INTERVIEWS
WITH
MINING ENGINEERS

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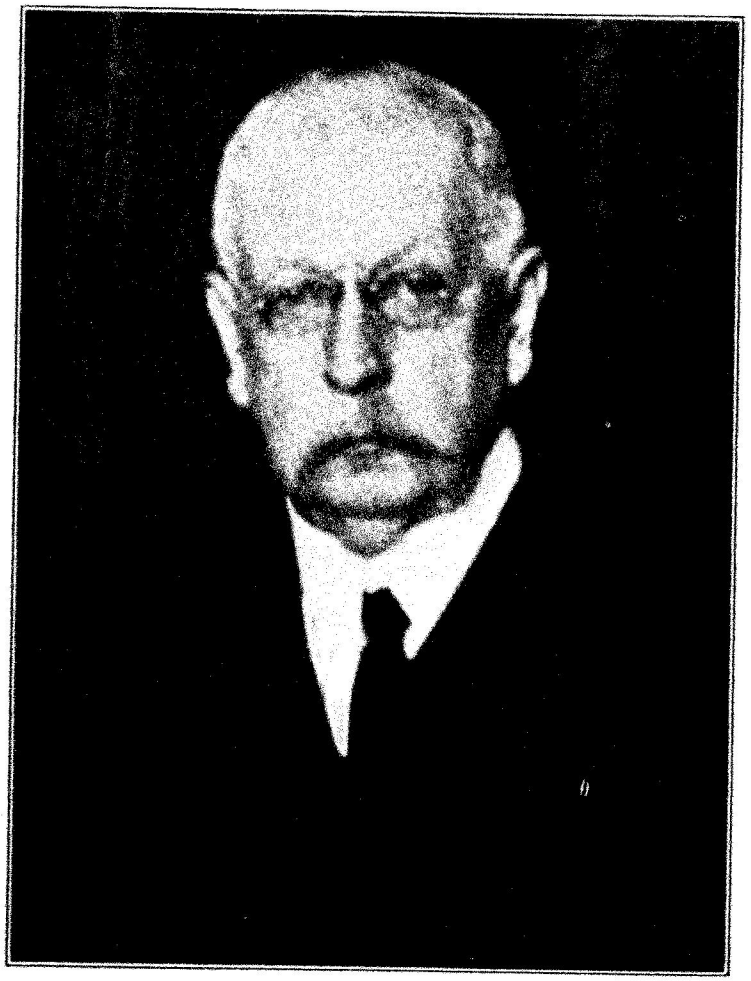

ARTHUR DE W. FOOTE

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AN INTERVIEW

Mr. Foote, you come of old American stock?

Yes, for eight generations; my ancestors came from Yorkshire in 1630.

Where were you born?

At Guilford, Connecticut, in 1849.

Was your father interested in mining?

No, my people were farmers and soldiers for generations.

That explains your interest in irrigation, and in engineering as applied to the improvement of farms.

I suppose it does; I was interested as a boy in a drainage scheme we had at home.

What was your early education?

Private school and high-school and a short time at the Sheffield Scientific School at Yale in the class of '69, which I left in 1868. My eyes gave out, so I had to stop studying. Then I went to Florida to grow oranges. After a year or two I went back to New York and got my eyes back. The next winter I was in the West Indies. Then I returned to New York and worked in the Atlantic Dock iron-works, in Brooklyn. Later, I was over a year at Washington, laying asphaltum pavements. During this time I was studying more or less on engineering lines. In the fall of 1873 I came to San Francisco.

What brought you here?

I was looking for something to do, and at that time San Francisco was lively.

Did you get a job soon?

Yes; I went up to Virginia City, Nevada, as assistant engineer on the Sutro tunnel.

Under Adolf Sutro?

Yes. Wederkind was chief engineer. He was a Dane who had run the lines for the Hoosac tunnel and came out to the Sutro tunnel as engineer several months after I got there.

Do you recall your impressions of the Comstock and Virginia City?

I had a letter of introduction from James D. Hague to Isaac Requa, the father of Mark L. Requa. He was very civil to me and showed me around. I remember being much impressed by the Cornish pump in the old Chollar-Potosi shaft. I met Ross E. Browne there at that time.

Which impressed you most, Ross Browne or the Cornish pump?

I think Mr. Browne made the most lasting impression. He worked with me on the tunnel some of the time before Wederkind came out. He has been a good friend of mine ever since. I left there in 1874. Sutro fired me. We had struck a flood of water in shaft No. 2 of the tunnel and were drowned out.

Why were you drowned out?

We had to run the pumps so fast that the steam-pipe heated the shaft until it became impossible for men to work. Sutro came to the office, fuming and swearing, whereupon I told him that we had not been 'drowned out' but we had been 'burned out'. He did not like it, so we parted company. I did not then know that he had put in the steam-pumps against the advice of everybody who understood the subject, because he could buy them for stock in the tunnel company. At that time the only kind of pump that would have served our purpose was the Cornish pump. Today, of course, under similar circumstances, we would have used electric pumps. It might be worth while, as a matter of record, to mention that while at the tunnel I helped J. B. Pitchford, who was master mechanic, put up the first air-compressor installed in the West. In fact, there had been but two in the whole country before that: one at the Hoosac tunnel and one at a Delaware & Lackawanna railroad tunnel.

What did you do next?

I went up on the Eldorado canal under F. A. Bishop, on the south fork of the American river. It supplied water to the hydraulic mines around Placerville. I remained there only a matter of eight months. Then I went down on the Southern Pacific railroad to Tehachapi, where I was under William Hood, chief engineer of the Southern Pacific. He was very kind to me and we have been friends ever since. I got tired of the desert country and got back to underground work at New Almaden.

Who was in charge of the New Almaden at that time?

J. B. Randol.

Who was in charge of the engineering staff?

No one but myself. Hamilton Smith came down to look over my work on a difficult piece of surveying, and thereby I became pleasantly acquainted with him, and through him with Henry C. Perkins. I stayed there some three years, and while there, in 1876, I was married to Mary Hallock.

Did you live in the old 'casa'? I remember making a visit there when W. H. Landers was manager in 1917.

No, we lived on the hill; I fixed up a little cabin there. Both of us enjoyed it. My work was absorbing; some of it was quite difficult, and the Mexican element was extremely interesting to my wife. Our son was born there. He is now general manager of the North Star mines, at Grass Valley.

Why did you leave?

Randol and I did not agree.

On technical matters?

No, on general principles. I resigned and went up to Deadwood, South Dakota, where I worked as engineer under Sam McMaster, superintendent of the Homestake. I opened an office on my own account, but most of my work was done for the Homestake Mining Company. The owner, George Hearst, who

was in partnership with Haggin and Tevis, was living there at that time.

Was Hearst a good miner?

His principal business was lawsuits. He always claimed he did not know anything about mining, and refused to act on his own judgment. He said, if he went to a dump he would be sure to pick up the only piece of good ore that was on it. He employed Henry Janin, Louis Janin, and James D. Hague. He himself was dirty, slovenly, and extremely vulgar.

Was there anything in your work at the Homestake of special technical interest?

Well, there was only one point of particular technical interest; that was whether the Homestake and the Old Abe veins came together in depth; but the mines were not opened sufficiently to warrant an opinion. It was thought finally that they would come together, so Hearst bought out the other parties, after trying to beat them in a lawsuit. I was not sorry to leave Deadwood, in '78, to go to Leadville.

Yes, I know you were at Leadville, because I read 'The Led Horse Claim', Mrs. Foote's book, about 35 years ago, and I still recall the charm of it. What took you to Leadville?

My first job was on the Iron Silver suit, as an expert. That used up several months. I established an office there and was afterward in charge of the Adelaide and several other small mines.

What was the mine that figures in 'The Led Horse Claim'? As I recall, the story dealt with a lawsuit and trespassing that culminated in fighting underground at the boundaries of two conflicting properties.

The foundation of the story was the suit between the Adelaide and the Argentine.

It is generally supposed that the hero was typified by Ferdinand Van Zant?

No, he was a friend of ours and he was my clerk at that time, but a great many incidents in the story were imaginary. It

was a picturesque case. When the fellows on the other side broke through below, they drove our men out. Steve Fleming grabbed his Winchester, threw his leg around the rope—a wire rope—and went down, hand over hand. He got to the bottom and ordered them out. They could not see him, of course, but they could hear the click of his rifle—not to mention the language that he used, suitable to the occasion—they went.

Who, among mining engineers, were at Leadville at that time?

Most of them used to come around to us: Clarence King, Rossiter Raymond, S. F. Emmons, James D. Hague, R. E. Booraem, R. W. Emmerson, and many others. Tom Walsh, of Camp Bird fame, was keeping a hotel in Leadville. When I first arrived, I could not get a room, so he took me in most kindly. I had known him at Deadwood.

Was he a carpenter at Deadwood?

No, I think he kept a restaurant there. It was a very pleasant summer in many ways, because Emmons had his camp near our cabin on the outskirts of the town, and we used to have delightful meetings with him and Clarence King, Hague, Raymond, and other men of high character, coming and going. Dr. Raymond wrote a poem on the cabin and sent it back to us. I remember twenty years afterward going to his office in New York, and as soon as he saw me enter the room he started to quote this poem of his. 'The Little Log Cabin by the Ditch'.

Can you mention some technical recollections?

Yes, I would mention the fact that at this time James B. Grant, afterward of the Omaha & Grant Smelting Company, and Governor of Colorado, did the first direct smelting of galena without roasting in a blast-furnace—a water-jacketed furnace. Those of us who were in Leadville at that time took a keen interest in the experiment.

How long were you at Leadville?

I was there over two years. Mrs. Foote enjoyed it more than I did, because it was such a contrast to her previous life on the Hudson river and in New York City. She began to write while at Leadville, and her first story was the one that you have

already mentioned. It encouragd her to keep on. Before that she had been an illustrator for magazines in New York. My health broke down, owing to the high altitude, which affected my nerves, and I went East for a while. That winter I went to Mexico and stayed down there for several months.

Where?

For a time I was at Morelia in the State of Michoacan. The trip did me lots of good, and on my return I went into the Wood River country, Idaho.

What mines?

I examined several mines, and finally opened up a prospect called the Wolftone.

Did you name it after the mine at Leadville?

No, it was probably named after the Irish leader. I stayed there until the beginning of the next winter, and while there I became interested in an irrigation project on the Boisé river in the Snake River valley. The land lies between the Boisé and the Snake, forming a peninsula. I took up water-rights on the Boisé river and made the surveys for a canal to serve some 300,000 acres of land.

On your own account?

I was doing it on behalf of myself and some friends. We organized a company later and called it the Idaho Mining & Irrigation Company. My habits as a miner led me to prospect the bars on the Snake river and to add the word 'mining' to the name of our company.

Did you find anything?

Yes, I found a large area of ground that would pan from 50 cents to a dollar per yard. Eventually, when we got a small canal built and water on the ground, we washed it as they do on the Snake river, by means of sluices, screens, and blankets. Our blankets we washed in a tub. That was my first experience with cyanide. We put a little cyanide into the tub to brighten the gold, and it immediately dissolved most of the gold, which was very fine and very pure. The clean-ups were disap-

pointing. We did not work long. That was just a year or two before the discovery made by MacArthur and Forrest.

But if the gravel contained from 50 cents to a dollar per yard, surely it will pay to work today?

I presume that it would; but at that time we gave our chief attention to the irrigation work. I was there some twelve years and had great difficulty in getting money to build the canal, but finally built a portion of it. Our directors had trouble among themselves, and the enterprise was abandoned. The canal has since been built by the Government. There was never much publicity about it, though it is the largest irrigation canal in America or Europe, having a capacity of ever 4000 cubic feet per second; and the Arrow Rock dam, which forms a huge storage reservoir for it, is the highest dam in the world. During that time I was engaged for a couple of years or more on Government work—the first Government irrigation survey in the United States. I had charge of the Snake River division under Major Powell, director of the U. S. Geological Survey. Those years were extremely interesting, with two or three parties running canal-lines on the Snake River desert, preliminary surveys for the irrigation of several million acres, hunting the Grand Teton range for reservoir sites on both forks of the Snake river, through Jackson's Hole, up to the Yellowstone and Henry's lakes.

So then you had to abandon this Boisé project, and you returned to mining?

Mining or quarrying. In 1893 I went to Lower California to open up an onyx deposit, in which Emmons was much interested. In fact, I went down there with him. There was a big mass there of the most beautiful rock you can imagine, but it was 75 miles from the coast. I built the wagon-roads and arranged for putting the material on board ship. Then the panic came on and the enterprise was abandoned. From there, I came up to San Diego, and Hague telegraphed me to come to Grass Valley. On my arrival he told me of some of his plans for the North Star mine. He told me that he was going to open up the Rocky Bar mine on Massachusetts hill—I mean the one in which the Watts made their money. It was rumored that there

was a good deal of water to be encountered, and Hague wanted me to go and see what few electric plants there were then in the West, so I went to the Fremont mine at Amador City and saw their electric pumping equipment. I was to have gone to Bodie, but I did not go. It was just after the Bodie electric line had been completed. But I went to the Calumet & Hecla in Michigan. They had just put in two sets of pumps having a 1600-ft. lift each. I stayed there for a week and learned all I could about them. In January 1895 I came to Grass Valley to open up the group of mines for Hague, who represented what is now the North Star Mines Company.

This company has an interesting proprietary.

Yes, we had a fine lot of shareholders. The Agnews and Blisses of New York, the Phelps Dodge people, including James Douglas. J. P. Morgan was one of the stockholders, also Balfour & Guthrie. Hague himself had a large interest.

The first time that I visited the North Star mine, Emile Rector Abadie was the superintendent. That must have been in 1886, because I remember being interested in comparing the methods of milling with those used in Gilpin county, Colorado. The next time I was at Grass Valley was on the eve of George Starr's departure from the Empire mine to go to South Africa. That was in 1893. I remember that my first meeting with you was on my return from Australia in 1898, when, like most intelligent mining engineers, I took the opportunity to visit Grass Valley, more particularly the North Star mine. You must have had an enormous number of visitors during your residence at Grass Valley?

Yes, it has been a great deal of pleasure to us to have them come there.

Will you say something about your experience at the North Star mine, more particularly with reference to its vicissitudes and its success?

I did not agree with Hague about using electric power for pumping. The mechanical application of the power was not sufficiently developed to constitute good engineering; so I put in a

compressed-air plant to do our pumping, hoisting, and drilling.

What sort of a plant did you erect?

We were getting our power from water. We bought water, delivered to us at the top of the hill over 2½ miles away, and we let that water down in a pipe to the lowest point of our land and applied it to Pelton water-wheels. Our ditch gave us an 800-ft. head of water, and that, by the use of large water-wheels, enabled us to employ direct-acting compressors.

Of what make were they?

The first two were designed by Edward A. Rix of San Francisco and were very successful. Later we put in two others of our own design.

How long did it take to unwater the old mine?

The mine did not make a great amount of water: four to five hundred gallons a minute. It took us about four months, after we started the pumps, to get to the bottom. That was late in 1896.

Then you began to explore the old workings and open up new ground? Were you put in charge?

After I got the machinery all in, I was appointed superintendent. That was in June 1896. We began sinking, and found that the old shaft was vertical for about 240 ft.; then it went off askew at a flat angle.

So that it was not usable?

Well, I made it work by putting in a vertical curve, as well as a horizontal curve to get into the old incline and then I was obliged to put another horizontal curve into that shaft to get down at right-angles to the vein. It was about as straight as a dog's hind leg. We found a nice body of ore on the 1300 level. We also found a good body of ore up above where the Watts had taken out their bonanza.

What level?

That was above the old workings, probably 200 to 250 ft. from the surface. As we went down, the vein became larger but very poor, and it continued to flatten, so that the conditions

became most discouraging. We stopped and abandoned the mine.

That was in?

In 1899.

Had you made any profit over the cost of equipment?

Yes, we had taken out enough to pay for all our trouble and a little more. We took out about $800,000 worth of gold. In the meantime we started a new vertical shaft to tap the North Star vein at the 40 level—that is, as measured on the dip of the vein. The shaft cut the vein at 1600 ft. below the surface in April 1902.

Did you find good ore?

Yes; we found, right at the bottom of the shaft, a bunch of fair ore. The quartz from the first blast, as it came up, showed little bits of gold in almost every piece. It probably assayed about $20—an ounce—per ton. Then we cut our station and commenced drifting and put up a raise to reach the bottom of the old shaft. Of course, we encountered a great deal of water. In driving at the 40 level and putting up this raise we often had to plug up the holes to keep the water from drowning the pumps.

But I presume that the pressure was greatly relaxed as the water-plane was lowered?

I presume so. After a year or so this flow of water almost ceased. We extended the 40th level, and then the 37th, and then others in succession. The 37th was the richest level in the mine.

By "rich" what do you mean in terms of feet and dollars?

There was over 2000 ft. on that level that would average $15 for a width of 2½ ft, in the mill. Near the shaft there was one bunch from which we took out $16,000 from ore that was so rich that none of it went to the mill. We crushed it up in the assay-office and put it into the crucible to be melted. It was great stuff, I tell you.

The mine has had no set-back since then?

Not until the War raised the prices of everything that we

had to buy, and did not raise the price of our product, namely, the gold.

What has been the output of the North Star since you have been connected with it?

I will have to refer to the records for that. They show about 1,600,000 tons averaging $11.35 per ton, making a gross value of $18,000,000, from which about five millions have been paid in dividends.

How is the bottom of the mine?

On the 6300 level the North Star meets what we call the 'X' vein, that is to say, a vein coming down from the east at a dip of about 40 degrees. Whether the North Star vein goes through, we don't know yet. Apparently it does not on the south side of the shaft. Meanwhile, the 'X' vein is going down strongly, dipping west, and shows a good width of milling ore scattered in a wide lode.

What is the vertical depth of the 6300-ft. level?

The dip averages 24°, so that level is 2500 ft. below the surface or 100 ft. below sea-level.

Are you doing any work below the 6300?

No. When we shut-down last winter, we stopped all the work on the 63, and now are doing development work and a little stoping on what we call the 'A' vein on the 34, 40, and 47 levels. This 'A' vein connects with the North Star vein between the 40 and 47 levels.

You say that you shut-down last winter. Why?

The mine was not paying owing to the fact that about one-third of the men would not do a fair day's work and would not allow the others to do so. Therefore, we discharged 250 men, retaining 110, doing just stoping enough to pay our overhead expenses and taxes, and a large amount of development work on the 'A' vein. These 110 men are doing more than two-thirds of the work done previously by the crew of 360.

The men that you have retained, I presume, have homes in Grass Valley?

Yes; they are old men who have been with us for years. They are mostly the sons of Cornishmen who came to Grass Valley in the early days. All the old fellows are pretty well gone.

What do you think of the proposal to levy a tax on manufactured gold under the McFadden Bill? Do you think it will help gold mining in California?

I think it might help gold mining, but I object to it as being special legislation and thus giving an excuse for other special legislation that would injure us about as much as the proposed law might help us.

Are you using flotation in your mill?

No. We made a pretty careful investigation to ascertain if it would be advantageous to us, but we found that the amount we might save would be very nearly eaten up by the royatly and would require a considerable investment. It was a question whether the profit would be sufficient to pay for the investment. The terms of the contract we could get from the Minerals Separation Company disgusted us so much that we told them to go to hell.

Mr. Foote, your son has followed in your footsteps?

Yes; he graduated as civil engineer from the 'Tech.' at Boston in '99 and came as my assistant at the mine in 1904. In 1912 we made him general superintendent, and in 1915 he was made general manager. Meanwhile, I was semi-retired as consulting engineer for the company.

By the way, you had an interesting experience in the Tightner mine, did you not?

We had an experience that was delightful for a time. It was rather interesting. Driving north on the vein, we struck a bunch of quartz about 30 ft. wide and perhaps 100 ft. long. We stoped up on the foot-wall, getting indications of gold; in fact, we milled about 5000 tons, which went $2.49 per ton. Then, in putting up a raise from the stope, we ran into coarse gold, and worked to the hanging over the former stope of poor quartz, taking out $750,000 in gold in a space less than 100 ft.

square. Some of it was so rich that we had to cut it up with chisels to get it to the mill.

Did you send it to a stamp-mill?

Yes, we put it under the stamps in order to remove the barren quartz, and then milled it.

That is, you used the stamp-mill as a crusher and not as an amalgamator?

Exactly.

I presume that the so-called barren quartz was good enough to be re-treated?

It went right on over the amalgamating-plates in the regular way.

Well, that must have been delightful, but did it happen again?

Not in such a large amount, but we found numerous bodies that yielded from $75,000 to $100,000 in the course of three years.

Did this gold occur above the water-level, or the limit of oxidation?

That is pretty hard to answer, because the apex of the vein is covered by 1000 ft. of lava. The Middle Yuba river near-by is at a level 2000 ft. below the horizon at which we found this gold.

Did you find the outcrop of the vein in the bedrock of the old alluvial channel?

That was where the old miners discovered it and told H. L. Johnson about it, and he opened the old tunnel and found it. That was the origin of the Tightner mine.

How much has the Tightner produced?

Under our management, it has produced about $1,700,000, and about $400,000 more for others.

Do you consider mining engineering a good profession for the young men of this generation?

Yes, it is a fine occupation. The mining engineer's life is as interesting as that of a civil engineer, and there is probably

more money in it, but the civil engineer or the railroad engineer or the hydraulic engineer has a broader education and a broader scope than the mining engineer.

Have you any suggestion for improving mining education?

Professional education, I suppose you mean. Prof. Christy used to ask me that question and when I suggested reading and writing he seemed disappointed until I explained that by 'reading' I meant reading good literature, historical mining, and geology until the student acquired something of a vocabulary and the proper forms of language, and by 'writing' I meant a cultivated hand-writing, and using words intelligently so as to convey ideas clearly with fine distinctions. When a man can do that he has advanced far in his profession.

Have you any particular ideas for the betterment of industrial relations, that is to say, for improving the relations of employer to employee in mining enterprises?

My idea is that the personal equation is everything. The great difficulty is that when you get a large number of men under one management you obliterate that personal equation and so render the relations unhuman. I think the remedy is coming by means of the shop committees, as they call them in England, or grievance committees—an unfortunate name—more properly welfare committees, composed of one man from each gang of workmen to meet with a special representative of the management freely and without prejudice at any and all times. Any serious matter that cannot be arranged by him is brought to the superintendent, and if not then fixed up, is brought before a Board of Conciliation composed of employees and officers in a proper proportion. This welfare man must have the special talent for spreading his personal equation of kindliness and reasonableness through all the working force. This man will be difficult to find, but the position is next in importance to that of the manager and should be treated accordingly.

What do you think about the proposed Department of Public Works to include all the engineering functions of the Federal government?

I think such a Department would save millions of dollars every year and get more, much more, useful work done than is

done now. Such a Department organized by and under the direction of Herbert Hoover, taking the place of the Interior Department, would prove so economical and efficient that soon the people would be demanding that all engineering work should be done under it.

What do you consider the prospects of further gold discoveries in the United States?

If you mean absolutely new discoveries, like Cripple Creek, I imagine few are to be made. If you mean new discoveries in small mines and prospect-holes now lying idle or being held by annual assessment work, I think there are great numbers to be made. When gold again reaches its normal value, gold mining will revive and our production will increase and continue for many years beyond our ken. It probably will not be as spectacular as in the past, neither will it be as uncertain. Much has been learned about gold mining, even in the last 25 years, and it seems to me that the future mining will become more and more a manufacturing business managed by trained men, who will take only reasonable risks and will be satisfied with reasonable profits.

What do you consider the most satisfactory experience of your career?

That is a somewhat difficult question, probably my twenty-odd years at the North Star mine have been the most satisfactory. There were several quite interesting engineering problems to work out: a good hard fight at times, when men had to be held to their work with moral suasion and profanity properly blended. There were times of discouragement, of course. I remember Hague saying to me very pleasantly, "Do you know, Arthur, you have spent over a million dollars since giving us a cent". Mr. Hague was a most delightful man to work for. His sense of humor would dominate any occasion and cover all trouble. He never bothered me with details. His only specification for a stamp-mill that was to cost $80,000 was, "Build it to last thirty years". So I built the mill of stone and iron, and it was satisfactory. Hague died in 1908, just at the beginning of our reward for ten long years of preparation. That year the mine produced over a million dollars and continued at that rate until war

prices shut us down. After James D. Hague died, his son William, or 'Billy' as everyone called him, came out as managing director. He built a house and brought his charming wife out, and his children were born here. As I had turned over the active charge of the properties to my son, I had the pleasure of watching the second generation carrying on the work of their fathers until the War came. Yes, I think I may say that the years from 1895 to 1916 were the most satisfactory or the least unsatisfactory of my life.

A YANKEE ENGINEER

*Among the pine-clad slopes of the Sierra Nevada, on the Pacific side and overlooking the central valley of California, is a pretty settlement called Grass Valley. It is a community devoted to gold mining, and is distinguished among other Californian mining centres as the locality where was started the first digging into hard rock for gold-bearing quartz in veins or lodes, following the early washing of the gravel in the river-beds from which the miners of '49 drew their riches. In 1851 the first shaft was sunk on Massachusetts hill; now the Empire mine has a vertical depth of 2705 feet and the North Star is 2500 feet deep; but these figures fail to measure the extent of the mining operations, because the North Star shaft, for example, follows the dip of a flat vein so that it is 6300 feet long from top to bottom, where, by the way, it is just a hundred feet below sea-level. The North Star has had its vicissitudes, like most mines, but it has been yielding gold almost continuously for 25 years. Moreover, it has been a mining school to a number of engineers now playing a useful part in the world. Originally it was an undertaking launched by that fine old gentleman, James D. Hague, and it was opened up under the technical direction of another engineer of the old school, the school of scholars and gentlemen. We publish an interview with the veteran manager, Mr. Arthur DeW. Foote, now partly retired and succeeded by his son. The story of the big men connected with the big mines is more interesting, we venture to suggest, than the statistics of production or than even the evolution of technical processes. Mr. Foote is a repre-

*Editorial in the 'Mining and Scientific Press' of December 25, 1920.

sentative American, in his ancestry, his early environment, his schooling, and the venturesome beginnings of his professional career. The interview shows that he is direct and outspoken, eschewing periphrasis. He speaks of men as he found them—and he had to deal with many kinds—but in all his dealings he asserted the essential manhood and self-respect that we like to consider peculiarly American. He could look any man in the face, and, if necessary, tell him to go to hell; but he did not say it too often, and he never said it without cause. He was always kindly and polite to those with whom he worked, either as subordinate or chief. Mr. William Hood, the veteran railroad engineer, to whom Mr. Foote was assistant 45 years ago, tells us that he was "exceedingly competent in his work and a most agreeable gentleman, with whom it was a pleasure and privilege to be associated". Another veteran engineer, Mr. Edward A. Rix, says that Mr. Foote impressed him always as "singularly fair and just in his dealings". He is a civil mining engineer in a double sense; he began with tunnel and railroad work, and then turned to hydraulic engineering on a large scale, before drifting into mining and metallurgy. His early training made him keen in the selection of the machinery employed in mining and more particularly the use of compressed air, for pumping and hoisting, as well as drilling. In this branch of mechanical engineering he was a pioneer, and, as the interview records, he found keen pleasure in planning and devising (with Mr. Rix, a specialist) new types of compressed-air machines, which were then, 25 years ago, in their infancy of development. He had the courage of his convictions, reinforced by a thorough knowledge of the principles involved. For example, the ordering of the 18-foot direct-connected Pelton water-wheel, which actuated the first compressor at the North Star, required some nerve, for it was of much larger diameter than any previously constructed and was built with spokes in tension like a bicycle-wheel. Mr. Rix says: "The usual knockers lined the fences to see her blow up when started, but they were disappointed". Mr. Foote has decided ideas on education, more particularly the need for teaching English to engineering students. He becomes explosive in talking of the jargon that is the accepted medium of literary communication among members of the profession. He has an understanding sympathy for the toilers underground and recog-

nizes that the entire morale of a working force depends upon the personality of the manager, superintendent, and foreman. He places his finger on *the* weak spot of industrial management, namely, the increase in the size of the operations and the number of men employed to such an extent that personal influence becomes extinguished and the relation of a manager to his employees becomes de-humanized. That is repellant to him, for his traditions and his education alike have given him a feeling of keen responsibility to the men whose work he directs and an appreciation of their troubles and distempers. He is like the type of Colonel who is a father to his regiment. Which reminds us that he appears disguised by literary art in a book called 'The Ground Swell', written by his wife, who, as Mary Hallock Foote, is known to many of our readers as the author of 'The Led Horse Claim', 'The Valley Road', 'The Chosen Valley', and a number of other books in which the refined imagination and the tender feeling of a New England gentlewoman give charm and reality to divers phases of Western life. In the retired General of 'The Ground Swell' we catch glimpses of our mining engineer at Grass Valley. "When he's happy he drops into Uncle Remus talk; when he is very happy he becomes nautical. In his far-off boyhood he had played with boats." Again: "My husband could do foolish things with money, but he had a long-distance wisdom at times that money cannot buy". When things did no go quite right he would describe them humorously, "not being a bitter person". As for example, in his disagreement with Adolf Sutro. It is a great help to one's philosophy of life to be able to see a joke against oneself; indeed it is the supreme test of humor. Looking at Mr. Foote's career as a whole, it may be remarked that a good training in any branch of engineering is a preparation for any other branch of the profession; undoubtedly mining engineering benefits from the incursion of ideas brought to it by competent civil engineers, and there is something in Mr. Foote's remark that the civil engineer or the hydraulic engineer has "a broader education and a broader scope" than the mining engineer; in short, much that the members of our profession are called upon to do is only slightly related to their technical training, but, for that reason, there is more opportunity, we believe, for the play of personal character in mining than in other phases of "the art of directing

the great sources of power in Nature for the use and convenience of man". In the exercise of that art it is necessary not only to direct natural sources of power but to direct the energies of human beings, and therein lie its chief interest, difficulty, and importance. Modern industry has developed an ugly aspect, largely because, with all the improvements in mechanics and in chemistry, we have not produced a sufficient number of men competent in character to be given the charge of large numbers of their fellow-men. That is the main problem facing our industrial democracy. We need more engineers like Mr. Foote, alert and sagacious, but also humane and sympathetic to those who work *with* him rather than *for* him; in short, the democratic ideal of industry is not serfdom but co-operation.