INDIVIDUAL RESEARCH

There are certain forces at work which tend strongly to concentrate hydrologic research in government bureaus and to hamper outside research. This condition arises in part from the fact that research can not progress without adequate data. Herein the government agency, with its prestige and power of taxation, has a marked advantage over the individual research worker. The heads of government bureaus should, however, recognize that scientific data collected through their agencies are paid for by the public and are not private property. When a scientific research is made by a government bureau, using such data, the results of the research may quite properly be withheld until the research is completed. The distinction between basic data and researches based thereon is not as clearly kept in mind as it should be. To withhold the basic data, thereby preventing any other qualified person or agency from duplicating the research or checking the results obtained by the government bureau, is a practice which can not be too strongly condemned. Many persons give great and often undue weight to research conclusions emanating from government bureaus, failing to recognize that a government employee is merely a more or less glorified human being and is sometimes subject to human foibles and errors. This is an additional reason why the basic data collected by governmental agencies for research purposes should be available to others who are qualified to check and verify published conclusions based thereon.

There are many qualities desirable on the part of one who is to direct scientific research, particularly research on a subject like hydrology. These include unfailing patience, creative imagination, both perspicacity and perspicuity, and, above all, the ability of the research worker to observe natural processes disinterestedly and at the same time sympathetically. He must interpret as well as observe natural phenomena. Nature will always reveal her secrets if given a fair chance. Invariably it is the human and not nature who is at fault, where natural phenomena and their processes are not fully understood. Too often this results from the fact that the worker, obsessed with preconceived notions, is unable to see what lies plainly before him.

There are many men who have the patience, energy and enthusiasm, and are excellent collectors of data, but very poor scientists. It is largely for this reason that government bureaus often serve better as collectors of basic scientific data than in the conduct of research based thereon. Men possessing, even in a moderate degree, the high qualities desirable in a person who is to direct a scientific research, can not be picked at random from the personnel of a government bureau or a university faculty.

There are many instances where the best results could probably be obtained at the least expense if some degree of governmental aid could be given to individual research workers. In addition to guidance and correlative background, such workers often need, and can not themselves afford to provide, competent assistance in compiling and analyzing data and preparing drawings and other material for publication. In setting up any central organization to guide or direct hydrologic research it should be made sufficiently flexible so that in cases where desirable such assistance could be furnished.

In relation to the place of individual research in the general scheme, the following quotation from a recent paper by Samuel W. Fernberger[1] is appropriate:

> In these days when huge sums are spent—and certainly most properly spent—upon research, it is interesting to note that, with only a small plot of unused garden at his disposal, with a few common garden tools at hand in any case and with a handful of dried peas; working alone and without advice of colleagues, but with infinite imagination and with the utmost care and persistence, Gregor Johann Mendel worked out one of the great laws to be found in the history of science.

There should be no monopoly of scientific research.

ON THE ORIGIN OF THE SARATOGA MINERAL WATERS

CRYPTOZOON: PLANT NATURE AND DISTRIBUTION

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IN late Cambrian time (Lower Ozarkian of authors) a notable succession of barrier reefs, composed entirely of species of the calcareous alga Cryptozoon bordered the Adirondacks, stretching from the east around the southern end of this oldland through the Mohawk Valley area and westward to an unknown distance beyond the present site of Utica. Three species of Cryptozoon are known: *C. proliferum* and *C. ruedemanni* occur only in the Hoyt limestone, which is preeminently a reef formation; *C. undulatum* in both the basal Hoyt

[1] Samuel W. Fernberger, *Jour. Franklin Inst.*, 223: 2, 147–172, February, 1937.

limestone and the Little Falls dolomite. The three species are best displayed in the Saratoga area, where the reefs are, in ascending order, the *C. proliferum*, the *C. ruedemanni* and the *C. undulatum* reef (described in detail by the writer in a paper now in press as a bulletin of the State Museum).

There are several facts that indicate organic origin for these forms. *C. proliferum* develops cabbage-like heads or stocks, composed of alternating limy and sandy layers. In the "Petrified Gardens," near Saratoga, they are seen to best advantage. Here the stocks, of great size, are so crowded that they touch and the spaces between are filled with coarse sand. These facts, together with the abundance of macerated Cryptozoon material, are interpreted as indicating the outer side of the reef where conditions were more favorable to growth and storm waves broke. Approaching the shore, that is northward in this area, the stocks become smaller and are more scattered in the rocks until, as north of Lester Park, in rill channels the individuals lose their characteristic shape and have grown out into long stringers which indicate not only organic, but plant origin for these forms. The same condition is seen in the *C. ruedemanni* reef in the "Petrified Gardens." In solution crevices vertical sections of *C. proliferum* show the mode of growth, starting from a point and expanding upward, which, with the dichotomous budding so well developed in *proliferum*, is an indication of plant life. From its early discovery the association of Cryptozoon with oolites has always been noted. The constant association of fossil calcareous algae with oolitic structure and also with dolomite has been pointed out by a number of writers (see Garwood, 1913, p. 552).[1]

Cryptozoons of the same age as those in the Saratoga Springs region have been found in Dutchess County, N. Y., southward in New Jersey, Pennsylvania and Maryland and still farther south in certain formations of the Appalachian Valley through Virginia, Tennessee and Alabama and west into Oklahoma and Texas. Species have been described from lower Ordovician (Canadian) rocks of northeastern New York and western Vermont (Champlain Valley) and elsewhere in the United States and Canada. In other countries they have been reported from the Cambrian rocks of Norway, Lower Paleozoic strata of Ellesmere Land and elsewhere and from the base of the Ordovician of Eastern Asia (South Manchuria and North Korea) where the Cryptozoon reefs constitute a great display.

DIFFERENT VIEWS HELD ON THE ORIGIN OF THE SARATOGA MINERAL WATERS

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H. P. CUSHING wrote in 1914:[2] "There are few problems in geology more difficult than those concerned with the origin of the mineral waters of a specific region." This is well proved by the various views advanced by geologists and chemists. The problem of the Saratoga Springs became a prominent issue in two large lawsuits, the first between spring owners, the last one by the state against the Carbonic Acid Pumping Companies. In both these suits numerous experts were called and the mapping of the Saratoga quadrangle by H. P. Cushing and the writer was ordered in connection with the last trial. At these trials the geological and chemical experts finally testified as a rule that the water was of magmatic or volcanic origin. J. F. Kemp, one of the experts at the trials, published a full account—"The Mineral Springs of Saratoga"[3]—in connection with the second trial, in which he states that the Saratoga waters are characterized by high content of chlorids and bicarbonates of sodium, calcium and magnesium, high content of uncombined carbon dioxide and extremely small content of sulfates. He distinguishes three divisions of underground water from the standpoint of origin, *meteoric* waters derived from the rainfall, *magmatic* waters derived from cooling igneous rocks and *connate* waters, generally marine waters buried in the rocks at the time of deposit and retained in them. Then by a process of elimination he rules out connate waters because they lack sulphates in solution, and meteoric waters because we know of no chemical method by which carbon dioxide and the chlorids might be produced in such waters, and finally concludes that these constituents are likely of magmatic origin. He inferred that the carbonic acid gas, the chlorids, bromids, iodids, fluorids and sodium carbonate are of deep-seated origin and that the carbonated waters take on calcium and magnesium carbonates from the limestones and more especially from the Little Falls dolomite.

H. P. Cushing, who made the most thorough study of the geologic conditions surrounding the Saratoga Springs, agreed that the carbon dioxide and the chlorids have a deep-seated source, but ruled out volcanic or juvenile origin of the waters, because the waters are not thermal and there is no evidence of

[1] *Geol. Magazine*, Dec. 5, 1913, 10: 440–46, 490–98, 545–53.

[2] N. Y. State Mus. Bull. 169, 1914, p. 153.

[3] N. Y. State Mus. Bull. 159, 1913.