Employment Outlook, Opinions and Opportunities

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On the Spelling of the Term: Ground Water*

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The spelling of the term "ground water" has evolved over the last 150 years. From the mid-1800's through the early 1900's, German engineering professors developed and taught many of the early geotechnical principles and techniques used in construction of the day. Science and engineering were, for all practical purposes, combined as one endeavor. The scientist developed the principles of light, sound, heat, energy, materials strength, and many other subjects including subsurface flow of water in a porous medium by analogy with heat flow. The scientist and engineer worked from opposite ends of the problem at hand. One developed, characterized, and applied the principles while the other constructed, operated, and commercialized the resulting structure or machine driven by the principles developed. Darcy, for example, was an engineer, who applied work done by other researchers, such as Laplace, etc. to improve the predictability of the ground-water supply to the Paris (France) system.

As time progressed, the basic research of the scientist was extended forward into field applications and development, while the engineer followed the research back to evaluating principles. Major developments were made by German professors in geotechnical engineering, which naturally included considerations of de-watering for construction purposes (see note[1]). Of course, the water in the subsurface had to be temporarily removed so that cement footers, foundations, and anchors of all sorts could be installed in a relatively dry environment.

In the German language, underground water is "Grundwasser," and, as the influence of German engineering professors spread to the U.S., the term "groundwater" was used by these engineering professors and subsequently by their assistants and students. Before the 1920's, geology was established as an independent scientific field of endeavor and became separated from engineering auspices for a number of reasons mostly related to philosophy of

approach[2]. Concurrently, the U.S. Geological Survey formally adopted "ground water" as the official usage[3], and introduced the use of a hyphen for the term ground water to modify another term, such as in ground-water monitoring, ground-water chemistry, etc. The analogy here is: little, red house, where "little" modifies "house", not "red"; whereas "ground" modifies "water", not "chemistry." In order to prepare the mind, the hyphen reminds the reader which word gets modified.

There are two distinct issues here: 1) whether the term ground water is spelled as two words or one, and 2) if spelled as two words, does it need to be hyphenated when modifying another term?

With regard to the latter issue, to hyphenate or not to hyphenate depends on the editorial policy of the group involved. However, in dealing with the first issue, as the 1950's and 60's came and went, the spelling "ground water" was adopted by the geology field[4], while through the continued influence of the German geotechnical engineering professors, as well as geotechnical engineering companies and consultants, "groundwater" continued to be used for de-watering and related geotechnical (and environmental) engineering activities, which, of course, was consistent with their engineering training while in college.

In the late 1960's, 1970's, 1980's and 1990's, however, the environmental field was established and developed, and the U. S. Environmental Protection Agency adopted "ground water" in their publications [5,6,7,8] until, that is, the early 1980's when the Cincinnati Office of EPA's Engineering Group[9] began to release publications using the term "groundwater."

As time went on, engineering consulting companies expanded into the environmental field and the usage became widespread in opposition to many years of adopted custom in the US, except, that is, in consulting companies and other companies and agencies where geologists or hydrogeologists established policy or set the tone for the organization. There are, of course, exceptions where the appropriate spelling is used in a number of companies led by "enlightened" engineers who have senior geological and hydrogeological personnel within their organizations. However, many engineering professors and engineers still believe geology is a subordinate field within the engineering field, not having had the benefit of the pronouncements by the U.S. Geological Survey, EPA, other academia, state regulatory agencies, and other groups who had removed geology from engineering (and commercialization) controls as early as the 1900's.

Even today, professionals in the environmental field will have the tendency to spell the term as they are taught, trained, or instructed to spell it. Those with geological and hydrogeological backgrounds should spell it according to protocol, while others who have been influenced inappropriately will spell it incorrectly, regardless of protocol.

The question should always be asked however. Is the spelling of ground water or any word, for that matter, really important? If we believe that nomenclature rules are important to follow then we should take this issue as being serious, although clearly irritating to everyone involved. This issue is important to hydrogeologists and environmental geologists because it typifies the problems between the two professions, and because it highlights and underscores the primacy problems present in establishing separate state professional registration of geologists and engineers. Most state professional registration programs for geologists are designed to keep improperly trained engineers and others from practicing geology (especially as it effects human health and the environment) just as registration programs for engineers are designed to keep others from performing engineering activities. Very clearly, the problem involves the definition of the glass containing 50 per cent water. One group will claim it is half full, while the other half empty. The answer is that both groups are correct based on their particular perspectives.

The subject, as present in the environmental field at least, requires multidisciplinary cooperation. No one discipline should be responsible for any final decision on remediation. Only the individual deemed by management to be capable of assimilating all input should be made responsible for such decisions on behalf on the company or agency, after consideration of all perspectives. This would be individual-dependent, not discipline-dependent. However, one can still reasonably predict that when a textbook (or report, article, etc.) deals with "groundwater", one could also expect a limited geological foundation and an engineering perspective or influence in the treatment of the subject. The following is a list of the available texts that deals with the subject, according to either geological or engineering perspectives:

As Ground Water:

De Wiest, R.J. M., 1965, Geohydrology, John Wiley & Sons, 366 p.
Davis, S. N., and R. J. M. De Wiest, 1966, Hydrogeology, John Wiley b Sons, 463 p.
Campbell, M. D., and Jay H. Lehr., 1973, Water Well Technology: Field Principles of Exploration Drilling and Development of Ground Water and Other Selected Minerals, McGraw-Hill Book Company, 681 p.
Bowen, R., 1980, Ground Water, Applied Science Publishers (John Wiley & Sons), 227

p.
Meyer, et al., 1988, "Historical Perspective": Chapter 1, in Hydrogeology, Volume 0-2; The Geology of North America, Geological Society of America, pp. 1-8.
Nielsen, D. M., 1991, Practical Handbook of Ground-Water Monitoring, Lewis Publishers, 717 p.
Domenico, P. A., and F. W. Schwartz, 1990, Physical and Chemical Hydrogeology, John Wiley and Sons, 824 p.
Watson, I., and A. D. Burnett, 1993, Hydrology: An Environmental Approach, Lewis Publishers, 703 p.
Fetter, C. W., 1994, Applied Hydrogeology, (3rd. Edition), Macmillan Publishing Company, 691 p.

As Groundwater:

Todd, D. K., 1959, Groundwater Hydrology, John Wiley (L Sons, 535 p.
Walton, W. C., 1970, Groundwater Resource Evaluation, McGraw-Hill Book Company, 664 p.
Huisman, L., 1972, Groundwater Recovery, Winchester Press, N.Y., 336 p.
Bouwer, H., 1978, Groundwater Hydrology, McGraw-Hill Book Company, 480 p.
Freeze R. A., and J. A. Cherry, 1979, Groundwater, Prentice-Hall, Inc. 604 p.
Mandel S., and Z. L. Shiftan, 1981, Groundwater Resources, Academic Press, N.Y., 269 p.
Driscoll, F. G.,(ed), 1986, Groundwater and Wells, (2nd. Edition), Johnson Screen Div., 1089 p.
Walton, W. C., 1991, Principles of Groundwater Engineering, Lewis Publishers, 546 p.

In general then, the inappropriate spelling is usually permitted out of ignorance and / or expediency. There is no "turf battle" on this matter because the use of the term: ground water has historical precedence in the US, and is within the domain and technical expertise, training, and experience of the hydrogeologist and environmental geologist, not the engineer.

In the environmental field today, assuming the responsibility of a professional endeavor without appropriate foundation is unsupportable, and in some states where such professionals must be registered, these activities are against the law. It is imperative, therefore, that the appropriate professions are brought to bear on technical issues at the appropriate time to ensure that the proper interdisciplinary mix is realized in environmental projects. Otherwise, ineffectiveness, wasted budgets, and litigation will result.

The P.E.[10] engineer should certainly also have technical guidance from the hydrogeologist or geologist (P.H.[11] and P.G.[12]) when preparing to design remediation systems. Without such guidance, conditions could be established where economic inefficiencies, imminent danger, and or potential damage to

human health and the environment could result from inappropriate system design and operation. In a similar manner, site characterizations should have input from the P.E. on subjects that relate to subsequent remediation and other engineering activities.

So it seems that the spelling of a word is important because the very selection indicates whose influence is being applied to a project. Extrapolating to projects that go wrong because of inappropriate interference, such actions could have a heavy impact on human health and the environment. If there is a time to say, "don't tread on my turf," this is one of them! Hopefully, these issues will be rectified as the State of Texas brings in a new law to register professional geologists, which will ultimately protect the profession from invasion by engineers and others wanting to practice geology, in the State of Texas at least.

References Cited:

***** Based on a letter to the editor of Houston Geological Society Bull., vol.37, no.6, February, 1995.
1 Nomenclature of Hofer-Heimhalt, 1920, "Grundwasser und Quellen," Friedr.Vieweg & Sohn, Braunschweig, Germany, pp.115-21
2 Tolman, C.F., 1937, Ground Water, McGraw-Hill Book Company, New York, 593 p.
3 Meinzer, O.E., 1942, Hydrology, Dover Publications, Inc., New York, 712 p.
4 In 1963, the Journal of Ground Water came into existence and soon became the principal journal in the field.
5 Anon, 1986, RCRA Ground Water Monitoring Technical Enforcement Guidance Document, NWWA/EPA, September, 317 p.
6 Anon, 1987, Handbook of Ground Water, U.S. Environmental Protection Agency, EPA/625/6-87/016, R. S. Kerr Environmental Research Labs, Ada, 212 p.
7 Anon, 1990, Handbook of Ground Water, Volume I: Ground Water and Contamination, U.S. Environmental Protection Agency, EPA1625/6-90/016a, September, 144 p.
8 Anon, 1991, Handbook of Ground Water, Volume II: Methodology, U.S. Environmental Protection Agency, EPA/625/6-90/016b, July, 141 p.
9 Anon, 1991, The Superfund Innovative Technology Evaluation Program: Technology Profiles, U.S. Environmental Protection Agency, EPA/540/5-91/008, November, 295 p.
10 P. E. Indicates certification or registration as Professional Engineer
11 P. H. Indicates certification or registration as Professional Hydrogeologist
12 P. G. Indicates certification or registration as Professional Geologist