energy needs. And the country's known oil and gas resources are negligible. Thus the appeal of homegrown deep gas.

More cynical observers, outside Vattenfall, see another possible motive. If the search for alternatives to nuclear power were a highly public, exhaustive one, the argument goes, Vattenfall could go back to the voters with proof that the nuclear route is their only choice.

With the odds long but the potential payoff high, Vattenfall bit. But the Swedish government wasn't willing to go it alone. It required that Vattenfall get outside financial help. The agency then formed a company, called Dala Deep Gas, to do the drilling and sold 49% of it in large chunks to industrial firms, municipalities, and private consortia. Swedish entrepreneurship even made it possible for the little guy to invest in the testing of this maverick American scientist's theory. Two holding companies bought some of the large shares and subdivided them, bringing the cost per share down to about $1500—well within the reach of small investors.

And then there was the enticing tax angle. Swedish income tax rates are high, and investors in risky ventures such as the Siljan drilling were able to quickly deduct most of their investment. If there were losses, more deductions could be made. "You don't risk anywhere near as much as you would" in the United States, says oil and gas consultant John Castaño of Houston, who represented GRI at the drill site. Of course, the burden then falls on the government and thus all taxpayers.

Finally, there was the gambler's enticement: the ever increasing size of the speculative carrot being dangled before investors. By the start of drilling in July 1986, Vattenfall's estimate of the amount of gas that might lie beneath Siljan had jumped from 100 billion to 800 billion cubic meters, according to a prospectus for Anathema Oil, one of the two holding companies marketing public shares. That volume of gas would have been worth upwards of $40 billion or $5000 per Swede. By the fall of 1986, Anathema Oil boasted in its prospectus that a Norwegian oil firm had an estimate of 4000 billion cubic meters, or more than all the gas ever produced in the entire world. Says Castaño, such claims "in this country would bring the Securities and Exchange Commission down on you with both feet." Things are obviously different in Sweden.

With expectations running so high, investors may not have noticed that the first 5 kilometers of drilling, all that was initially planned, failed to support Vattenfall's justifications for the project. The first 5 kilometers of fractured granite made a poor reservoir rock, if sufficient pore space existed at all. The possible reservoir seals turned out to be solidified magma intrusions, not carbonate deposits. And there was no sign of mantle gas.

But investors were now told of a possible reservoir with a seal at 7.4 kilometers, and drilling was going smoothly. Indeed, the hole had become the second deepest ever drilled in crystalline rock. At one point, the stock actually soared to ten times its initial value.

"Some people are totally unwilling to give up their views in a field that has been their livelihood."

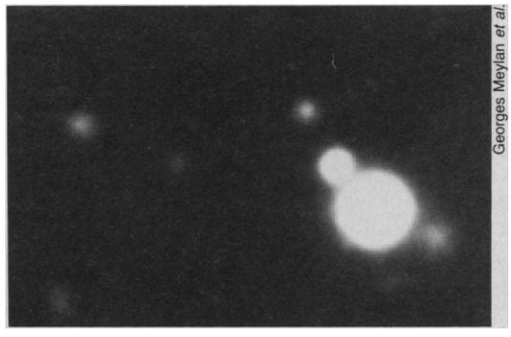
But then came the disasters. The worst of these involved wayward drill bits. Drillers could not keep the hole from bending away from the vertical until the drill bit and the increasingly bent pipe connecting it to the surface became stuck. Drilling finally stopped last September at a depth of 6800 meters.

Most oil and gas professionals see little reason to try to resume drilling (see box). Sure, they say, the Siljan granite contained about 100 parts per million of methane (the principal component of natural gas), but that is less than the amounts found in dry holes at conventional exploration sites. And the isotopic composition of the accompanying helium demonstrates, by conventional reasoning at least, that none of the gas is seeping up from the mantle. "The amount of gas we saw in the more interesting zones still makes any future prospecting very speculative," says Castaño, "just as speculative, if not more so, than when we started."

"The results on the Siljan hole show that it's highly unlikely that there are commercial quantities of gas there," says Gordon MacDonald of the Mitre Corporation in McLean, Virginia. Once the chairman of GRI's advisory committee on the Siljan drilling, he had strongly supported Gold in the early 1980s in Gold's bid for serious consideration of his theory in the United States.

Despite such apparent setbacks, Gold remains adamant. "The drilling has been done in an atmosphere of extreme passion pro and con with hardly anyone with an open mind in between," he says. "Some people are totally unwilling to give up their views in a field that has been their livelihood." Gold still argues that gas is seeping up from the mantle and probably being trapped just a few hundred meters below the bottom of the hole. "I would expect we would see the free gas below" 7.4 kilometers, he says.

As incredible as it seems to most U.S. experts, Swedish investors, some of whom contributed to the $40-million dry hole, may be willing to back Gold up on his latest prediction. Vattenfall is out of the deep gas business, having just sold its share in Dala Deep Gas. But the man at Vattenfall whom Gold initially had to convince, engineer Tord Lindbo, now heads Dala and is gathering funding for another Siljan hole. Gold is on the board of directors. As he once told the *Wall Street Journal*, "In choosing a hypothesis, there isn't any virtue in being timid." ■ **RICHARD A. KERR**



Georges Meylan *et al.*

Twin Quasars Found. If a galaxy happens to have an ultramassive black hole at its core, the theory goes, and if another galaxy happens to come close enough for gravitational tidal effects to push gasses and other matter into the hole, then the result will be a violent spasm of activity known as a quasar. The recent discovery of twin quasars—the closest such pair ever observed—has given a big boost to the theory; they formed, presumably, when two galaxies, both with central black holes, got together. The discovery, which was announced in January at the Washington, D.C., meeting of the American Astronomical Society, is the result of a joint effort by four astronomers: Georges Meylan of the Space Telescope Science Institute of Baltimore; S. George Djorgovski and his graduate student Nicholas Weir, both of the California Institute of Technology; and Peter Shaver of the European Southern Observatory in Garching, West Germany.

Djorgovski and Weir first thought the quasar pair might be a single quasar exemplifying the gravitational lens phenomenon, that is, the bending of light that can produce a double image. But even though the two astronomers were looking for evidence of gravitational lenses, they have no question that the two quasars are distinct bodies. Explains Djorgovski: they have different spectra. ■ **SARAH WILLIAMS**