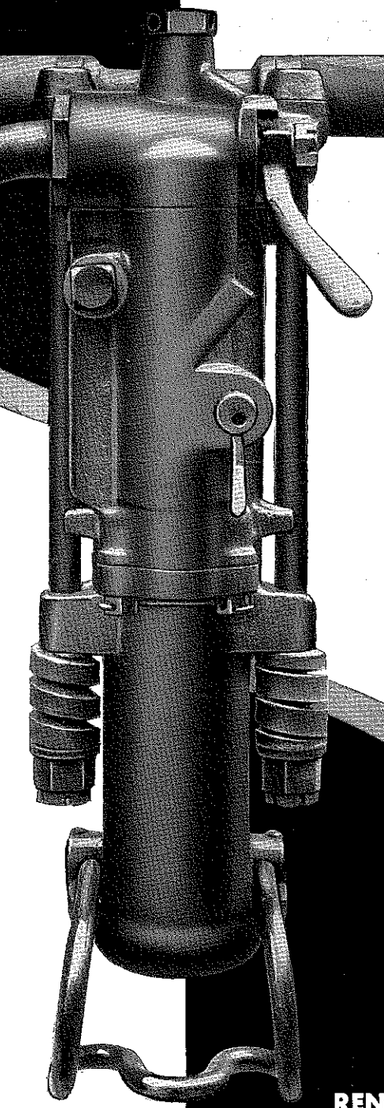

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