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ROBERT HALLOWELL RICHARDS

I have been asked to write this short article in commemoration of the fortieth anniversary of the beginning of Professor Richards's service with the Massachusetts Institute of Technology, to express in some degree our appreciation of his work and its results, not only for and in direct connection with the Institute, but also apart from this in the fields of mining engineering and metallurgy, to all of which he has been equally devoted during these twoscore years.

The time I have had for preparation and my lack of familiarity with much of his life and work prevent my being able to do full justice to the subject, but, so far as I am able and so far as I do know, I can and do testify to the great value of his performance, and to the debt which we, as students, and the profession at large owe him for these years of service.

"If I were asked," said an associate of many years, "what has been most distinctive and conspicuous in Professor Richards's career, I should say that it was his intense devotion to the Institute." This is undoubtedly true, and the interest in his life and the appreciation of his work should by no means be confined to the students and graduates of the mining and metallurgical courses. Entering the Institute with the first of its students in February, 1865, in his twenty-first year, after an unsatisfactory and, in fact, dishearten-

ing educational experience in the then almost universally classical courses, scientific studies and technical work opened for him, as he himself says, "the beginning of a new life." The work in the laboratory, in the field, the lectures on the natural sciences, then so new as subjects of instruction, were like "the opening of windows to permit of wide vision over the ripening harvest of knowledge." The exhilaration of these studies aroused an enthusiasm not only for the subjects themselves, but for the development of the future of the institution with which they were so closely welded, and which was then fighting its way into recognition. Thus, immediately after graduation, he accepted a position of assistant in chemistry, and successively, during subsequent years, was instructor in chemistry, professor of mineralogy and assaying, and in 1884 professor of mining engineering and metallurgy. But his activity during these years was not by any means wholly indicated by the titles of these positions which he held. The Institute's existence and growth were far from easy, many obstacles had to be overcome, hard times had to be passed through, hard problems had to be solved, and in all of these he assisted. Thus, in the late seventies, Professor Richards assumed the duties of Secretary of the Institute in addition to his work of instruction, and discharged the tasks of these several positions with energy, patience, and devotion during a time of great need.

Professor Richards's lectures in mining and allied subjects were to me always interesting, and impressed themselves by their thoroughness and the evidences of care in their preparation. And such qualities, as expressions of the conscientiousness of the man, had, and always must have, a great influence upon the student. His patient and painstaking example has always remained with me since my student years, as a stimulant to further endeavor when discouraged by failure,

as a check upon impulsive action and rash conclusion. These personal qualities of a teacher are sometimes of more importance to the future career of the student than are the actual subjects studied, and the successes which have been attained by many of his graduates have, I think, been in no small part due to these qualities of our mentor.

The laboratories of mining engineering and metallurgy of the Institute were the first of their kind in the world, and have been the model for many others since established. Their development has been almost entirely due to Professor Richards, and are an achievement of which he may well be proud. Their usefulness primarily for instruction cannot be disputed: they offer the opportunity for "doing things," and the act of doing things is in itself a most important part of education. As Professor Richards himself expresses it, "a thing done which is good enough to stand on its own feet is a victory and a source of strength. If it is a failure and cannot stand on its own feet, it is a lesson one never forgets." But, in addition to their value as instruments of instruction, these laboratories have been perhaps equally valuable as aids in the investigation of milling and metallurgical problems. It was in these laboratories that some of the first investigations were made of the treatment of ores of the Calumet & Hecla Mine, and the contributions of that company, I believe, aided at least in the first equipment of the laboratories. Since then ores from many mines of many parts of the country have been tested and treated, and many graduates and other engineers have made use of the equipment for the testing of ores or of processes, the results of which work have led to the successful operation of many mines and mills. Thus the usefulness of these laboratories has not ended with the instructing of the pupil, but the engineer of later years has come back to make use of the old

tools, and, in return, has assisted in renewing and improving them. Therefore an acknowledgment which Professor Richards would especially like to make is the part his old students have played in making it possible for him to develop the Institute laboratories.

Professor Richards was associated with the first summer school of mining in 1871, and has maintained and developed them ever since. Their value as means of instruction was very great. They afforded opportunities for students to see how things were actually done, they strengthened the ties between teacher and pupil, they introduced the student to managers of mines and works, which frequently lead to subsequent employment, they showed the latter that the student was a useful sort of person, and could be trusted.

The product of the teacher is the student or graduate: the accomplishment of the latter is a test and measure of the former. The wide scope of the work, the high standing of many, and the successes his students have accomplished in the fields of mining and metallurgy are especially a source of gratification to Professor Richards, and redound greatly to his credit. The students of the mining engineering and metallurgical departments to date who have gone out into the world must number fully six hundred. Of these by far the greater part are in the practice of their professions or allied branches, and fully one hundred and thirty occupy leading places, and of these as many as forty have attained especial prominence. Among the latter may be included such names as Henry M. Howe, of the class of '71, Charles W. Goodale, of the class of '75, Walter R. Ingalls, of '86, Thomas C. DuPont, of '84, Frederick H. Newell, of '85, and many others.

During the many years of his professional life, and notwithstanding his activities at the Institute, Professor Richards

has done much important work for the advancement of other enterprises. As early as 1868 he was engaged in assaying for the Calumet & Hecla Mining Company, and he has continued to serve that company to a greater or lesser extent ever since. His years of principal service, however, were between 1878 and 1888, and since that time his relations with the company have been more in consultation at irregular intervals. Mr. Alexander Agassiz, in speaking of Professor Richards's services, says that his work was principally for the development and improvement of the mill, especially immediately after the fire of the early eighties. This work, Mr. Agassiz says, resulted in important increases in saving, especially in the recovery of values from the tailings through the development of the slime plant, and in improvements in smelting methods. The later growth of the mill and smelting plant have been in a large part along lines laid out by Professor Richards, and in furtherance of his original suggestions, with the improved means available in later years.

Professor Richards has further acted as consulting engineer in the ore dressing mill of the Pennsylvania Steel Company at Lebanon, and has served in a similar capacity for the Sulphur Mines & Railway Company of Virginia. At the Longdale Iron Works in Virginia he introduced hydraulic classifiers. He is on the staff of the Firth, Sterling Steel Company in connection with the concentrating of their wolfram deposits in Boulder County, Colorado, and he has served the Boston & Montana Company of Great Falls, Mont., in connection with their concentrating plant, and also the Eustis-Pyrite Mine in Quebec. In 1905 he spent the summer at Portland, Ore., working, in connection with Dr. David S. Day, for the United States Geological Survey on an investigation of the black sand deposits.

The results of this work were of value not only directly

to those employing him, but also in widening his own field of work, and in making him thereby of greater value as an instructor. The outcome of his work in other fields is embodied partly in a large number of publications, a list of which is appended to this article. Further results are expressed in various inventions upon which he has been working intermittently for many years. Particular attention has been given to classifiers, and his classifiers and pulsators have been installed in many places, and their use appears to be increasing. These investigations included not only the necessary practical calculations for large installations, but also many theoretical studies, the results of which have been put into literature. He has at all times, during the past few years, had one or more private assistants engaged on this work. As developments of this line of work, he has made the following inventions: a Suction Filter Pump (described in the *Chemical News* in the early '70's); a Jet Pump (described in the transactions of the A. I. M. E. in the early '70's); the Calumet Classifier (patented in the '80's); a Sieve Jig (patented in the '80's); a Stadia Prism (patented in the '90's); and a Hindered Settling Classifier, a Pulsator Jig, and a Pulsator Classifier, the last three all patented in 1908.

But the greatest single product of Professor Richards's life-work is his well-known work on Ore Dressing. This is the most exhaustive American treatise on the subject, and for thoroughness and usefulness is not surpassed by any other publication. The first edition of this work was published by the *Engineering and Mining Journal* of New York and London in 1903. It comprises over 1,200 octavo pages, and there are incorporated 560 illustrations, many of which are from original drawings. The preparation of this work occupied Professor Richards many years, and it will always remain a valuable work of reference and a monument to his

memory. In addition there are a large number of minor publications on a great variety of subjects,—a list of which is given in the appended bibliography.

Professor Richards is a long-time member of the American Institute of Mining Engineers, and was its president during the years 1886–87. He is further a member of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, the American Forestry Association, the New Hampshire and Massachusetts Forestry Associations, the Massachusetts Cremation Society, the Boston Society of Natural History, the Boston Society of Arts, the Economic Club of Boston, the University Club, and other organizations.

Professor Richards is a member of the Protestant Episcopal Church, and is prominent in its work, and is also junior warden of the Church of the Good Shepherd in Boston. He is also president of the Board of Directors of the Eliot School in Jamaica Plain. He received the degree of S.B. from the Institute of Technology in 1868, and in June, 1908, there was conferred upon him the degree of LL.D. by the University of Missouri.

But beyond these material facts and accomplishments I, and, I believe, all his students and those who really know the man, love and esteem him for his unselfish and gentle nature, for his patience and his forbearance, and for the steadfastness with which he has held to his ideals through life, with all its hard work, its drudgeries, and its disappointments. He has lived serene through them all. To him, as is the case with all others, there must have been much that was irksome in the constant grind of the lecture-room, of the laboratory, of the shop, the mill, and the office. His tastes are nature-loving, and his pastimes are with plants and flowers and camera. He delights to be out of doors, to walk and to

ride through field and forest. His is a vigorous, well-knit frame, which is still fit to share and enjoy the active sports of much younger men. With so much work so well done for so long a time, may the next score years bring to him the well-earned rest and play which will round out and carry his life into serene old age!

ARTHUR WINSLOW, '81.

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