GROUND WATER

READERS' FORUM

NONECONOMIC MOTIVATIONS IN GROUND-WATER USE: HYDROSCHIZOPHRENIA[a]

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SUMMARY

This article is the text of the last lecture in the cycle "12 Lectures on Economic Criteria for Ground-Water Development" given in Madrid University in June 1973. *Hydroschizophrenia* is described as the mental attitude which leads some of those responsible for water resources policy and planning in a given country to make a radical separation between projects related to surface water and those concerning ground water.

The possible causes of *hydroschizophrenia* are classified and analyzed in four different groups: (a) a technological gap or lack of know-how; (b) the water law is not up-to-date enough; (c) social and bureaucratic constraints; and (d) political factors.

Following a general analysis of each group, the situation in Spain is described, a remedy is suggested and, in some cases, the development of the "ailment" in the near future is forecasted.

INTRODUCTION

More than once it has been written that the feasibility of a project is supported by three pillars: its technical or physical feasibility; its economic feasibility; and finally, its social, political and legal feasibility.

The eleven preceding lectures of this cycle contain an analysis of the criteria most used for establishing the economic evaluation of the different projects or alternative solutions which may be technically feasible to meet a set demand for water in a particular region and at a fixed time.

However, this cycle of lectures would seem incomplete without a consideration of this third social-political-legal pillar; that is to say, the many varying motivations other than the economic ones, which may frequently cause the use of ground water to be neglected in hydraulic projects. The influence of these motivations has created a mental attitude which leads those responsible for a country's hydraulic planning to make a radical separation or split between what concerns surface water and what concerns ground water. This attitude was termed "hydroschizophrenia" by Nace (1973) with reference to the water policy of the United States.

There can therefore be no doubt that this article does not refer exclusively to Spain. It deals with a universal ill extending over the earth's surface almost regardless of the ideology and political regimes in various countries. This "ailment" has recently gained an increasingly marked emphasis due to two factors: firstly, because of the narrowing of the safety margin between the water demand and the traditional or best-known water resources—those of surface water; and secondly, because of the remarkable progress made by hydrogeology. It has not normally been possible for this science to be pursued by traditional engineers who still commit the error of believing ground water to be something mysterious or immeasurable.

This article sets down the roots or causes of *hydroschizophrenia,* classifying them in four main groups. The first deals with the lack of know-how or the technological gap; the second, with the influence of legislation; the next discusses the causes brought about by social and administrative constraints; and finally, constraints caused by politics, using this word in the best and broadest sense, are considered. Obviously, there is no clear and distinct Cartesian type of dividing line between these four groups of possible causes of *hydroschizophrenia.*

After the analysis of each of these groups of causes, the most suitable treatment to be administered to each one is suggested and in some cases, the development of the "ailment" in the near future is even forecasted.

The increasing importance of the environment at this time—only one earth for all men—and the fact that water—that is to say, the hydrological cycle—is perhaps the fundamental factor within the environment, heightens the relevance of the possible worsening or spreading of *hydroschizophrenia.*

THE LACK OF KNOW-HOW AS A CONTRIBUTING CAUSE OF HYDROSCHIZOPHRENIA

Introduction

It is a well-known fact that today scientific research and technological development is considered to be a decisive factor in a country's economic growth. Anyone interested enough to follow this up will find a good summary of these concepts and of their application to Spain in the Report of the Commission of Scientific Research and Technological Development of the Third Plan of Economic and Social Development.

In the first lecture of this series, reference was made to the most important hydrogeological studies carried out during the last decade and the principal needs for basic and applied hydrogeological research such as is carried out in Spain at the present time. However, it is not to be thought that the lack already pointed out is the main cause of the "ailment" in Spain, since the country where the most extensive research in this field is carried out seems to suffer from outstanding *hydroschizophrenia*—note the previous reference to Nace (1973). In the author's opinion, independently of the legal, social causes, etc. to be dealt with later, this is to a great extent a problem of mental sluggishness and of a lack of permanent education or refresher courses which is increased by the relative "youth" of Hydrogeology as a science and its near "infancy" as technology.

There are very few of the hydraulic engineers responsible in the main for the important decisions regarding water planning, who learned in their academic studies what an aquifer is and its role in the hydrological cycle. There are even fewer ground-water geologists whose university studies have equipped them with the kind of mathematical and economical background that would provide a clear

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understanding of the problems of water resources planning. Until very recently, in most countries the predominant feature in this field has been on the one hand hydraulic engineers working more or less in collaboration with surface-water hydrologists, and on the other hand, ground-water geologists attached to the field of academic geology or that of mining. Water Resources Engineering which integrates these varying fields of knowledge with economy and the modern Systems Engineering has been in existence for no longer than two or three lustra (Buras, 1972).

The Situation in Spain

The knowledge or "how" and "where" hydrogeology has been taught in Spain, brings to the fore one of the obvious causes of the *hydroschizophrenia* which exists in this country. It may be summarized as follows (for further detail, see Llamas, 1971):

(a) Throughout the five-year degree courses of advanced engineers, Hydrogeology figures as a subject in only one engineering specialty. Even in this case, it still has no Chair; that is to say, a stable teaching post equipped with an educational and research team.

(b) During the five years of the degree course of Geological Sciences, it exists only as a subject in the fifth year and then not in all Universities. There have only been two Associate Professors in this subject since 1972.

(c) Hydrogeology exists in various of the Faculties of Science and Higher Technical Schools as a monographic course of the Doctorate but the courses are extremely short and the number of graduates who attend them is low.

(d) Every year since 1967, in Madrid and Barcelona, graduate courses of six months' duration have been given. These have had a great success both in Spain and internationally. Naturally enough, most of the participants in these courses are young geologists or engineers with only a few years of experience behind them. It may therefore be said that in Spain almost all the engineers and geologists working on the important projects of Total Water Resources evolved by the Ministeries of Agriculture, Industry and Public Works which were referred to in the first lecture of this cycle, have attended these courses. It is also a significant fact that the most international of these courses should take place in Barcelona, the capital of the watershed of the eastern Pyrenees where there is scarcely any evidence of *hydroschizophrenia.*

(e) Lastly, since 1965, a variety of seminars or cycles of lectures have been organized on specialized subjects (modern techniques regarding the construction of water wells, analogical and digital models, etc.). These too have been extremely well attended.

Important progress in Hydrogeology was unknown in Spain until almost the sixties. For example, the first Spanish publication which refers to the Theis method—published by Theis in 1935—is probably the work of A. Benitez (1963). It is not in the least surprising, therefore, that a great many of the engineers and geologists most closely connected with water problems should have excessively simple and even erroneous ideas regarding the role of ground water in hydraulic planning.

The author knew a case of some engineers who held important posts in the water administration of the country. The guide they used to consult for matters of ground water was an article of Moragas, written in 1896. Moragas was a good hydraulic engineer of his time, perhaps the best in ground water among his Spanish contemporaries, but that was almost eighty years ago—practically twice the time that elapsed between the publication of Darcy's Law in 1856 and the article of Moragas.

The simplified concept of the functional unity of water and the erroneous concept of "open" and "closed" ground basins has been much defended by some well-known Spanish hydraulic engineers. This basic error may well have contributed to the fact that surface reservoirs have been accepted with a certain amount of enthusiasm while the possibilities of ground reservoirs have been treated with near neglect or even disdain (Sáez, 1962; Torán, 1970; etc.). Now Spain is the third country in the world in its number of big dams, after the United States and Japan.

Remedies

The following measures would probably be suitable enough to provide a short term elimination of the technological gap.

(a) Increase the teaching of Hydrogeology in the Departments of Geology and of Engineering at the Universities at a Master degree level and not only at the Doctorate level.

(b) Continue encouraging the organization of the six months' courses for graduates as a means of initiating or improving the formation needed by geologists or engineers who specialize in this subject and who did not have the opportunity to attain sufficient depth in their University studies.

(c) Continue promoting short refresher or follow-up courses or seminars with a view to furnishing professional hydrogeologists with knowledge of new technology.

(d) Start conventions lasting a few days, cycles of lectures, study trips, etc. with a view to giving information about the possibilities of ground reservoirs to the chief engineers of different government agencies in connection with water resources. This kind of activity too can clearly be of use to acquaint those present with many other problems connected with water resources engineering.

THE INFLUENCE OF WATER LEGISLATION ON HYDROSCHIZOPHRENIA

Introduction

There can be no doubt about the necessity for a reformation of water legislation in force in most countries. During the last decade, legislative activity in this field has been very lively in many countries. This is borne out by examples such as the Water Laws recently proclaimed in France, Chile, Peru, Belgium, England, etc.

The fact that these changes should be required is due on the one hand to scientific progress in water research and in water prospecting techniques, well construction, storage, treatment and distribution, and on the other hand, to the fact that the rising demand for water creates clashes among different social groups with conflicting interests.

The Situation in Spain

The Spanish Water Law dates back to almost 1866 so that it is nearly a century old. It has been an important factor contributing to the present *hydroschizophrenia,* for it

states that, as a general rule, ground water is private property while surface water is public. This legal declaration gained greater significance when the handling of proceedings related to ground water was subsequently alloted to the Corps of Mining Engineers and those concerning surface water and "underflow" to the Corps of Civil Engineers. These two professional groups are well known pressure groups in Spain.

In any case, no initial harm resulted from this two-sided control, since it was a question of two Corps belonging to a single Ministry, the Ministry of Development, responsible for public works, mining, agriculture, etc. and all water, including ground or surface water, depended on the aforementioned Department. When in 1931 all mining affairs and the Corps of Mining Engineers separated from this Ministry of Development—after this, called Public Works—the rift between ground-water and surface-water engineers became notably wider. A good summary of the mishaps which have befallen hydraulic legislation on ground water may be found in Guaita (1970, pp. 159-195). With regard to the contamination of ground water, there is practically no legislation at all (Varillas, 1973).

During the last few years there have been further attempts to reform the Water Law. In 1972, for example, a commission appointed by the Directorate of Hydraulic Works prepared a first draft of a new Law, at the present time being reviewed in the Ministry of Public Works. In 1971, the Directorate of Mines of the Ministry of Industry states on page 82 of the National Mining Plan, " . . . there can be no doubt of the utmost necessity for the immediate proclamation of a Ground-Water Law." Fortunately, it seems that the idea of creating a law exclusively for ground water has not flourished. Had this been the case, *hydroschizophrenia* would probably have become more marked and in a few decades' time, it would have gained a permanent foothold.

Finally, on a more hopeful note, the proclamation during the last decade of special legal systems in some areas of the country (Canary Islands, Balearic Islands, the River Guadalquivir watershed) would seem worthy of mention. These systems establish the joint supervision, to different degrees, of organs of the Directorate of Hydraulic Works and the Directorate of Mines for the exploration and exploitation of ground water. It is still too early to be able to judge the efficiency of these legal measures.

Remedies

It is clear that the Water Law in force is obsolete, at least insofar as some of its principal concepts are concerned. There can also be no doubt that the new Law should give much more detailed consideration to the mutual interference between surface water and ground water. The way in which suitable legal measures can be drawn up is closely bound up with the administrative and social constraints subsequently to be dealt with. It may, however, be said that the new Law is bound to have a remarkable influence such that *hydroschizophrenia* will be eliminated with some degree of rapidity.

THE ADMINISTRATIVE SYSTEM, THE PRESSURE GROUPS AND HYDROSCHIZOPHRENIA

Introduction

It is beyond all doubt that the administration of a country is closely bound up with its legal system and that its sociological structure is also influenced by its political system. Some of the ideas now about to be put forward could therefore well have been included under either the previous heading or the following one.

From the administrative point of view, it may be said that the allocation of ground water to one Department and surface water to another in no way helps to check *hydroschizophrenia.* It is an inescapable fact that each Department keeps a tight hold on its rights and tends not to be at all objective in extolling the superior qualities of the water subject to its supervision. However, water administration is probably in the hands of two or more Ministries in the majority of countries.

Situation in Spain

As has already been mentioned, there are two Departments in our country which are the main competitors in hydraulic affairs: Public Works, through the Directorate of Hydraulic Works, and Industry, through the Directorate of Mining. In addition to this, taking into account that according to the Directorate of Mining (1971b, p. 146) "Of the substances studied in the National Mining Programme, water is the one of greatest importance," it is understandable that the Ministry of Industry does not wish to be out of the running in this field.

In the case of Spain, independently of the competition between the Ministries of Public Works and Industry, there is another factor which has contributed in no small way to the relative neglect of ground reservoirs in water planning.

This factor is a direct consequence of the relatively low quality of the quaternary and tertiary aquifers located under the capital of Spain and the area it influences. In an administrative system which has been so centralized as Spain's has for the last few centuries, the fact that the wells in the area surrounding Madrid have a very low water yield, has contributed to the psychological erosion of the prestige of ground water in the eyes of those in the government and in high administrative posts and, what is still more important, of the senate of lecturers of the Departments of Civil and Mining Engineering. It should not be forgotten that until very recently all those studying these engineering specialties had to live in Madrid and that even today the majority of both types of engineers still study in the capital of Spain.

If Madrid had provided a better setting for the study of Hydrogeology, similar to that in Barcelona or Valencia, for example, ground water would not have been so neglected or rejected as it was in the country's hydraulic planning.

In probably the vast majority of countries, professional groups constitute fairly strong and well organized pressure groups. In Spain, the "Corps" (State Lawyers, Property Registrars, Solicitors, Civil and Mining Engineers, etc.) have been and continue to be fairly clearly defined pressure groups with no mean strength. Each group tends to stand up for its rights zealously for reasons of prestige, tradition, order, the common good and sometimes for reasons of an economic nature. It is therefore logical that the competition between the Corps of Civil and Mining Engineers, increased by the fact that they are within the fortress of different Ministries, has been an important factor in the *hydroschizophrenia* prevailing in Spain.

Remedies

The inclination towards administrative regionalization, the creation of Schools of Civil Engineers in Valencia, Santander and shortly in Barcelona and the establishment

of a School of Mining Engineers in Oviedo; the fact that these Schools have ceased to be preparation centers for officials since the study programme of 1957 was brought into being—all this brings one to believe that within a few years the "esprit de corps" and tendency to concentrate power in the center of Spain—in Madrid—will have a much less powerful influence on *hydroschizophrenia* than at present. The new Mining Law, created this year, has also established a precedent of considerable interest; it gives official recognition to graduates from the Science Departments to work as professional hydrogeologists.

POLITICS AS AN ELEMENT IN HYDROSCHIZOPHRENIA

One might include a great many factors under the term "politics" which often have a very strong influence, frequently a stronger one than the ones mentioned earlier, on water management in all countries. This occurs independently of whether the system of government is inclined either towards socialism or capitalism. As examples of these factors, one could mention the struggle against unemployment, state protection for agriculture, energy autarchy, the promotion of investment, the protection and/or promotion of tourism as a source of foreign currency, the evening out of economic regional differences in the country, the protection of the environment, the equilibrium of payments, etc.

Obviously, a detailed analysis of this complex subject would go beyond the limits of the aims of this lecture. For this reason, in this section, we shall deal only with those political factors that may have the greatest influence on the choice of equivalent theoretical solutions regarding surface or ground water. We shall also keep on a universal level without going into the particular case of Spain. Anyone interested in analyzing the recent situation in Spain may turn to the following papers; for matters concerning ground water, the works of the Directorate of Mines (1971a and b) and that of Gomez Angulo (1971); for surface water, Gomez de Pablos (1972 and 1973); and for studies regarding the conjunctive use of surface and ground water, Llamas and Sahuquillo (1971).

It is understandable and even reasonable that in the hypothetical case of equality of technical and economic conditions, the politician should prefer hydraulic works to be carried out on the surface, thus bypassing the use of ground water. In all political systems, to a greater or lesser degree, those in power need to present their fellow citizens with facts which give evidence of their efficiency. As far as this is concerned, it is difficult to beat the spectacular nature of public works and among these, the exceptionally expressive beauty of hydraulic works makes them particularly outstanding.

As well as this, aesthetic values may sometimes create an economic impact. In 1965, therefore, the United States Congress recognized the legitimacy of including the profits derived from recreational uses and from environment improvement in the cost-benefit analysis of the federal hydraulic projects. A good idea of the present and ever-increasing importance of recreational uses in Spain is given by Urbistondo (1973).

Something that recently happened to one of the author's friends whose work concerns the exploration and exploitation of ground water gives a fair idea of the mentality of the majority of the public. His son, aged six, was asking him what kind of work he did; he wondered if he made dams and canals like the ones he had seen at the cinema and on television. When his father explained that his work consisted of studying the earth and then making holes for extracting water, the boy was most disappointed and "advised" his father to change his job and spend his time making dams. This childish point of view is probably shared by more than one adult.

It is not to be thought that this issue is exclusive to countries with socialist or authoritarian regimes where there is supposedly a greater interest in great public works. If anyone reading this is in doubt about this question, he should turn to Tolman's article (1970) quoted in the bibliography, where he will find a commentary on the situation in the United States.

The previous lectures of this cycle have given evidence of the wide range of influence of the price of money—the discount rate—in the economic comparison between alternative surface- and ground-water projects; low discount rates are usually in favour of surface-water projects; on the other hand, high discount rates are in favour of ground water. The fixing of discount rates is a problem of considerable complexity where the general economic policy of each county's government carries a great deal of weight.

Neither must it be forgotten that in decisions of hydraulic policy, factors whose influence is not easy to gauge must be taken into account. For example, how great a value may be attached to the "cleanliness" of hydroelectric energy, with respect to thermic energy, as far as pollution is concerned? How important is the political-economic independence of hydroelectric energy in countries like Spain lacking in conventional or nuclear combustibles?

Finally, it must be mentioned that during the last few years, great hydraulic projects—nearly always with surface water (Aswan in Egypt, irrigation from the Indus and the Ganges, the Kariba dam on the Sambezi River, etc.)—have been viewed by some with considerable alarm. It is felt that a retrospective analysis should be made of the effects of these projects and that their influence on the environment should be analyzed particularly. It was once said that "Like big guns, big hydraulic projects may have a lot of back-fire." To this end, one usually finds quoted the problems of salting caused by the irrigation from the Indus and the Ganges with surface water in the Hindustani peninsula; it seems that the Aswan dam threatens to do more harm than good for it helps to spread the disease Schistomiasis, carried by snails; there are other cases of this kind (cfr. *Water Newsletter*, May 22, 1970 of Water Information Center, Port Washington). However, it seems premature to affirm that this alarm has been caused by an objective danger, for it may well be a question of a lesser version of "The limits of growth." This was probably one of the best organized cases in the history of mankind where a preliminary work relying on extremely prejudiced and controversial assumptions was presented as the result of an indisputable and reliable scientific analysis.

CONCLUSIONS

Hydroschizophrenia is an "ailment" suffered by some water planners and consists of a failure to make a joint study of surface and ground resources. It is evident in almost all countries of the world as well as in Spain. Its causes may be of various types: technological backwardness, mental sluggishness, administrative centralization, rivalry

between "corps," the aesthetic value of hydraulic works using surface water, etc.

As far as Spain is concerned, the most important remedies for fighting the "ailment" are considered to be: the best education possible of the geologists and engineers responsible for future hydraulic policy; reform of the Water Law and, in all important projects, the achievement of a technical and economical analysis which permits an adequate comparison to be made between the different alternative solutions which guarantee that the future demand for water will be met.

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PEOPLE IN THE NEWS

by **Robert C. Minning, President**
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Michael A. Apgar, former senior hydrogeologist with Roy F. Weston, Inc., is now supervisor of ground-water management for the State of Delaware . . . . . **Fred L. Troise** has been named Vice President and General Manager of Water Information Center, Inc., a firm he has guided since 1968 when he transferred from the parent company Geraghty and Miller. Under his direction, WIC started *The Ground Water Newsletter* and has become a major book publisher in the water field . . . . . **Leggette, Brashears & Graham,** Consulti Ground-Water Geologists, have moved their main office from New York City to 55 West State Street, Westport, Connecticut 06880. Their regional office in Florida will remain in Tampa.

Willard Owens Associates, Inc. of Wheat Ridge, Colorado have recently taken over management of Western Well Logging Inc., enabling them to provide borehole geophys services to the mineral exploration and water well industr in the Rocky Mountain region . . . . . **William C. Ackerma** chief of the Illinois State Water Survey, received the 1975 Illinois Man of the Year Award given by the Illinois Sectic of the American Water Works Association in Peoria. His citation read in part, "For a career dedicated to water resources research, planning and management both in the State of Illinois and at the national level." . . . . . **Dr. Olin Braids,** noted authority on ground-water contamination associated with waste disposal on land, has joined the staf of Geraghty & Miller, Inc., consulting ground-water geolo with headquarters in Port Washington, New York.