The Primary Water Institute

Water Beyond Politics

www.PrimaryWaterInstitute.org

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Primary Water Institute
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To: Board Members
State Water Resources Control Board

Subject: Use of Primary Water as Alternative to the DWR Proposal for Permits to Divert Water From the North Delta

I am aware of an effective and efficient alternative that would help solve California's water problems and avoid the expensive and unwieldy process of building antiquated water diversion systems including tunnels in the North Delta. This supports SWRCB's rejection of the permits requested by DWR for the California WaterFix as they are unnecessary in lieu of this far superior and available new and clean water option for California.

There is a source of fresh water that is never mentioned in the mainstream media, or widely understood by geologists. This forgotten resource is called ***primary water***.

Most water conservation agencies today focus on managing ***atmospheric water*** in the form of surface runoff and ground water, while negligible consideration is given to ***primary water***. Pressuring up from deep within the earth through rock fissures, primary water is virtually limitless and clean. According to recent research, ***water within the earth exceeds five times the amount of water in all the world's oceans.***

The practice of accessing primary water has been around for centuries. What early Greek philosophers like Aristotle and the Italian Leonardo DaVinci believed, and enlightened scientists working at well-known universities today are exploring, is that ***all water is created in the mantle of the earth and is available in limitless quantities worldwide***.

Drilling for primary water looks similar to drilling for ground water. The main difference in accessing primary water is that it requires ***drilling into a geologic fissure or fault to release the primary water that has risen near the surface***.

Locating well sites for primary water requires special training and experience. There are countless primary water wells that have been functioning for decades all over California and around the world.

Primary water advantages

- Provides excellent quality, clean, unspoiled water.
- Is fresh and not subject to pollution or surface radiation.
- Is created under pressure, so that it comes near the surface by itself, incurring less pumping costs.
- It never dries up.
- Unlike groundwater, is not subject to the effects of drought.
- Does not cause subsidence like some groundwater wells.
- Refills depleted groundwater supplies from below in some instances.
- Is plentiful and replenishable.
- Can create localized water supply that is available where it is needed, when it is needed.
- Horizontal drilling rigs can benefit fish and wildlife by refilling dried up streams and lakes. Primary water was used to refill dried up lakes such as Lake Elsinore (which went dry in the 1950s).
- Primary water wells can be used to supplement existing water transport systems like the California aqueduct.

Some history of Primary Water

In the 1960's, the late Dr. Stephan Riess, a geologist and mining engineer, introduced the California government to the concept of primary water. He proposed a water delivery plan which included drilling 8,000 primary water wells along the foothills of the western slope of the Sierra Nevada Mountains. The State government at the time was geared toward managing only atmospheric water, so the Riess proposal was ignored and the California Aqueduct was built instead.

Had Riess' plan been endorsed, the output of these primary water wells, at a conservative average of 270 gallons per minute, would be producing more than 3,100,000,000 gallons of water per day (8,000 x 270 x 60 x 24), 365 days a year. If this system was in place today, it would be unnecessary to drain the Delta through additional diversions.

By accessing primary water, it is unnecessary to use massive public works transport systems because water can be localized to meet the water needs of individual communities. DWR needs to explore and research primary water as a viable option and SWRCB needs to deny the DWR proposed water diversion intakes in the North Delta.

It is essential to consider primary water in addition to atmospheric water when managing California's inconsistent water resources.

I'm including some historical information about primary water including an illustration showing both the primary and atmospheric water cycles (you can download in HQ). Additional technical, historical and scientific papers are available on the Primary Water Institute's website; www.PrimaryWaterInstitute.org.

Please do not hesitate to contact me to discuss a plan to make use of primary water to benefit California.

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The mission of the Primary Water Institute is to train individuals to locate and drill for Primary Water in California and around the globe.

California's Missed Opportunity: The Stephan Riess Story

by A. M. Stinnett

The year 2015 saw the State of California, and indeed the American West, in the grip of a long-term drought. Everyone was thinking about water, or the lack thereof. Property owners were wondering whether it was time to get out ahead of a rush of people trying to leave a dry and thirsty land without suffering financial loss. One headline captured the ubiquitous malaise: "California's Epic Drought: One Year of Water Left."

Government and Water Resources bureaucrats were not standing about idle, and their efforts culminated in major legislation signed by Governor Jerry Brown on April 1, 2015, to effect drought relief by means of more usage regulation and restrictions, as well as the appropriation of seven billion dollars for drought relief projects to be submitted by local Water Resources agencies and private corporations.

Local newspapers published tens of thousands of words by journalists who threw themselves wholeheartedly into the work of investigation, interviewing experts, and reporting; yet in all this delving into a universally crucial topic, they failed to stumble upon a salient fact, a fact that since the 1990s is widely acknowledged by the scientific community. To quote just one of the many testimonials to this fact, Earth scientists of the University of Minnesota wrote in Physics Today in 2012: "Over the past 20 years, scientists have come to appreciate that vast quantities [of water] are stored in Earth's interior....Surface water is only a fraction of Earth's water inventory."

The failure to report, recognize, and act upon such a potentially beneficial reality is egre-gious in California, where for sixty years there lived an extraordinary man who confounded the California Water Resources establishment and the government by demonstrating over and over again the fact of an abundant availability of water even in desert and rocky places: Stephan Riess.

Stephen Riess, German-born geo-chemist, whose revolutionary theories on primary water have stirred a tempest among geologists.

Who Was Stephan Riess?

In 1923 Stephan Riess (b. Bavaria, Germany, 1898 – d. Escondido, California, 1985) emigrated to the U.S. at the age of 25, having completed his formal education in geology at the University of Austria. Like many a young man in the New World, he headed West to get experience in his chosen field, mining engineering. He went to California and became an overnight success among mining companies after he came up with a solution for an ore-processing problem. Thereafter he had no shortage of consulting jobs. His reputation earned him an invitation from President Herbert Hoover to join a metallurgical processing firm with his two sons.

During his first decade in California, his diverse experiences in mining completed the academic geological training he had received at university. Two experiences led to his scientific probing of the question of what has come to be called deep-earth water.

In the first, dynamite was set off in the bottom of a deep mine at high elevation in order to break up the rock. After the blast, the unexpected happened. Water came gushing up from the rocks at 25,000 gallons

per minute! Riess was struck by the fact that in all the geology textbooks he had studied, not one dealt with this phenomenon. Yet among miners it is a truism that mines more often wash out before they work out. The temperature and purity of the water also suggested an origin other than ground water. Riess resolved to investigate this phenomenon.

A subsequent incident advanced his understanding. He was in a mine shaft where a mill was processing ore. He saw water flowing unexpectedly, but it was not coming from the mill; it was bubbling up from beneath the mud. He heard a hissing sound like gas so he lit a match, setting off a mini-explosion. He surmised that catalysts in the ore-processing had also catalyzed the formation of water from hydrogen and oxygen. He later duplicated the water-producing process in a laboratory.

Stockholm professor of mineralogy, A. E. Nordenskjold, 1886.

Riess's discovery that new water is best found in rocks was not a first. He had encountered in the field what the Stockholm professor of mineralogy, A. E. Nordenskjold, had discovered in Sweden—water can been drilled for in solid rock! In 1896, he reported the phenomenon in his paper "About Drilling for Water in Primary Rocks." He had discovered that a new type of water was available, potable fresh water that is distinctly independent of the hydrological cycles of atmospheric water. He called this water "primary" due to its association with so-called primary rocks. The essay earned him a nomination for the Nobel Prize in physics, but his death in 1901 prevented the advancement of his nomination for the prize.

Riess found confirmation of his experimental knowledge from mining and lab work in the historical and geographical records: Writers from antiquity up through Leonardo da Vinci wrote about water coming from rock. The castle courtyards of Europe, situated on rocky promontories, had wells dug into solid rock that are still producing water. The arid lands of the Sahara and the Near East have springs that have been flowing for millennia from a source clearly not that of the atmospheric water cycle. And in Brittany, modern-day Frenchmen still drill for water in solid granite.

Riess Proves the Hypothesis

A decade of work, study, and research had led to the formation of a strong hypothesis: the elements hydrogen and oxygen are present in the Earth's mantle. Primary water is generated in the rock strata when the right temperature and pressure are present. The new water is forced up towards the surface through the faults and fissures in the Earth's crust until it is halted by impermeable rock. Using the sciences of mineralogy, petrology, and structural geology precisely one could locate high-pressure, low-temperature hydrothermal systems like the ones routinely encountered by engineers in mine and tunnel flooding incidents.

In 1934 he was given the opportunity to test the hypothesis. A mining company in Nelson, Nevada, (25 miles southeast of Las Vegas) needed a source of water in order to make a mine profitable. Discarding the

Stephen Riess beside one of the wells he has drilled in Ventura County, California. He says this well is unaffected by climate conditions. Photo by the author.

standard practice of contemporary geohydrologists, the plan was to drill into a mountainside for water. They struck water at a depth of 182 feet with sufficient flow to provide the needed water. The mine subsequently extracted four million dollars' worth of bullion till it closed in 1945. When a company came back to the area in 1977, they were able to reactivate the water well.

Riess' first big well on his property can produce up to 1,200 gallons a minute. Unlike the other water in the area it tastes like mountain spring water.

To Riess's mind the hypothesis was proven, so he decided to stake his own money to confirm it. He purchased a barren plot in the Black Canyon, above the Simi Valley in Ventura County. He brought in three wells which produced 3,000 gallons per minute (gpm), or 4 ½ million gallons per day!—enough to supply the daily needs of 10,000 people. Some of his neighbors benefited from free water from the Riess property.

Word of Riess's success in drilling water wells got around. He became a water developer throughout California. From San Francisco doctors investing in orchard groves, to horse breeders in Ramona, to aspiring citrus growers in the Coachella Valley near the Salton Sea, people turned to Steve Riess when they needed water. And he reliably came through.

David v. Goliath

Not everyone was delighted. The State of California was getting ready to invest heavily in a water transport system of dams, canals, and pumping stations, the first installment of which was the looming Feather River Project. Bonding issues necessary to fund it were being prepared to submit to the voters. A lot of money was being invested, and a lot was going to be made by some. But private individuals began writing to their water authorities questioning the need for such a vast undertaking when Mr. Riess had demonstrated that drilling inexpensive wells situated in the right spots yielded ample water. Moreover, California was not lacking the right geological structure, fissures, and faults for providing abundant water to the growing population throughout the State.

The confrontation between two competing understandings of the origins of water came to a head over the course of the mid-1950s.

A magazine article sparked the conflict. The headline of a two-part story published in 1953 by the Southern California magazine Fortnight proclaimed the potentially transformative reality: "Revolution in Water Seeking." The subtitle spelled it out: "Steve Riess has a new idea of how to look for water and 69 wells to support his theory." The magazine editorialized that the reason for Sacramento's displeasure was simply greed.

Sacramento sent out investigators who conducted a shallow investigation. They made a report without having spoken to Riess's clients, or Riess himself. They asserted that the Simi Valley wells were just tapping into ground water (an impossibility for the amount of water he had extracted).

This round in the Riess v. Sacramento fight was decided by an outsider. Texas oil and gas tycoon Clint Murchison heard about the wells. Since he was interested in investing in California real estate, he sent out a team of his own engineers to test the wells in order to prove their worth as an enduring water supply for a large housing tract. After eighteen months, they gave the green light. In 1955, the Ventura County Star-Free Press headlined the million dollar purchase, one of the biggest amounts paid for property in California at the time.

Round Two: Sparkletts Drinking Water had drilled wells for its Lakeside facility in San Diego following the advice of a Water Resources (WR) specialist. Within six months the water quality had declined and the supply was running out. The owner was desperate. After the Murchison purchase made the headlines, he got in touch with Riess. Riess ultimately drilled into the bottom of an existing 400-foot well that had gone dry. He drilled down an additional five hundred feet till he struck high-grade water at 300 gpm. The plant

was saved. (And in 2016, it is still supplying Sparkletts with water.)

Round Three: A situation then arose that pitted the scientific theories directly against each other. A University of California groundwater geologist and consultant for the State Water Resources Division advised a specialty grower in the Anza Valley, desperate for irrigation water, to drill in a particular place in order to tap into groundwater: the well yielded a mere 4 gpm. Meanwhile, an editor of the Christian Science Monitor working on a story about California's ongoing water crisis informed Riess about the situation. Riess convinced the desperate man to fund one more well. He chose as the site a 350-foot granite hillock on the property. State officials of the WRD learned of the plan and sent down six of their agents to try to talk the farmer out of doing it, to no avail.

Before drilling began, based on his knowledge of geohydrology, Riess predicted the depth (300 feet) and water volume (300-1,000gpm) he anticipated; he was spot on: the well produced from an occasional flow of 1,030 gpm to a steady 400 gpm. The UC professor's mind was totally unyielding to the evidence. He ascribed Riess's success to luck.

Just Lucky?

Word of Riess's ability to find water in desert places even reached the State of Israel. In 1958 Prime Minister David Ben-Gurion invited him to Israel. They needed water for the new city of Eilat, situated in the Negev Desert on the Gulf of Aqaba on the Red Sea. When Riess explained his methodology to Israel's hydrological experts, they at first resisted, but "encouraged by their superiors" they co-operated with Riess. He located a well a mile and a half outside the city near the Jordanian border, enough to supply a city of 100,000 inhabitants and twelve outlying villages. His success in Israel led to his being invited to Egypt, where he brought in three wells along the Nile for prominent individuals, and also to Saudi Arabia, where he drilled in the northeast of that country.

Second Theory: A Boon for Southern California
Back in California he had another opportunity to show the validity of his theory for locating water and to test another—the theory that a supply of water runs in the system of fissures under the Mojave Desert large enough to supply the needs of all of southern California.

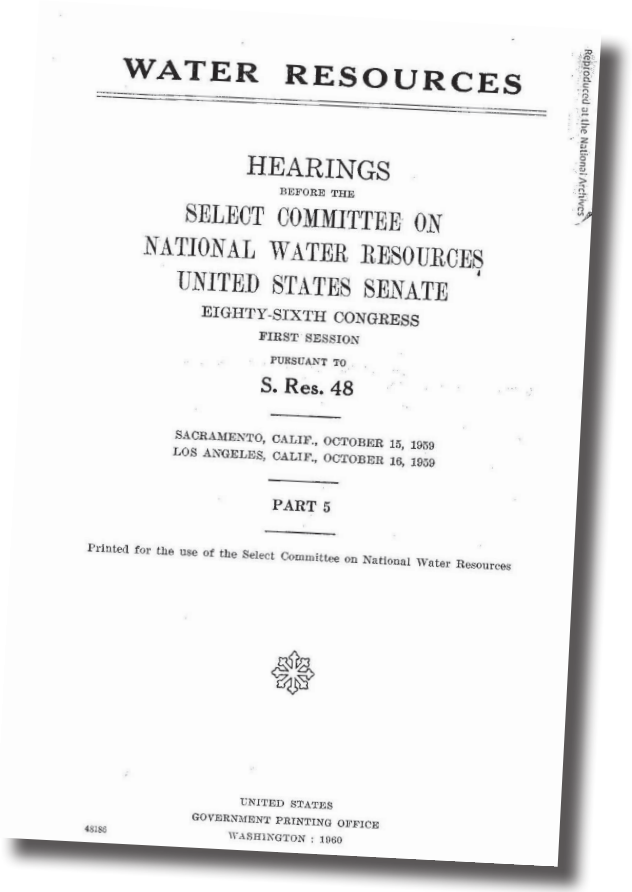
In 1958 a land developer wanted to make a huge development in the Mojave for which, obviously, he needed water. He hired Riess. Riess sunk three wells which enabled the huge tract of land to become California City. In order to assess the wells', and the new town's, long-term prospects, the land developer commissioned a quarter-of-a million-dollar study to test Riess's hypothesis. The study concluded that indeed a vast quantity of water was traveling in the fault system under the desert and that it had nothing in common with any water in "alluvium sedimentary aquifers," that is, ground water. The co-ordinator of the study, Olindo Romulus Angelillo, told the Christian Science Monitor that more than a million acre-feet flow under the desert, enough to meet the needs of five million people.

The Grand Coalition of the Status Quo Strikes Back
Decades before the 1950s, federal and state politicians had committed California to an immense system of dams, canals, and pumping stations to resolve the problem of providing water to the burgeoning populace. By the late 1950s, planning on the Feather River Project was advancing. In 1959 the expected cost was $14 billion (in reality it turned out to cost many billions more). Riess meanwhile had contracted with the San Bernardino Municipal Water District (SBMWD) to drill wells sufficient to supply the needs of the huge San Bernardino county in perpetuity for a sum "infinitesimally smaller than that to be levied against the district as its share of the Feather River Project." He brought in the first well at Yucaipa: 900 gpm in 600 feet of solid granite. Word of the success got back to Sacramento. When the well was on the point of being accepted by the SBMWD, Riess was summoned to a private meeting with the manager, who told him that Governor Brown had told him to shut down the well. Why? "Because he felt that if you couldn't be stopped from running around the country bringing in maverick water wells, the whole bonding issue was in jeopardy."

Riess went to court to collect his costs. He lost both cases in the lower and appeals court, but finally won when the decision was reversed by the Supreme Court of California. Riess was given the opportunity to testify before a Select Committee on National Water

Resources of the U.S. Senate in Los Angeles in October 1959.

Riess proposed that a serious study of water flowing in rock fissures be undertaken. Within the solid rock beneath the Earth's crust is a system of fissures—Mother Nature's own pipe lines. Surely it is more economical to pump water vertically 450 feet than to pump and transport it 450 miles!



WATER RESOURCES

HEARINGS
BEFORE THE
SELECT COMMITTEE ON
NATIONAL WATER RESOURCES
UNITED STATES SENATE
EIGHTY-SIXTH CONGRESS
FIRST SESSION
PURSUANT TO
S. Res. 48

SACRAMENTO, CALIF., OCTOBER 15, 1959
LOS ANGELES, CALIF., OCTOBER 16, 1959

PART 5

Printed for the use of the Select Committee on National Water Resources

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WASHINGTON : 1960

The State launched a counterattack. The California Director of Water Resources put out an Information Bulletin, "Is 'Primary Water' or 'Rock Fissure Water' a Potential Source of Water Supply?" (December 1960). It denigrated the Mojave Desert study as worthless and attacked Riess's ideas. It was distributed to all State offices.

But Riess did not quit. One of his colleagues relates that he conducted a hydrological survey of the entire State: eight thousand wells would enable California to have a limitless, secure, high-quality water supply at a cost of only two percent of the Sacramento River Delta water tunnels being planned in the 21st century. But the Governor's decision stood, and the proposal disappeared from institutional memory.

Riess remained active until his death in 1985. He had a career total of 800 productive water wells. His last year, he brought in a well at Escondido, California, on a site a thousand feet higher than the City's supply with a pumping cost 80 percent cheaper.

Truth vs. Vested Interests

Since his death, science has come around to Riess's way of thinking:

- Japanese researchers reported in Science in March 2002 that the earth's lower mantle may store about five times more water than its surface oceans.
- Earth scientists Hirschmann and Kohlstedt of the University of Minnesota reported in their 2012 article "Water in Earth's mantle," (Physics Today, 65 [3], 40 [2012]), "scientists have come to appreciate that vast quantities [of water] are stored in Earth's interior. . . . Surface water is only a fraction of Earth's water inventory."
- Australian scientists have discovered vast freshwater reserves beneath the oceans, miles out to sea. According to the report published in the December 2013 issue of Nature, there is an estimated 500,000 cubic kilometers of low-salinity water beneath the seabed along the continental shelves around the world.
- Scientific American (March 2014) documented the presence of vast quantities of water locked far beneath the earth's surface, generated, not by surface rainfall, but from pressures deep within: "There is a very, very large amount of water that's trapped in a really distinct layer in the deep Earth…approaching the sort of mass of water that's present in all the world's oceans."
- In October 2014, the Special Inspector General of Afghanistan Reconstruction reported that affordable deep-well technology has turned 200,000 hectares (about 770 sq. mi.) of desert in southwestern Afghanistan into arable land.
- In December 2014, BBC News reported the results of a study presented at the fall meeting of the American Geophysical Union, in which researchers estimate there is more water locked deep in the earth's crust than in all its rivers, swamps, and lakes together.

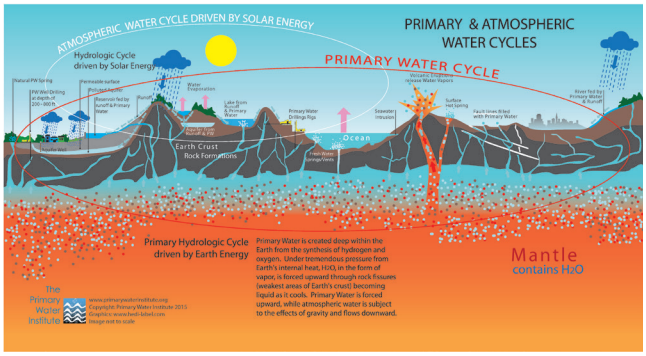
- So, a generation after Stephan Riess's death, scientists generally admit the existence of "vast quantities" of water within the earth. Moreover, engineers have proven that the water is readily accessible, since water projects in Afghanistan (but not, of course, in the U.S., although the Afghan water projects were funded with U.S. dollars) were able to transform 770 square miles of desert into arable land.

So, scientists, despite their vested interest in defending the theories they mastered in graduate school, have finally yielded to the evidence. Yet the politicians and Water Resources bureaucrats have not been keeping up with advances in science. They are still working from their 1950s' playbook. In 2016 they are still proposing the same policies advanced a half a century ago.

To conclude this survey of the career of a man who could rightly be called a pioneer and a genuine benefactor of mankind, it is fitting to quote the concluding remark of Aldous Huxley's foreword to the 1960 book by Michael Salzman that thoroughly examined the work of Stephan Riess, New Water for a Thirsty World:

"Vested interests are of many kinds. There is the intellectual vested interest of those who have taken their doctorates in a science at a certain stage of its development, who have taught and applied that science at that particular stage, and who regard any questioning of the postulates underlying that science at that stage as a personal affront and a menace to their position in the Establishment. And then, of course, there are the more substantial vested interests of contractors who make money by selling concrete for dams and irrigation works, of bankers who make money by handling state and municipal bonds, of bureaucrats who, obeying Parkinson's Law, feel an urge to expand their departments and extend their authority, of politicians who find it prudent to say yes to powerful pressure groups. But even against vested interest truth (particularly if it be a useful truth) will ultimately prevail. How long is 'ultimately'? That is the question."

Download HQ Primary and Atmospheric Water Cycle Poster
http://primarywaterinstitute.org/images/pdfs/PWI_poster_rev3_May2015.pdf



The earth has two major water cycles as shown above - the primary water cycle and the atmospheric water cycle. All of earth's water originates in magma in the earth's mantle and is transported in the form of super-heated, high pressure steam or vapor through geologic cracks and fissures to or near the surface of the earth. This is the primary water cycle as depicted above as the blue above the orange mantle and below the earth's crust. As this vapor reaches the earth's surface it is either released through volcanic steam and fumaroles, or has cooled enough to liquefy into water and forms artesian and other springs and lakes – even in the mountains. This is pure water that has never before been in contact with the atmosphere.

The secondary water cycle is the most familiar hydrologic cycle and moves what is also known as atmospheric water. The secondary water cycle takes the primary water which has reached the earth's surface and, with the sun's heat, utilizes the processes of evaporation, transpiration, and heating and cooling of the atmosphere, to create precipitation which is transported to re-supply the earth with cleansed water or snow - replenishing lakes, streams, rivers, and the ocean.

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The Foremost DR-24 is a perfect choice for drilling for primary water. It can handle any type of geologic formations. These rigs are in use all over the world.

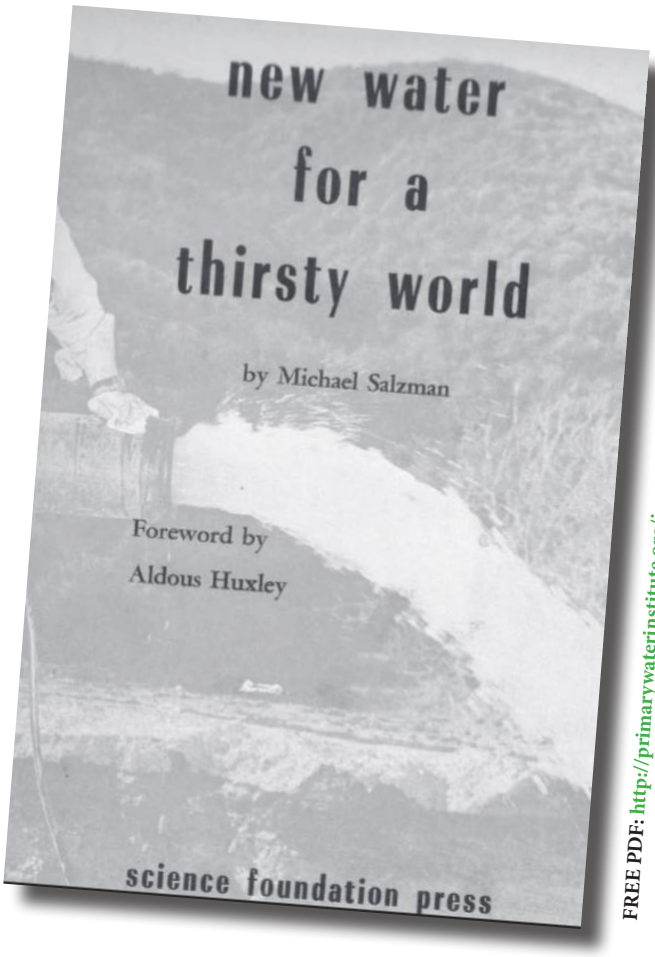
Inexpensive horizontal drilling rigs can benefit fish and wildlife by refilling dried up streams, lakes and rivers.

FOREWORD

New Water for a Thirsty World

by Aldous Huxley

As a child, born into a rainy country and brought up in the midst of what at that time was advanced modern plumbing, I took water for granted. One turned a tap and water appeared. That was all there was to it. With foreign travel came the discovery that things weren't as simple as all that. I rented a delightful villa in the hills above Florence. What a paradise! But the pump that should have raised the bath water from a well in the courtyard stopped working; and a little later, when the pump had been repaired, there was no water in the well. From one dry hole I moved on to a succession of vast dry regions. I crossed the deserts of Rajputana and what is now Pakistan; I visited the city of Bikaner, where the water supply is hoisted from deep wells by oxen harnessed to a rope, at the other end of which is a leather bucket. Then came the deserts of the American Southwest, seen first at the end of a wet cycle and later lived in during a prolonged drought which finally dried my well and the wells of most of my neighbors. No rain, no water in the wells. It stands to reason, doesn't it? But in some places there is no rain, and yet an unfailing abundance of water in the wells. At Nefta in the Sahara, at Jericho in the Jordan valley, I saw things which, by all the rules of common sense, I had no right to be seeing. Nefta lies in a part of the desert where it rains on the average once every three or four years; for the rest of the time there is only wind and sunshine. But though no water falls from the sky, water comes pour- ing out of the ground—enough water to support a forest of date palms and a population, in that incredibly fertile oasis, of several thousands. And after Nefta there was Jericho. Jericho is the site of the first walled city, built by a neolithic people thousands of years ago. And for thousands of years before that city was built men had lived on what was to become its site. Jericho is and has always been an island of greenery in the barren land. In a place where, by all the rules, there should be no water, a spring gushes out of the rock and has been gushing from time immemorial. From these two sets of object lessons I learned two significant facts about water; first and most obviously, that over vast expanses of the earth's surface, water is scarce or non-existent; and second (to my extreme puzzlement) that here and there water makes its appearance in places where it seemingly has no right to be present.



Such was the extent of my knowledge when, some few years since, I first met Stephan Riess. After seeing a few of his wells spouting water from the solid granite at the rate of two or three thousand gallons a minute, and after listening to what he had to say about faults and fissures, about juvenile water and primary water, about hydrogen and oxygen coming together at high temperatures and under vast pressures in the bowels of the earth and rising, as H2O towards the surface, wherever the crust was weak, I began to under- stand the mystery of Nefta and Jericho; and I began at the same time to feel a little more hopeful about humanity's prospects for survival and a good life on this underwatered and soon to be overpopulated planet.

And now comes Michael Salzman's book. Jack of all trades and master of four or five, Salzman is one of those rare, indispensable men who refuse to confine themselves to a single academic pi- geon- hole, but with systematic restlessness and a boundless curiosity climb about on the woodwork between the specialists' insulated boxes, peering in now here, now there, and correlat-

ing the knowledge they extract from each compartment into a comprehensive pattern that permits a better understanding of the artificially isolated facts and, along with a better understanding, the possibility of new and more fruitful kinds of action.

If Riess is right (and the proof of the pudding is in the eating—or rather, since we are dealing with water, in the drinking), and if Salzman has correctly stated the chemical and geological reasons why Riess finds water in places where orthodox hydrologists affirm that it cannot possibly exist, then clearly we must be prepared to make a number of revolutionary changes in our ideas and our poli- cies. If brand new, primary water can be found near the place where it is to be used, then the building of huge dams to impound old waters, and the digging of long canals to lead the water to its place of use, will become completely unnecessary. Every reservoir behind a dam is bound, sooner or later, to silt up.

By the time California has fifty million inhabitants and five or six times its present water needs, Lake Mead will be well on its way to becoming the world's largest beaver meadow, and the Feather River Project, after bankrupting the state, will be hard at work depositing mud.

If Riess and Salzman are right, the needs of California's future millions can best be supplied, not by inordinately expensive dams and aqueducts, but by drilling into faults and fractures for local sources of new primary water.

Again, if Riess and Salzman are right, it will be possible to use the applied science of tapping primary water in order to ease the political tensions and alleviate the chronic miseries of the Middle East and Africa. The high dam at Aswan will reach completion at a date when Egypt's population will have already outstripped the yield of the new lands which that future beaver meadow will have made fertile. How much quicker, cheaper and more efficient to start drill- ing for primary water in the rocks that shut in the Nile Valley!

Time is everywhere against us; and unless we can provide enough extra food in the desperate interim between present population explosion and future population stabilization, the social, economic and political consequences of death-control without birth-control are bound to be disastrous. The extra food can be produced most rapidly by supplying the vast dry areas of the earth with water; and this in turn can be done most rapidly by locating and exploiting those deep telluric sources which (if Riess and Salzman are right) are nearly ubiquitous and for all practical purposes inexhaustible.

And even in those regions where rain falls and rivers run, primary water may turn out to be useful and even indispensable. As population grows and technology advances, more and more water is consumed. And not only is more and more water consumed; more and more sources of water are polluted. To the chemical and excre- mentitious pollution with which we defile our rivers, lakes and beaches there is now added regularly radio-active pollution. Danger- ous even in peace time, such radio-active contamination might have the most appalling consequences during and after a war. In the years ahead, and for the inhabitants of densely populated and highly indus- trialized countries, sources of uncontaminated and uncontaminable water will become increasingly valuable.

For everybody's sake, let us hope that Riess and Salzman are right. Having seen some of Riess's wells and having now read the proofs of Salzman's book, I myself not merely hope, but feel pretty sure that they are right. It remains to be seen whether those who are now regarded as experts in the field of hydrology and the poli- ticians whom they advise will also agree that a good case has been made and that large-scale experimentation is in order. Vested inter- ests are of many kinds. There is the intellectual vested interest of those who have taken their doctorates in a science at a certain stage of its development, who have taught and applied that science at that particular stage, and who regard any questioning of the postu- lates underlying that science at that stage as a personal affront and a menace to their position in the Establishment. And then, of course, there are the more substantial vested interests of contractors who make money by selling concrete for dams and irrigation works, of bankers who make money by handling state and municipal bonds, of bureaucrats who, obeying Parkinson's Law, feel an urge to expand their departments and extend their authority, of politicians who find it prudent to say yes to powerful pressure groups. But even against vested interest truth (particularly if it be a useful truth) will ultimately prevail. How long is 'ultimately'? That is the question. —***Aldous Huxley***