Ellen Swallow Richards My Hero

Barbara Arnold

Penn State

Professor of Practice in Mining Engineering

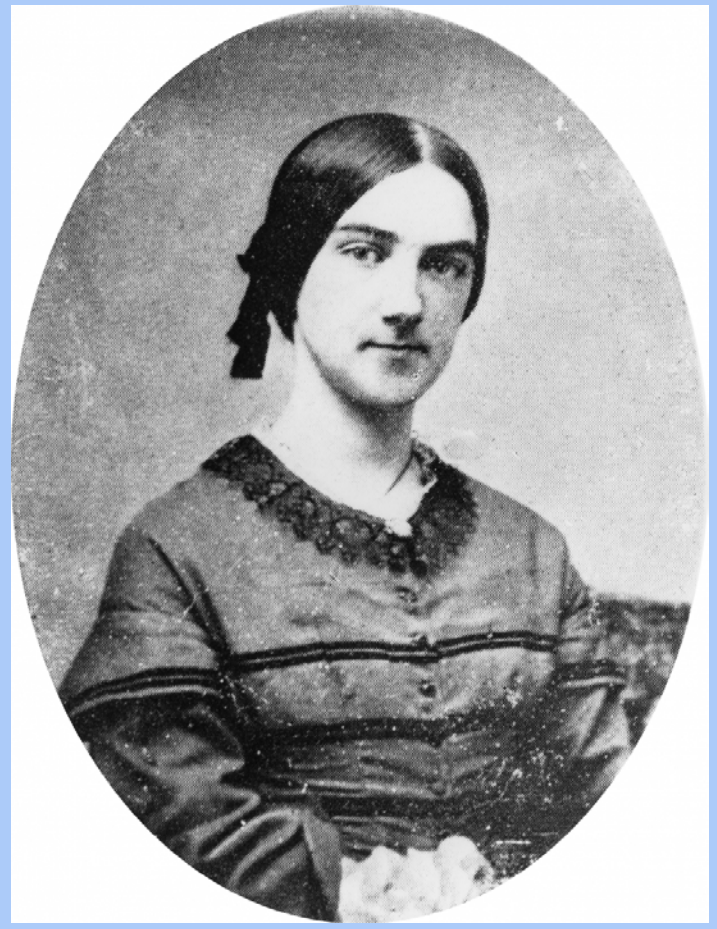
- Established Women's Laboratory at MIT
- Founded American Association of University Women
- Founded Ecology or the Art of Right Living
- Founded Home Economics

Timeline

- Born 1842 near Dunstable, Massachusetts
- Graduated from Vassar BA in Chemistry in 1870 (she was 28 years old!)
- Became the first woman student at MIT, graduating with her BS in chemistry in 1873
- First female faculty member at MIT
- Married Professor Robert H. Richards in 1875

2014 National Mining Hall of Fame Inductee

- Ore and Mineral Chemist
- Mining Engineer
- Public Mineral Education Ambassador
- Environmental Scientist/Sustainability Pioneer



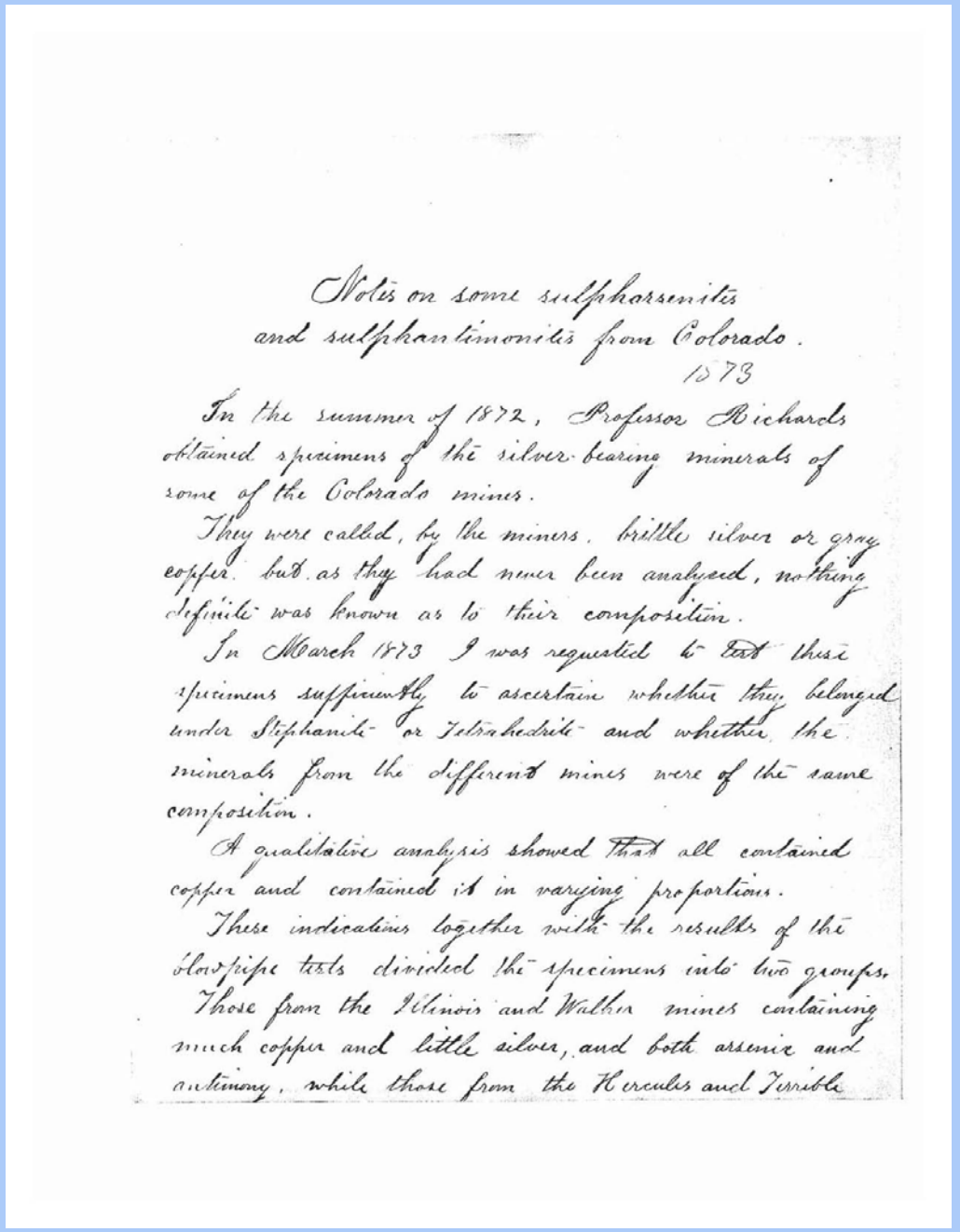
Ore and Mineral Chemist

- In 1872, she isolated 0.02% vanadium from an ore; this work was recognized by Vassar with an MA in Chemistry in 1873 with her thesis titled “Notes on the estimation of vanadium in an iron ore from Cold Spring, NY”

Ore and Mineral Chemist

- She also studied a sample of samarskite as an undergraduate and identified an insoluble residue. Others would later identify this as two new rare earth elements: samarium and gadolinium

- Ore and Mineral Chemist
  - In 1873, she completed her BS in Chemistry at MIT with her BS thesis titled, “Notes on Some Sulpharsenites and Sulphantimonites from Colorado”



Notes on some sulpharsenites
and sulphantimonites from Colorado.
1873

In the summer of 1872, Professor Richards obtained specimens of the silver-bearing minerals of some of the Colorado mines.

They were called, by the miners, brittle silver or gray copper, but as they had never been analyzed, nothing definite was known as to their composition.

In March 1873 I was requested to test these specimens sufficiently to ascertain whether they belonged under Stephanite or Tetrahedrite and whether the minerals from the different mines were of the same composition.

A qualitative analysis showed that all contained copper and contained it in varying proportions.

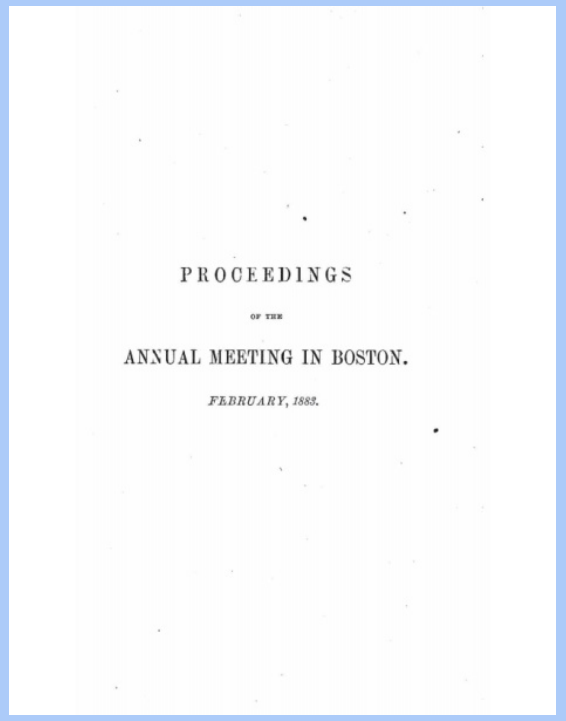
These indications together with the results of the blowpipe tests divided the specimens into two groups.

Those from the Illinois and Waltha mines containing much copper and little silver, and both arsenic and antimony, while those from the Hercules and Terrible

Ore and Mineral Chemist

- 1877 “A New Method to Determine Nickel in Pyrrhotites and Mattes”
- Recognition as a fellow of the American Association for the Advancement of Science
- 1879 became first woman member of the American Institute of Mining Engineers
- Became a recognized international expert mineralogist

- AIME
  - In attendance at the 1880 AIME Annual Meeting in Boston

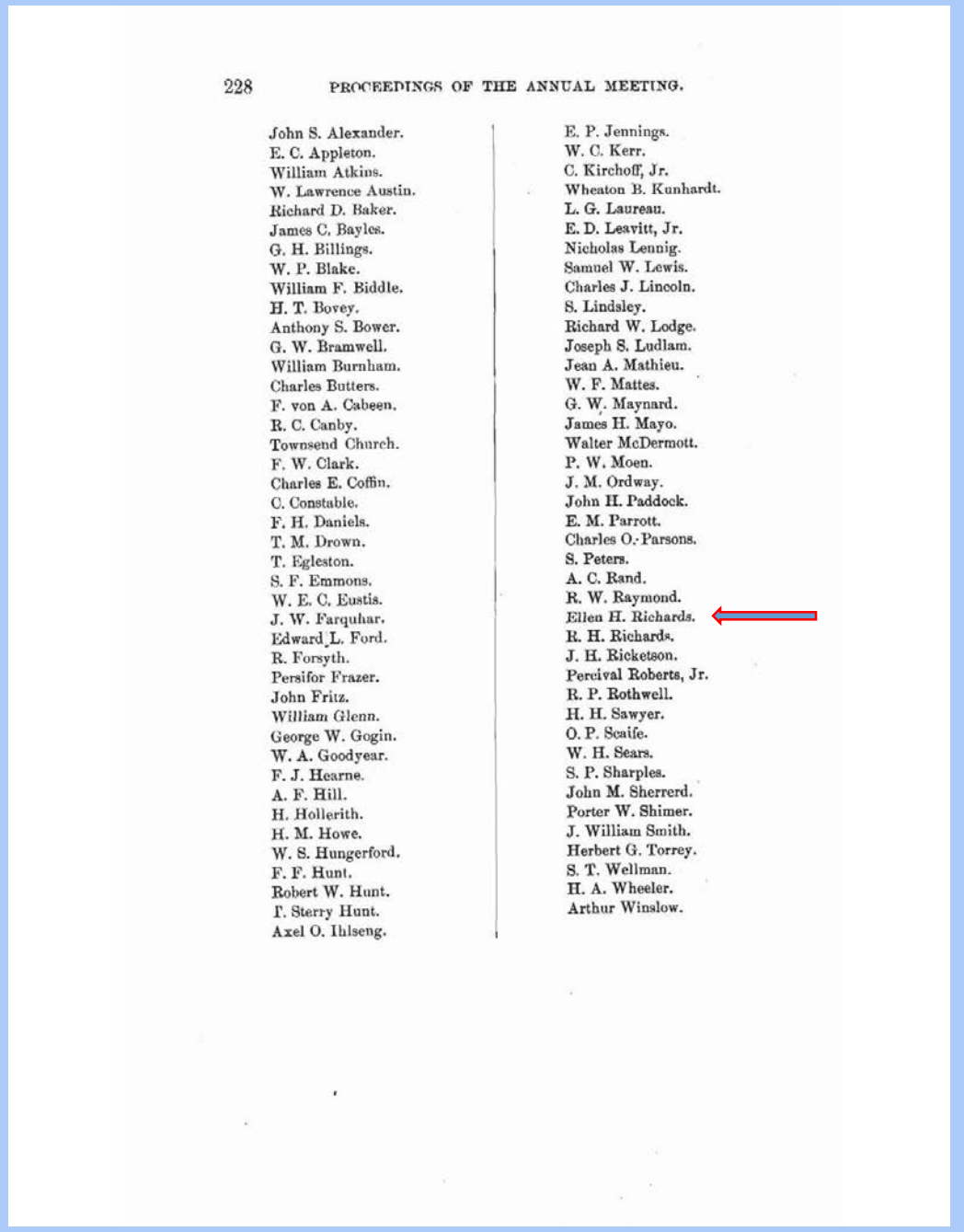


PROCEEDINGS

OF THE

ANNUAL MEETING IN BOSTON.

FEBRUARY, 1880.

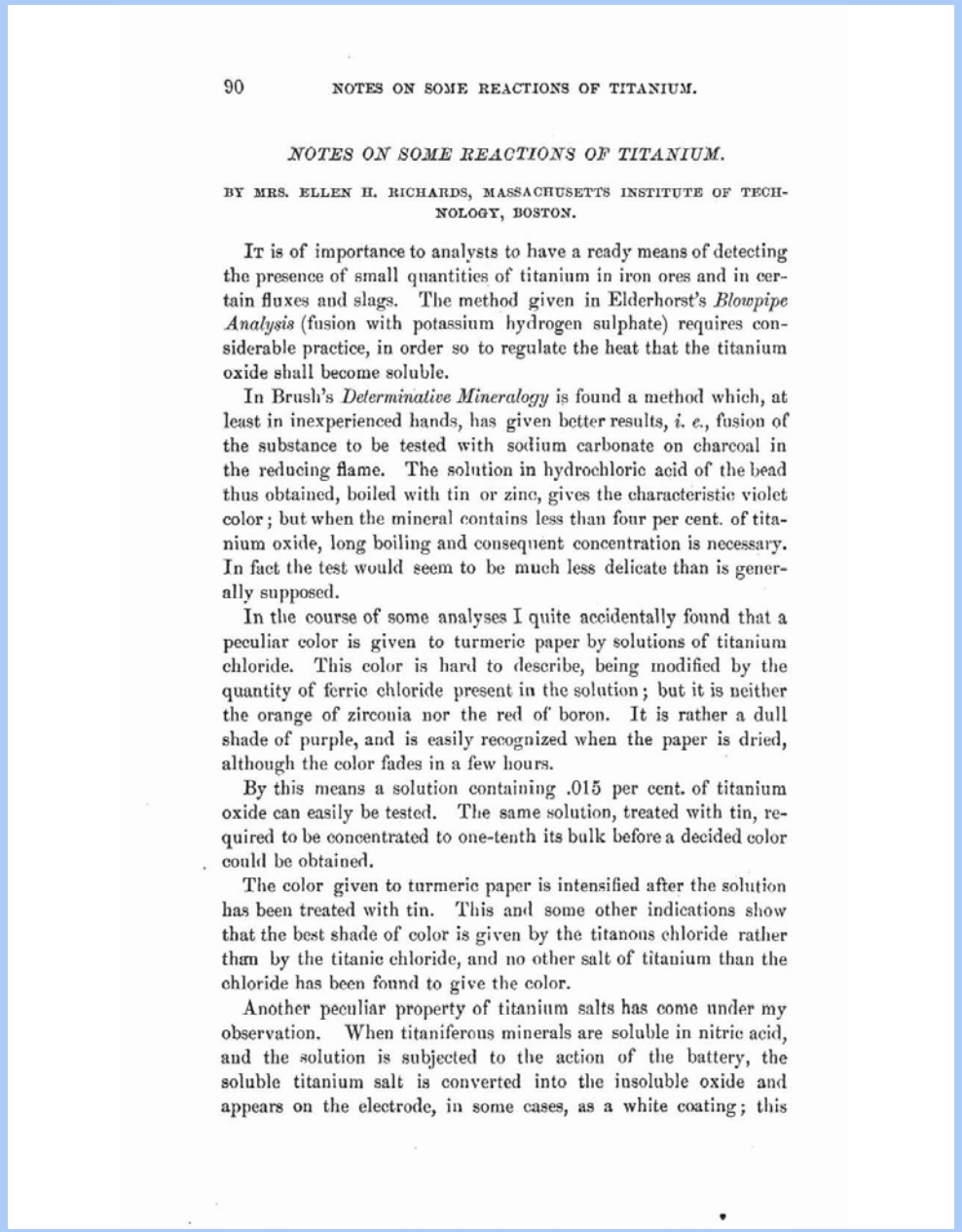


John S. Alexander.
E. C. Appleton.
William Atkins.
W. Lawrence Austin.
Richard D. Baker.
James C. Bayles.
G. H. Billings.
W. P. Blake.
William F. Biddle.
H. T. Bovey.
Anthony S. Bower.
G. W. Bramwell.
William Burnham.
Charles Butters.
F. von A. Cabeen.
R. C. Canby.
Townsend Church.
F. W. Clark.
Charles E. Coffin.
C. Constable.
F. H. Daniels.
T. M. Drown.
T. Egleston.
S. F. Emmons.
W. E. C. Eustis.
J. W. Farquhar.
Edward L. Ford.
R. Forsyth.
Persifor Frazer.
John Fritz.
William Glenn.
George W. Gogin.
W. A. Goodyear.
F. J. Hearne.
A. F. Hill.
H. Hollerith.
H. M. Howe.
W. S. Hungerford.
F. F. Hunt.
Robert W. Hunt.
T. Sterry Hunt.
Axel O. Ihlseng.
E. P. Jennings.
W. C. Kerr.
C. Kirchoff, Jr.
Wheaton B. Kunhardt.
L. G. Laureau.
E. D. Leavitt, Jr.
Nicholas Lennig.
Samuel W. Lewis.
Charles J. Lincoln.
S. Lindsley.
Richard W. Lodge.
Joseph S. Ludlam.
Jean A. Mathieu.
W. F. Mattes.
G. W. Maynard.
James H. Mayo.
Walter McDermott.
P. W. Moen.
J. M. Ordway.
John H. Paddock.
E. M. Parrott.
Charles O. Parsons.
S. Peters.
A. C. Rand.
R. W. Raymond.
Ellen H. Richards.
R. H. Richards.
J. H. Ricketson.
Percival Roberts, Jr.
R. P. Rothwell.
H. H. Sawyer.
O. P. Scaife.
W. H. Sears.
S. P. Sharples.
John M. Sherrerd.
Porter W. Shimer.
J. William Smith.
Herbert G. Torrey.
S. T. Wellman.
H. A. Wheeler.
Arthur Winslow.

AIME 150th Celebration

- AIME
  - “Notes on Some Reactions of Titanium” at the 1883 Colorado Meeting

Thanks to onemine.org!



NOTES ON SOME REACTIONS OF TITANIUM.

BY MRS. ELLEN H. RICHARDS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, BOSTON.

It is of importance to analysts to have a ready means of detecting the presence of small quantities of titanium in iron ores and in certain fluxes and slags. The method given in Elderhorst's *Blowpipe Analysis* (fusion with potassium hydrogen sulphate) requires considerable practice, in order so to regulate the heat that the titanium oxide shall become soluble.

In Brush's *Determinative Mineralogy* is found a method which, at least in inexperienced hands, has given better results, *i. e.*, fusion of the substance to be tested with sodium carbonate on charcoal in the reducing flame. The solution in hydrochloric acid of the bead thus obtained, boiled with tin or zinc, gives the characteristic violet color; but when the mineral contains less than four per cent. of titanium oxide, long boiling and consequent concentration is necessary. In fact the test would seem to be much less delicate than is generally supposed.

In the course of some analyses I quite accidentally found that a peculiar color is given to turmeric paper by solutions of titanium chloride. This color is hard to describe, being modified by the quantity of ferric chloride present in the solution; but it is neither the orange of zirconia nor the red of boron. It is rather a dull shade of purple, and is easily recognized when the paper is dried, although the color fades in a few hours.

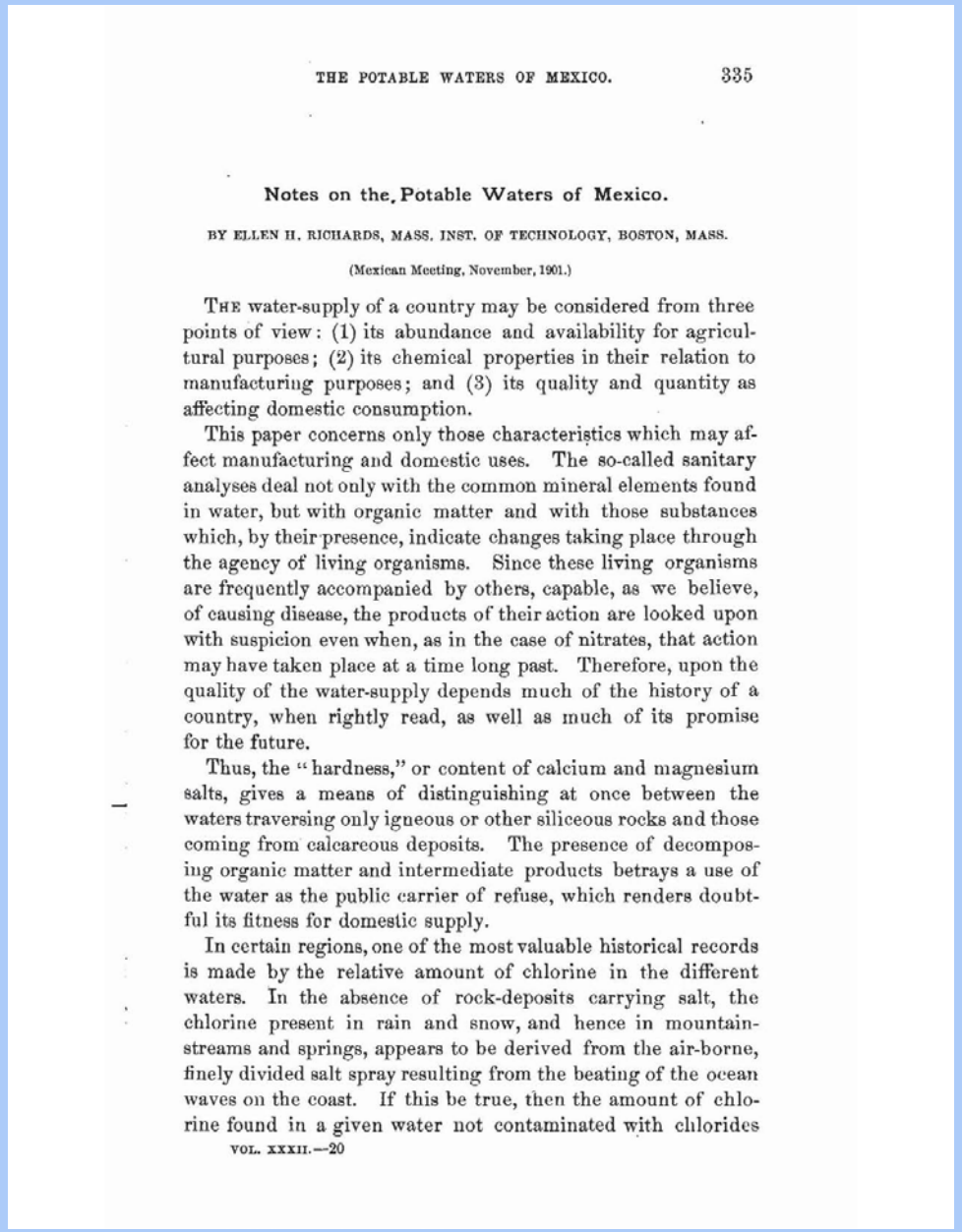
By this means a solution containing .015 per cent. of titanium oxide can easily be tested. The same solution, treated with tin, required to be concentrated to one-tenth its bulk before a decided color could be obtained.

The color given to turmeric paper is intensified after the solution has been treated with tin. This and some other indications show that the best shade of color is given by the titanous chloride rather than by the titanic chloride, and no other salt of titanium than the chloride has been found to give the color.

Another peculiar property of titanium salts has come under my observation. When titaniferous minerals are soluble in nitric acid, and the solution is subjected to the action of the battery, the soluble titanium salt is converted into the insoluble oxide and appears on the electrode, in some cases, as a white coating; this

- AIME
  - “Notes on the Potable Waters of Mexico” at the 1901 Mexican Meeting

Thanks to onemine.org!



Notes on the Potable Waters of Mexico.

BY ELLEN H. RICHARDS, MASS. INST. OF TECHNOLOGY, BOSTON, MASS.

(Mexican Meeting, November, 1901.)

THE water-supply of a country may be considered from three points of view: (1) its abundance and availability for agricultural purposes; (2) its chemical properties in their relation to manufacturing purposes; and (3) its quality and quantity as affecting domestic consumption.

This paper concerns only those characteristics which may affect manufacturing and domestic uses. The so-called sanitary analyses deal not only with the common mineral elements found in water, but with organic matter and with those substances which, by their presence, indicate changes taking place through the agency of living organisms. Since these living organisms are frequently accompanied by others, capable, as we believe, of causing disease, the products of their action are looked upon with suspicion even when, as in the case of nitrates, that action may have taken place at a time long past. Therefore, upon the quality of the water-supply depends much of the history of a country, when rightly read, as well as much of its promise for the future.

Thus, the “hardness,” or content of calcium and magnesium salts, gives a means of distinguishing at once between the waters traversing only igneous or other siliceous rocks and those coming from calcareous deposits. The presence of decomposing organic matter and intermediate products betrays a use of the water as the public carrier of refuse, which renders doubtful its fitness for domestic supply.

In certain regions, one of the most valuable historical records is made by the relative amount of chlorine in the different waters. In the absence of rock-deposits carrying salt, the chlorine present in rain and snow, and hence in mountain-streams and springs, appears to be derived from the air-borne, finely divided salt spray resulting from the beating of the ocean waves on the coast. If this be true, then the amount of chlorine found in a given water not contaminated with chlorides

- Calumet Mills, Lake Superior
  - Summers of 1881 and 1882 conducted the chemical analysis assisting Professor Richards with a concentrator circuit analysis.
  - Saved the company $200,000-$300,000 per year

- Copper Cliff, Sudbury, Ontario (early 1880s)
  - Sample of “copper” ore from David H Browne
  - Ellen did a complete ore analysis, indicating 5% nickel
  - Copper Cliff became one of the first major nickel mines in Sudbury, kicking off the Sudbury nickel industry

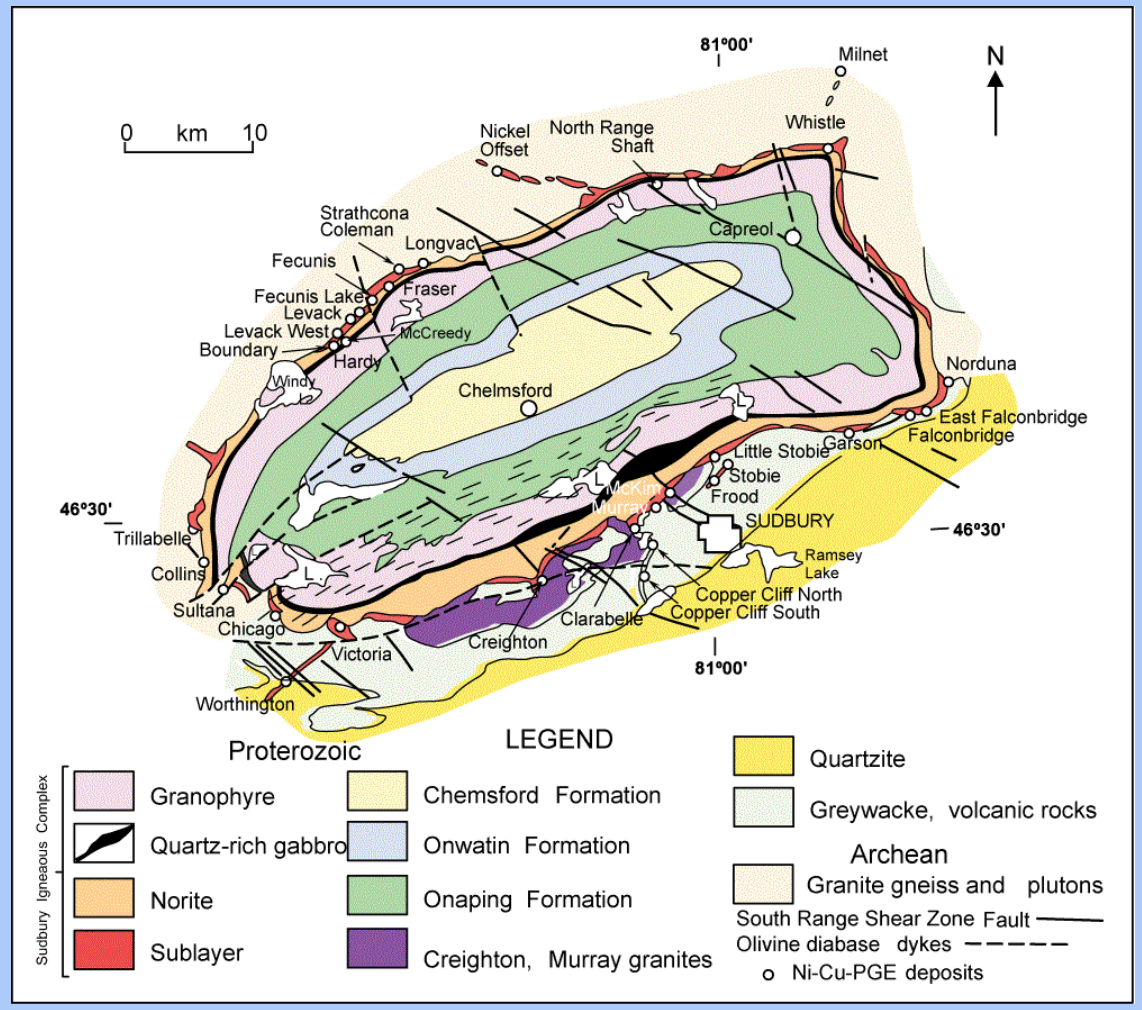
Development of Mining in the District.

Though nickel and copper were discovered in the Sudbury district in 1856 by Murray at what is now the Creighton mine, undoubtedly the most productive existing nickel mine,[48] no importance was attached to this occurrence as long as the region was inaccessible except by canoes; and the history of mining in the district dates from the construction of the Canadian Pacific railway in 1882, when the ore deposit later called the Murray mine was disclosed. In 1883, the ore bodies of what are now the Stobie and Copper Cliff mines were found, but at first they were taken up for their copper contents, and it was only three or four years later, after a thousand tons of the Copper Cliff ore had been sent away for treatment, that its value as an ore of nickel was established.[49]

1903 Ontario Bureau of Mines—The Sudbury Nickel Deposits and the Development of Mining in the District

AIME 150th Celebration

- Late 1880s, development of “nickel steel” less corrosive and stronger than ordinary steel
- Stainless steel production at the beginning of the 1900s
- Sudbury nickel deposits continue to be a major source of nickel

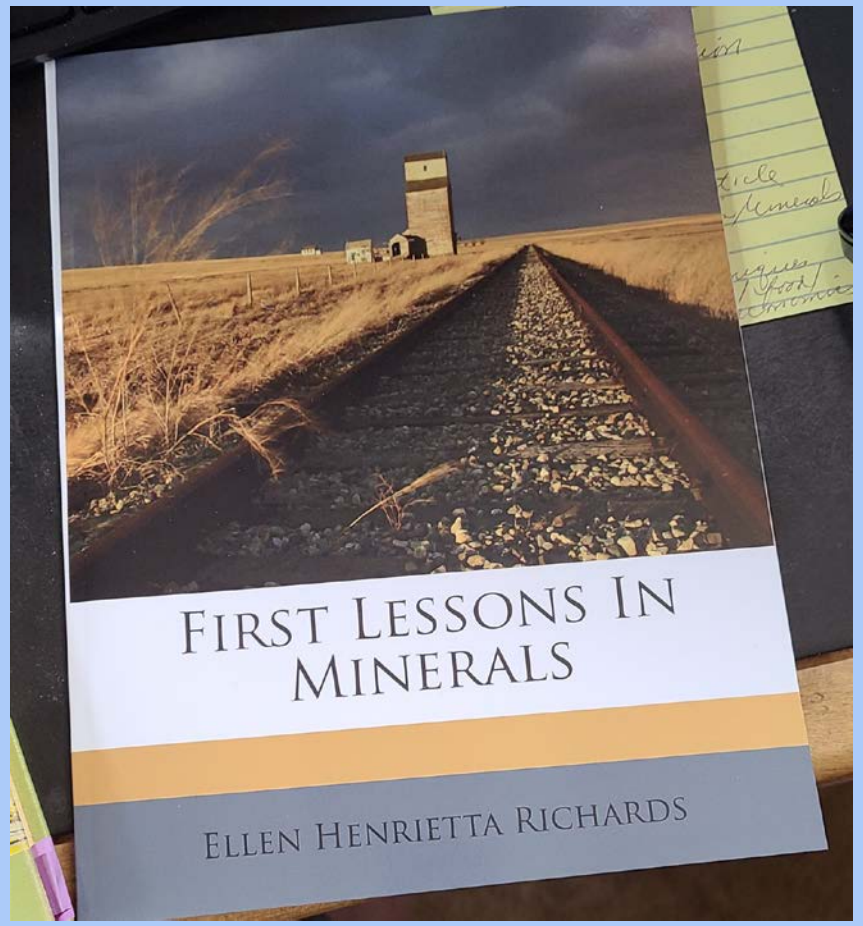


Mining Engineer

- Translated German mining and metallurgy publications for Professor Richards
- Organized housing, tours and experiments for MIT mining field camp and participated in the camps
- Taught Professor Richards' mining engineering classes while he recovered from typhus pneumonia in the mid-1880s

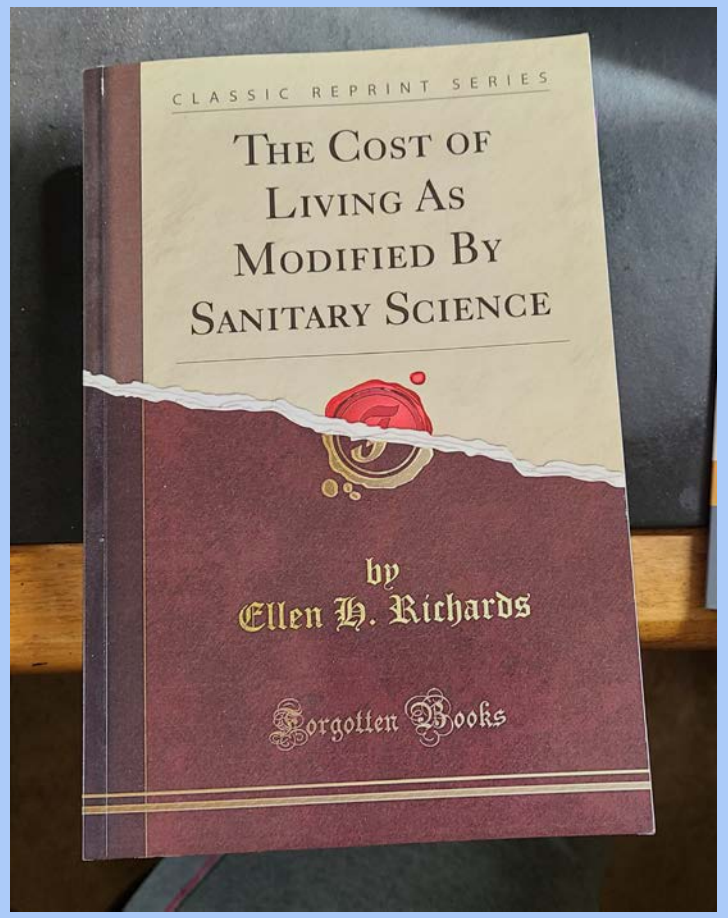
Public Mineral Education Ambassador

- First textbook in 1882: *First Lessons in Minerals*
- Expanded later to a full-length book published by the Boston Society of Natural History
- Society of Home Studies—conducted correspondence courses with people throughout the US for 20 years—geology, mineralogy, physical geography, botany

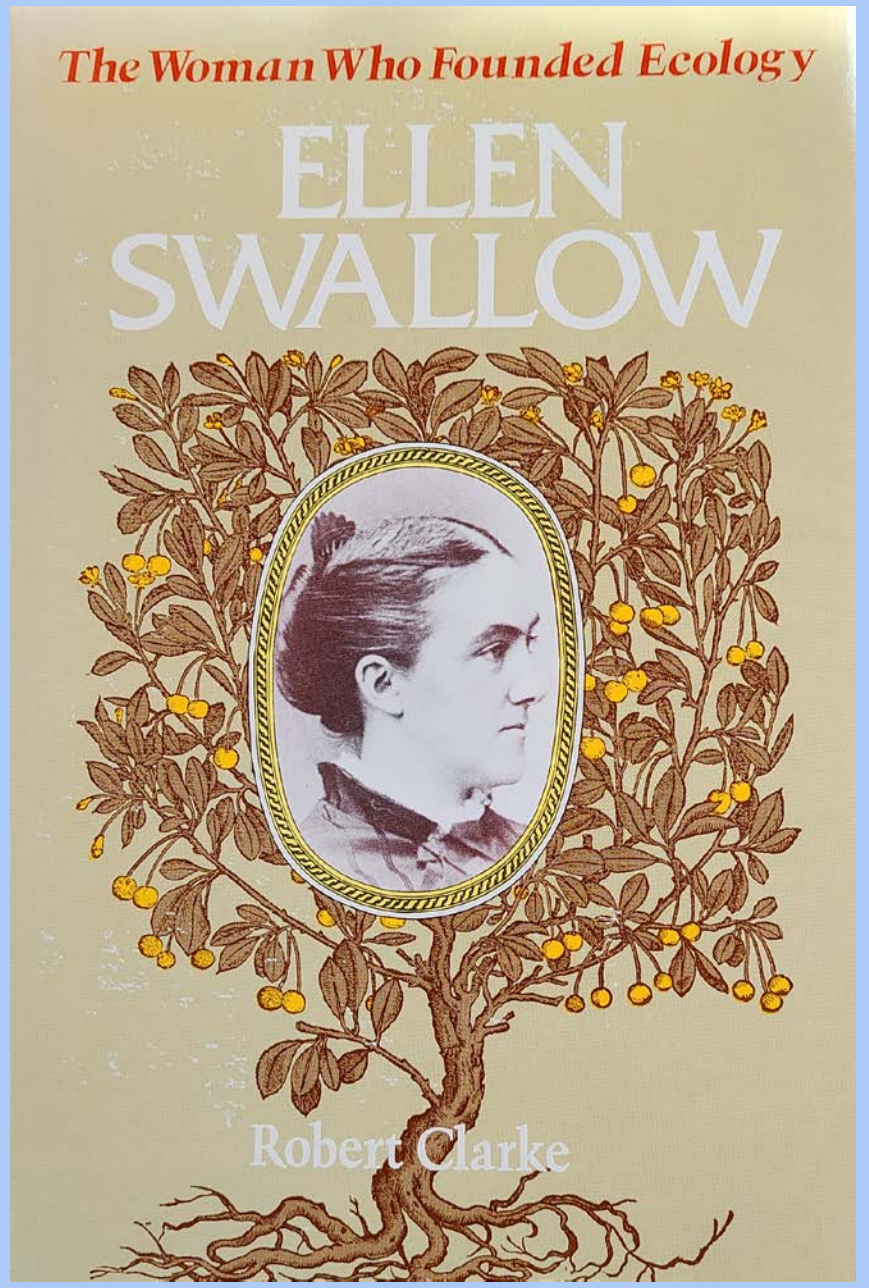


Environmental Scientist/Sustainability Pioneer

- Water surveys (her first paid position at MIT was as a professor in Sanitary Chemistry)
- Evaporation test for volatile oils became an international standard
- Food chemistry studies led to the Rumford Kitchen at the Chicago World's Fair in 1893
- American Home Economics Association founded in 1909

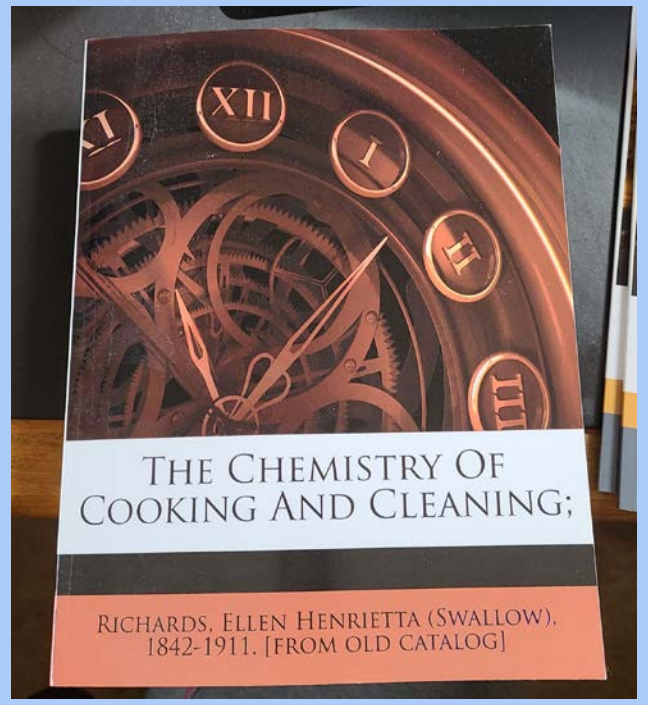


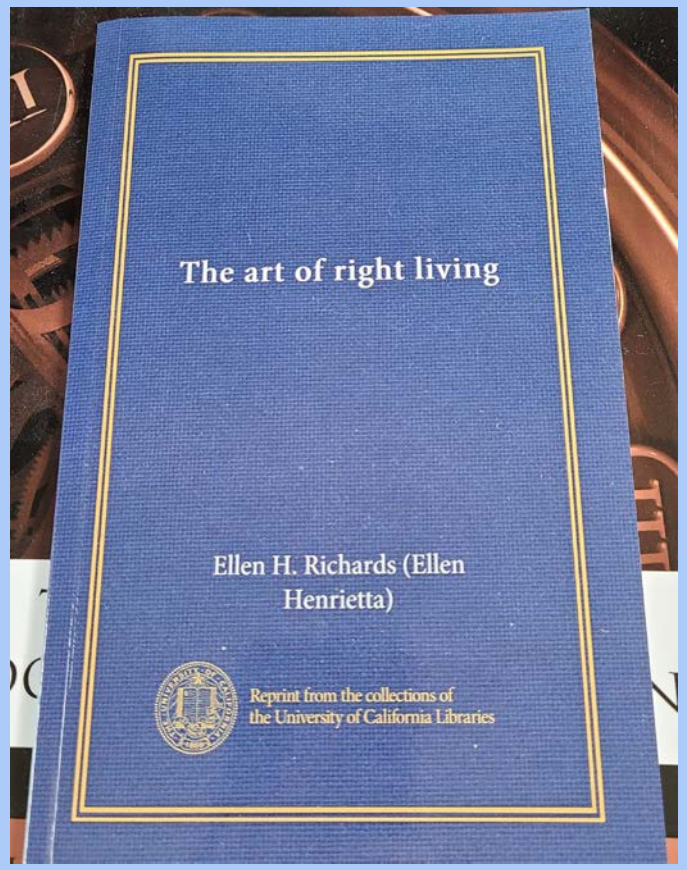
- Environmental Scientist/Sustainability Pioneer
  - 1973 book by Robert Clarke—The Woman Who Founded Ecology



Environmental Scientist/Sustainability Pioneer

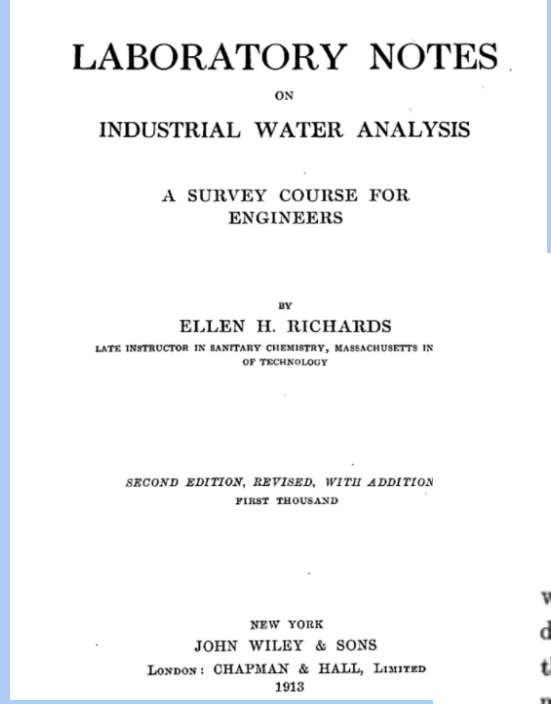
- Air, Water and Food, 1900
- The Art of Right Living, 1904
- Sanitation in Daily Life, 1907
- The Cost of Living, 1899
- The Cost of Food, 1901
- The Cost of Shelter, 1905
- The Cost of Cleanness, 1908





Forward-looking

- “The quality of life depends on the ability of society to teach its members how to live in harmony with their environment—defined first as the family, then with the community, then with the world and its resources.”



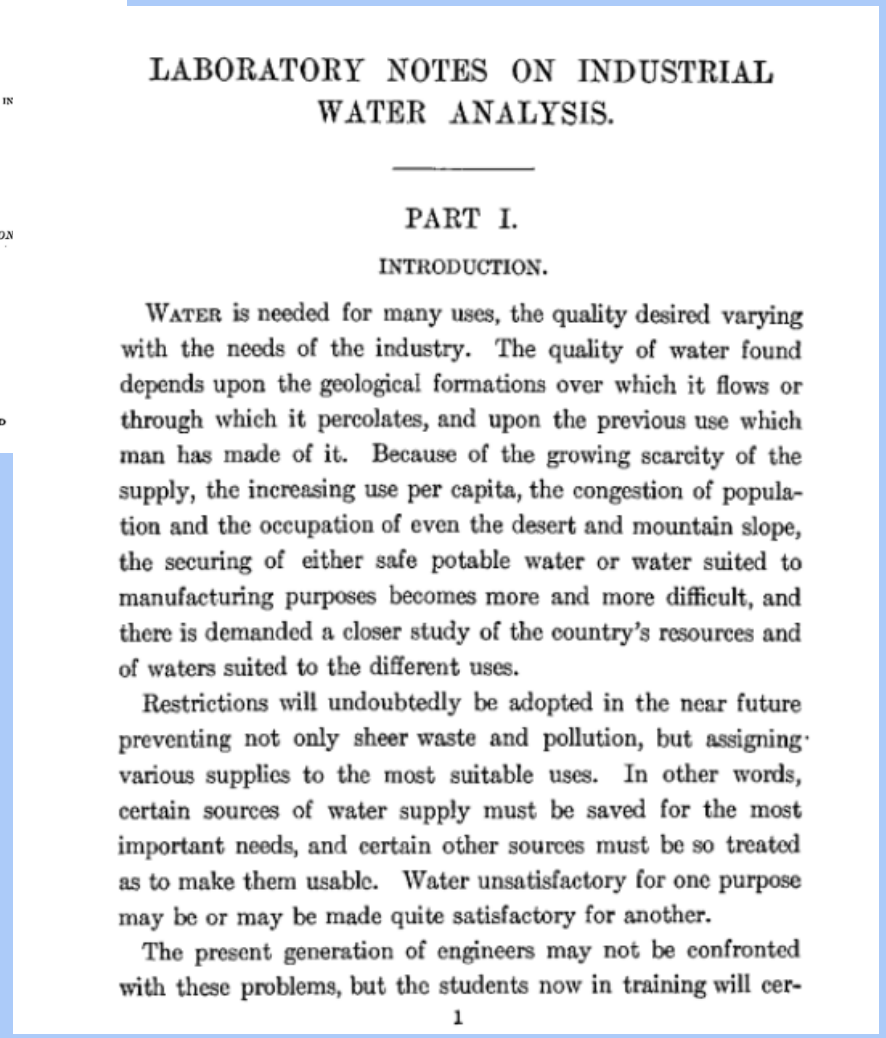
LABORATORY NOTES
ON
INDUSTRIAL WATER ANALYSIS

A SURVEY COURSE FOR ENGINEERS

BY
ELLEN H. RICHARDS
LATE INSTRUCTOR IN SANITARY CHEMISTRY, MASSACHUSETTS IN OF TECHNOLOGY

SECOND EDITION, REVISED, WITH ADDITION
FIRST THOUSAND

NEW YORK
JOHN WILEY & SONS
LONDON: CHAPMAN & HALL, LIMITED
1913



LABORATORY NOTES ON INDUSTRIAL WATER ANALYSIS.

PART I.

INTRODUCTION.

WATER is needed for many uses, the quality desired varying with the needs of the industry. The quality of water found depends upon the geological formations over which it flows or through which it percolates, and upon the previous use which man has made of it. Because of the growing scarcity of the supply, the increasing use per capita, the congestion of population and the occupation of even the desert and mountain slope, the securing of either safe potable water or water suited to manufacturing purposes becomes more and more difficult, and there is demanded a closer study of the country's resources and of waters suited to the different uses.

Restrictions will undoubtedly be adopted in the near future preventing not only sheer waste and pollution, but assigning various supplies to the most suitable uses. In other words, certain sources of water supply must be saved for the most important needs, and certain other sources must be so treated as to make them usable. Water unsatisfactory for one purpose may be or may be made quite satisfactory for another.

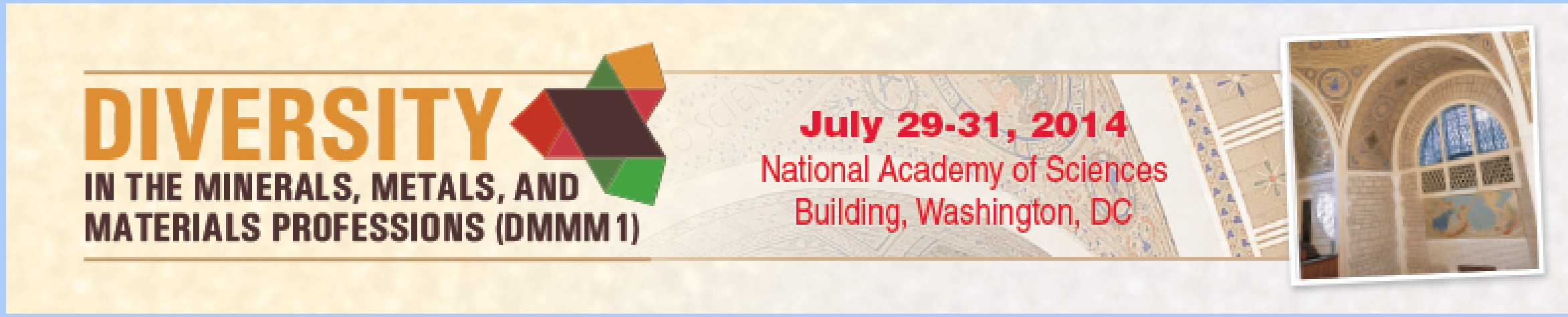
The present generation of engineers may not be confronted with these problems, but the students now in training will cer-

1

- Honorary Doctorate from Smith College, 1910

Diversity in the Minerals, Metals, and Material Professions (DMMM1)

- Summit inspired by Ellen Swallow Richards
- July 29-31, 2014
- National Academy of Sciences, Washington DC
- One of her dresses donated to the Smithsonian Institution



- 2014 National Mining Hall of Fame Inductee
  - September 13, Denver, CO
  - Inductee Number 226

Thank You!
Ask me questions!