

**BULLETIN OF THE DEPARTMENT OF
MINING AND METALLURGY, UNIVERSITY
OF CALIFORNIA. PRESENT PROBLEMS IN
THE TRAINING OF MINING ENGINEERS.
PP. 979 - 1008**

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[TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING ENGINEERS.]

GIFT

UNIV. OF CALIFORNIA

Present Problems in the Training of Mining Engineers.*

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"The man is always greater than his work." The training of the men who are to develop the mineral resources of the world is the most important problem connected with mining engineering. It becomes ever more important to civilization as the mineral wealth of the earth approaches exhaustion. I have therefore decided to consider a few of the more important problems arising in the training of the mining engineer, and especially those arising in America.

THE PECULIAR NATURE OF MINERAL WEALTH.

Mining and Agriculture are the two fundamental arts. Without the latter our existence would be precarious; without the former, our civilization impossible. Agriculture furnishes that regular supply of food and raiment which leads to the growth of large communities in which cultivated leisure first becomes possible; while mining furnishes the metallic thread from which is woven that complex fabric we call civilization.

But in these two arts the conditions for success are widely different. Most of the crops that the farmer reaps may be harvested year after year, and the proper fertilizers being added, he may continue the annual harvest indefinitely, while, as a result of cultivation, his farm becomes yearly more valuable.

But the crop the miner reaps can be harvested but once in the history of the race. Our mineral wealth has taken unknown ages to mature in the bosom of the earth. The ripened fruit can be plucked but once. There are no fertilizers for worked out mines. It never pays to work over a mine that has been

* Presented at the Congress of Arts and Sciences at the Louisiana Purchase Exposition, St. Louis, September, 1904, and at the Meeting of the American Institute of Mining Engineers held at the same place and date.

"robbed," either through ignorance or lack of skill; and a worked out mine is utterly worthless.

These differences between the two kinds of natural wealth have been long recognized, and have led in the old world to a very conservative policy in the utilization of mineral wealth.

Though the fragmentary history of primitive mining-law is full of contradictions, it would seem that the development of the mineral wealth of the world was at first everywhere due to the free initiative of the miner, whose exertions were stimulated by the right to possess what his energies discovered. But everywhere in the old world the mailed hand of the sovereign soon seized this important source of wealth and power. It was used at first exclusively for his own benefit, but as more enlightened views of the duty of the sovereign to his people spread through Europe at the end of the middle ages, these special rights and privileges have been used more and more for the benefit of the whole people. At the present time in some of the continental countries individual initiative and ownership has asserted itself once more; still, it is generally true that in most of the countries of continental Europe the mines are either owned or are worked under the direction of the government. In these matters the policy of Great Britain and her colonies has been, in general, intermediate between that of the United States and of continental Europe. Hence, in what follows I shall dwell chiefly on the differences between Continental and American customs.

CONTINENTAL AND AMERICAN MINING-SCHOOLS.

When European mining-schools were first organized they also came naturally under government control, and there consequently resulted a close union between the mines and the mining-schools. This in turn led to many other important consequences. A regular career was opened for the graduates of the mining-schools either by their direct employment in mines operated by the government or in the inspection and direction of the working of mines under government control. As a consequence of this policy, well-trained men have always had the management of the mines under a sort of civil service system. And also a wise conservation of the mineral wealth of these countries has resulted; the mines are worked syste-

matically and have often kept producing a steady output for several hundred years, while in our country they would have been worked out and abandoned in one or two decades. While, according to our ideas, there are drawbacks to the Continental policy, it certainly lends a restraining influence to the natural uncertainties of mining life; it gives a more certain tenure of office to the mining officials; and, consequently, results in a more conservative policy in the management. It effects a more complete extraction of all the ore in the deposit, a better avoidance of wastes and a more complete utilization of all the side products. On the whole, the system, when wisely administered, leads to excellent results.

Its effects on the early development of the mining-schools were also favorable. The close relation between the mines and the mining-schools made it easy for the one to assist the other. The graduates of the mining-schools were as sure of employment in an honorable profession as are the graduates from our government military and naval academies at West Point and Annapolis. Historically, this connection has lent the air of distinction that clings to the profession of the mining engineer apart from his function as a mere money-getter.

On the Continent two grades of mining-schools have grown up. The *Bergschule* and the *Bergakademie*. The *Bergschule* trains working miners for the duties of mine foremen, while the *Bergakademie* trains young men of the educated class for the duties of the mining engineer.

The system here outlined possesses many advantages and is admirably adapted to the countries where it originated. But it would be impossible in America. In the first place our government gives away its mines and does not attempt to control either them or the mining-schools. No official connection either exists or is possible between them. Moreover, though there is much to be said in its favor, the sharp distinction drawn between the *Bergschule* and the *Bergakademie* in Europe is at variance with American ideals of democracy.

It has become an axiom with us that not only genius, but also talent, ability and capacity of any kind, are too precious to the entire community to allow them to go to waste. We err, indeed, by going to the other extreme. But there is no doubt that the wonderful industrial progress of America is

largely due to that equality of opportunity that is here practically open to every young man of ability.

THE AMERICAN TEMPERAMENT.

It has often been claimed that the American temperament is due to our peculiar climatic conditions. As a matter of fact nearly all the climates of the globe characterize our country. And in order to disprove this theory one has only to cross the narrow line that bounds our country either to the north or to the south to find a relief from the strenuousness of the American temperament. The American temperament is due, not to climatic conditions, but to a mental attitude toward life. When a man feels that his future depends not so much upon his own efforts, but mainly upon the position to which he was born, he is, if not contented with his lot, at least more likely to be reconciled to it; for he feels it idle to waste himself in useless effort. But, if you can convince such a man that there is no limit to his ambition but that of his own powers, you have fired him with the most powerful stimulant that can influence human nature. It is this stimulant, working day and night for over a century upon men descended from every race in Europe, that has produced the American temperament.

It is a temperament that was not unknown in Greece in its great democratic days. Republican Rome felt it, too. But in monarchies its influence is mostly confined to the army and the navy. For in war times the best man must be had regardless of his birth. Napoleon overran Europe by declaring to his men: "Every soldier carries the Marshall's baton in his knapsack."

THE RÔLE OF "THE PRACTICAL MINER" IN AMERICA.

Nowhere in America has this influence been more keenly felt than in the mining industry, particularly in the Western States. The policy of our government in throwing open to the hardy prospector its ownership in the mineral wealth of these States has stimulated men without previous technical education and training to accomplish what in older countries would be regarded as physical impossibilities.

It is true that the path has been marked with waste of money, labor and life. Blunders, failures there have been, and still

are, innumerable. But the accomplishment is all the more remarkable when we recognize these facts, for it testifies to the almost superhuman energy with which these obstacles have been overcome.

We are greatly indebted to the old world for its contributions to the mining and metallurgic art, but we are beginning to repay the loan with generous interest. And, to tell the truth, it is largely due to the plain average American, without college education or training, that many of these advances have been made. Every one who has mixed much with American miners has met and honored many such uncrowned kings. *And unless the graduate of American mining-schools is ready and willing to meet with this kind of competition without fear or favor, he will surely and deservedly fail.*

This was the first great problem that confronted the American mining-schools and it has proved their greatest advantage. There is no royal road for their graduates. They cannot depend on the government for places in the mines, because the government neither owns, works, nor attempts to control the mines. Neither can they look to their diplomas as a guarantee of employment.

The American attitude on this question has hitherto been very different from the European. Credentials, degrees, diplomas and recommendations that in Europe carry great weight, in America often receive but scant attention. The American often amuses himself with titles, but deep down in his nature is an instinctive distrust of anyone who takes them seriously. Among the men who have done most to develop the mineral wealth of our country this feeling is particularly strong. What a man is, is more important to them than, Who he is. What a man knows interests them but little; it concerns them much more, what use he can make of this knowledge.

Herbert Spencer, a radical in so many of his opinions, was quite in sympathy with this point of view. I quote from his *Autobiography*, vol. i., p. 199, beginning with a passage from a letter to Herbert Spencer from his father.

“I am glad you find your inventive powers are beginning to develop themselves. Indulge a grateful feeling for it. Recollect, also, the never-ceasing pains taken with you on that point in early life.” Herbert Spencer then adds:

"The last sentence is quoted not only in justice to my father, but also as conveying a lesson to educators. Though the results which drew forth his remark were in the main due to that activity of the constructive imagination which I inherited from him, yet his discipline during my boyhood and youth doubtless served to increase it. Culture of the humdrum sort, given by those who ordinarily pass for teachers would have left the faculty undeveloped."

Footnote by Mr. Spencer. "Let me name a significant fact, published while the proof of this paper is under correction. In *The Speaker* for April 9, 1892, Mr. Poulteney Bigelow gives an account of an interview with Mr. Edison, the celebrated American inventor. Here are some quotations from it: To my question as to where he found the best young men to train as his assistants, he answered emphatically: 'The college-bred ones are not worth a —! I don't know why, but they don't seem able to begin at the beginning and give their whole heart to the work.' Mr. Edison did not conceal his contempt for the college training of the present day in so far as it failed to make boys practical and fit to earn their living. With this opinion may be joined two startling facts; the one that Mr. Edison, probably the most remarkable inventor who ever lived, is himself a self-trained man; and the other that Sir Benjamin Baker, the designer and constructor of the Forth Bridge, the grandest and most original bridge in the world, received no regular engineering education."

Mr. Spencer might have added himself to this list of remarkable self-made men, for his schooling, though excellent as far as it went, was very meager, and he made himself what he came to be.

In the words: "*I don't know why, but they don't seem able to begin at the beginning and give their whole heart to the work,*" Mr. Edison has put his finger with singular acuteness on the principal failing of improperly trained college students. The reason why they are not willing "to begin at the beginning and give their whole heart to the work" is because their education has often been so exclusively theoretical that they are filled with the conceit of learning, and they have an inordinate idea of their untried abilities. Hence their unwillingness "to begin at the beginning." They feel that they ought to begin at the end and be put in charge of everything. If, in their training, theory and practice had gone hand in hand, this conceit, which is natural to all young men, would have been soon dissipated by the hard realities of practice, and the young men would have been more willing "to begin at the beginning," and more ready and able "to give their whole heart to the work."

At the same time I cannot help thinking that Mr. Edison must have been unfortunate in his choice of "college-bred assistants," or in the colleges that trained them; for in opposition to his experience may be quoted the practice of a large number of his important rivals in the electrical business and of an increasing number of iron and steel, railway, bridge construction and mining and smelting companies, to draw upon the graduates of engineering schools for their assistants; and, where they wisely insist on the men beginning at the bottom and working their way up according to merit, the results have been, on the whole, more and more satisfactory as the engineering schools have adjusted themselves more closely to their environment. I have given these strong statements of the failings of college-bred men, not to endorse them, but because they contain an important truth that must be recognized and met.

This condition of public opinion has from the very first forced the American mining-schools to stand on their own merits. Whatever success they have achieved has been due to this hard necessity.¹ The atmosphere surrounding European mining-schools is so different from that in America that graduates from such schools have always found in America much

¹ I append in this connection the following concise and caustic note from the *Engineering and Mining Journal*, p. 403, June 12, 1880, which shows the condition of affairs in America only 25 years ago. The hope expressed in the last paragraph has since been largely realized to the benefit of all concerned.

"A correspondent writes us, asking 'If it is absolutely necessary to be a graduate of a school of mines before being able to engage in the business of a mining engineer.' Certainly not; in fact, before engaging in the business of mining engineering it does not appear to be absolutely necessary that a man should know anything at all, as our correspondent can very well satisfy himself by visiting nine out of ten of the mines nearest to him, wherever he may be. Had our correspondent asked, whether it would be desirable that a man should be a graduate of a school of mines before engaging in mining engineering, we should have answered in the affirmative, for the simple reason that the course of study in a school of mines is calculated to give the elementary education necessary for a mining engineer, and, other things being equal, should give its recipient an advantage over those who have learned the business only in practice. The course of study in a school of mines is not, however, sufficient to qualify a mining engineer to take charge of important works; but it forms an excellent foundation upon which to build a practical knowledge of the business.

"Many of our mines are now under the direction of competent engineers and the results of this policy are justifying the hope that, before very long, all companies of good standing will place their mines in charge of men specially trained for the discharge of the responsible and important duties of a mining engineer."