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TRENDS IN URANIUM AND THEIR SIGNIFICANCE FOR INVESTORS IN MINING SHARES

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URANIUM BECKONS

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Our host, George Palmer of the "Financial Mail" proposed the theme "Uranium Beckons." It has certainly been beckoning to me since the closing days of the second World War, when the US Air Force arranged for two uncontrolled nuclear reactions above Japanese cities - the second on my 13th birthday. I began scouring the libraries and bookshops of Bath in the West of England for clues why, when all matter, I knew, consisted of atoms, the uranium atom should possess this unique and terrifying ability to "fission" - that is, to split open, releasing immense amounts of energy.

A few years later I came uncomfortably close myself to an uncontrolled fission reaction. I was a national serviceman responsible for the care and maintenance of the computer in tanks at a remote Army outpost in Cumbria, in the north of England, when over the mountains a few miles away one of Britain's "nuclear piles" ran out of control. The basic difference between a "pile" and what we now call a reactor is that in the reactor, the nuclear processes take place inside a pressure vessel, analogous to what the chemical industry calls a reactor. The Windscale piles were simply massive cubes of graphite bricks over 100 feet high, through which thousands of rods of uranium ran horizontally. A very brave Irishman called Tom Tuohy, who much later I came to know as a friend, made an uneviable reputation for himself as "the world's most experienced nuclear firefighter" when he carried the fire hose to the face of the pile, and doused the fiercely-blazing uranium. At that stage of our knowledge of nuclear energy there was a very real risk that a deluge of cold water upon several tons of red-hot uranium at the heart of the pile would cause the pile to split open, releasing the dreaded radio-active cloud.

Perhaps I should mention at this point - since Britain's Windscale nuclear accident is so often cited nowadays by the very vociferous critics of nuclear energy - a claim that Britain's chief nuclear inspector makes with great relish. This is that not only did the accident harm nobody - not even Tom Tuohy - but

that it actually saved two lives. One of the helicopters surveilling the scene rescued two sailors in serious trouble offshore.

I began reporting on nuclear energy as a science writer in the early 1960's, and soon found myself drawn closer and closer to the special problems of an emerging new industry born - for the first time in the case of an energy industry - in the laboratory. Britain then was deeply engaged in the world's first nuclear power programme, a series of uranium-fuelled reactors known as the magnox reactors - this name comes from the magnesium alloy can in which the uranium fuel is sealed up, and testifies to the paramount importance of the fuel and its can in a successful nuclear system.

The magnox programme in the early 1960's had plenty of problems. It was certainly proving more difficult than the experts had thought a few years before. It had also lost some of the political steam that had driven Britain to pioneer nuclear power in the mid-1950's, simply because the energy supply situation had grown much more relaxed. Oil was flowing freely from the Middle East and its price was still falling. Coal was flowing more freely from UK mines. And natural gas had been discovered in the North Sea. The single-minded devotion to nuclear energy's immense technical difficulties, that had characterised the first decade or so of effort after the war, began to waiver. My professional colleagues, the science writers who had drawn so much copy from nuclear energy in the early years, began to loose patience with the delays; with what they saw as mere "engineering details," not to be compared with the scientists' problems in the early years.

Yet somehow the nuclear industry overcame its problems and provided the UK electricity industry with a family of very satisfactory powerplants. Let me quote some remarks made by Arthur Hawkins, chairman of the Central Electricity Generating Board - the world's biggest electrical utility - at a conference in Paris on the theme of "nuclear power maturity" last spring. Our first nuclear programme, said Arthur Hawkins, "has undoubtedly been highly successful and has brought great rewards to the UK."

He illustrated his point with the following figures: "At the end of 1974, total world generation of nuclear power - apart from that in the Soviet Union - amounted to nearly 1 000 million MWh. Almost 30% of this total was contributed by Britain's 11 magnox stations." Reliable, untemperamental workhorses - that is how I regard our magnox reactors, he said. "Year after year they have demonstrated their stamina and effectiveness."

Still more to the point, although when originally ordered the magnox reactors were not expected to compete with fossil-fuel electricity in overall electricity generating costs, in fact they now turn out to be highly competitive. This is partly a consequence of the excellent performance they have been giving, and partly a consequence of soaring fossil-fuel prices.

To quote Hawkins again, on the comparison with coal-fired plants: "Last year the CEGB's magnox stations cost us £49 million more in depreciation, interest and operating expenses because they are nuclear. Nevertheless, they saved us no less than £133 million on our fuel bill. This, then, gave a net balance for the year of £84 million in favour of the magnox stations."

Just to put Arthur Hawkins' remarks into a slightly clearer perspective, this was the man who led recent efforts to persuade the UK Government to abandon UK nuclear reactor designs, and let him embark on a crash programme of nuclear construction based on an American design of reactor. In cold logic, his plan was unassailable but in political sensitivity, on almost every conceivable front his plan left a great deal to be desired.

The picture presented in Paris, however, was neither exaggerated nor unique. Other electrical utilities can boast comparable experiences with nuclear energy, among them Electricité de France, Ontario Hydro in Canada, and several US utilities. Nuclear reactors with the capacity to supply a city of about 1.5 million people have recently come into operation in Germany and the US. A very advanced reactor called the fast breeder reactor,

of 250 MW output - enough to supply a city of 300 000 - has been operating successfully in the south of France for more than a year; although this type of reactor is not expected to be ordered commercially until the mid-1980s at the earliest. In short, nuclear energy is already a mature, highly competitive alternative to fossil and hydro-electric sources of electricity, in contrast to the highly-publicised "benign and renewable" sources - solar energy, wind energy, tidal and wave power, geothermal energy, and so on. Such sources, endlessly debated by enthusiasts in Britain for their possibilities for powering say one house or a school, have not even begun to tackle the engineering problems associated with providing a large, central source of energy round-the-clock, with absolute reliability.

All this nuclear energy comes at present from uranium, and will continue to do so for a long time yet. Uranium is a metal, although a comparatively useless one in engineering terms. Its most obvious physical property is its very high density - I have brought along a bar of the metal which weighs half a kilogram, and for comparison bars of exactly the same dimensions of iron and aluminium. Uranium is more than twice as heavy as iron and about seven times as heavy as aluminium. Only three metals are denser - gold (almost the same density), platinum and osmium, all precious metals. Efforts to find a use for uranium once its nuclear energy has been consumed tend to focus on this high density, in situations (such as instruments) where a bit of inexpensive ballast is needed, or else on using the intense colours of its compounds in decorating ceramics.

But the real value of uranium can be found in the fact that fission of the nucleus of the uranium atom liberates about 30 times as much energy as is set free in almost any other nuclear reaction. For practical purposes it is difficult to get more than 1% of the uranium atoms to fission and release their energy. Even so, this discovery - by the German scientists Hahn and Meitner in 1938 - can fairly be claimed as the most important property of a metal to be uncovered since metals first were smelted.

Today the strategic stockpile of yellowcake - that is uranium oxide - stored in drums around Britain, much of it from South Africa of course, represents more power than the economically workable coal reserves of the UK. I should add that this claim assumes that, in due course, we shall perfect commercially the advanced nuclear reactor known as the fast "breeder" reactor, which we know can make much more efficient use of uranium - 50 or 60 times better than present-day commercial reactors. In such a reactor, the neutrons released in the fission reaction are made to do extra work converting ordinary uranium to plutonium, a man-made metal which can also be used as a very efficient nuclear fuel. One day, it is hoped, such reactors will breed more fuel than they consume, at which point uranium demand will start to slacken.

Uranium occurs very widely around the world, in more than a hundred different minerals. It can be counted a fairly common element. Unfortunately it is thinly dispersed. The sea contains about 3 millionths of a gram per litre, equivalent to 11 tons per cubic mile. For comparison, a cubic mile of seawater contains only about 16 kilograms of gold.

Such figures always bring a gleam to the eye of those irrepressible optimists who believe there's a fortune waiting to be extracted from the sea. The famous German chemist Fritz Haber worked for a decade on a process for extracting gold from seawater in the hope of using it to pay off Germany's First World War debts. In fact, Britain's nuclear research centre at Harwell has developed a way of extracting the uranium by absorbing it on a chemical called hydrated titanium oxide. They have even demonstrated it at sea, in experiments at Weymouth.

It looks fine - except for the cost of pumping the seawater, which puts the price of the uranium far beyond that of the mined ore today. Undeterred, some genius has proposed the "floating uranium extraction factory" perhaps, the nearest thing yet to perpetual motion that still retains some credibility. The idea is that long chains of another UK invention for extracting energy from the sea - in effect, a duck-shaped buoy that bobs

with the waves and could turn this rocking motion into a head of hydraulic pressure - should be towed into the mid-Atlantic. These chains of "bobbing ducks," miles long to generate all the energy needed, would then be allowed to drift with the Westerlies back towards Britain. All the while they would be using their energy to pump seawater through uranium extraction columns.

The sea apart, uranium is widely dispersed on land. But a worldwide search lasting from the end of the Second World War until 1960, probably more intensive than any metal ever received before, revealed commercially attractive reserves totalling only 700 000 tonnes or uranium. This figure must be set against an estimated annual demand for uranium that may well reach 300 000 tonnes before the curve levels out in response to the much higher fuel-burning efficiencies of fast "breeder" reactors. Even so, the low price that yellowcake was fetching in world markets kept the price depressed during the 1960s and early 1970s. Now, with a tripling or quadrupling of the price in the past year or two, the incentive is greater for renewed searches using much more sophisticated methods.

For each nuclear power station ordered in the West from now on, fresh reserves or uranium will have to be discovered. All readily accessible reserves known to the West are already bespoke to meet the needs of nuclear reactors now in operation or under construction - that is, expected to be producing by about 1980. The ramifications of this situation - commercially, financially and politically - have prompted the uranium producers this summer to set up a "think tank," called the Uranium Institute, in London, to help find answers to some of the producer's problems.

Founder-members of the Uranium Institute include the Buffelsfontein Gold Mining Company, Rüssing Uranium, the Vaal Reefs Exploration and Mining Company, and Rio-Tinto Zinc. I'm told that the idea of a co-operative planning effort has been discussed among the uranium producers for about 15 years. The rapid rise in oil prices in 1973 that gave urgency to a situation

which had been stagnating. Overnight, for most industrialised nations, nuclear power became a matter of highest priority in the scramble to safeguard the long-term security of energy supplies.

Yet in spite of the urgency the Uranium Institute was quite a long time gestating. The fears of their customers that the uranium-rich nations might take their cue from the oil producers and organise a "uranium OPEC" were enough to ensure that the producers moved circumspectly even once they'd agreed they should set up a "think-tank". Then they suffered a sharp setback last January when an article in the influential if idiosyncratic US business magazine Forbes, provacatively entitled "It worked for the Arabs..." asserted that South African, Australian, Canadian, French and British uranium producers had been meeting since 1972 to discuss the possible consequences for the industry of a sharp resurgence of enthusiasm for nuclear power.

Privately the producers admit that the article killed any idea that the US uranium producers - ever sensitive to cries of "cartel" - might join the club from the outset. No secret is made of the fact that, in writing the articles of association for the Uranium Institute the 16 founder-members - since joined by three more producers and some uranium processors - have leaned over backwards to help the US producers to join once it has been working a while. But this may still not materialise before 1983-84 when American uranium demand begins to outstrip domestic capacity.

Now we come to the question: what should the uranium industry's "think-tank" be thinking about? Several issues seem to me to loom large today for the uranium industry and therefore, I presume, for its new "think-tank". Let me put four issues to you:

1) There are questions of supply and demand;
2) There are daunting questions of the financing of exploration and exploitation, in order to meet an expected demand of seven or ten times the present world output of uranium - within 25 years;

3) There are the idiosyncrasies of government policies among the uranium-rich nations, and whether and how they can be reconciled with supply and demand; and
4) environmental problems, including the activities of nuclear energy's opponents, which in turn could greatly influence supply and demand.

Let us look at each of these four issues more closely.

First, uranium supply and demand, the "think-tank's" most obvious task, and the one with which it has begun. Post-War enthusiasm for uranium prospecting and exploitation waned in the 1960's, when cheap oil and gas coincided with the first signs that nuclear energy was going to be neither so easy nor so cheap to exploit as was once being forecast. The price of uranium, steady for years at around $8 per lb, was too low to justify major investment in exploration, let alone in exploitation.

The mining companies expect to spend upwards of $20m, just to search an area of say, 50 square miles which they suspect may contain useful deposits.

But the energy crisis of 1973-74 put a spotlight on problems already well appreciated by the mining companies but largely ignored elsewhere - namely, that by around the end of the century the world would need perhaps [illegible] to ten times as much uranium each year as is being produced today.

If nuclear plans already in motion fully materialise, an additional 50 000 tonnes a year of uranium will be required by 1985. To put this figure into perspective present-day demand for uranium in the West is only about 25 000 tonnes a year, and it takes ten or even fifteen years to locate and exploit a new deposit. Even Australia's well-publicised uranium resources - put at a total of 188 000 tonnes a year or so ago - begin to look puny when set against a demand that may peak at 200 000 or 300 000 tonnes a year.

The issue, then, is that the present "guestimates" about supply and demand, produced in the past with widely varying degrees of co-operation from individual uranium producers and producing nations, now need to be turned into confident estimates,

acceptable not only to the uranium industry as a whole but to its customers and their governments. The institute has begun to collect its first data early next year.

On the demand side, however, we need to try to harden present estimates of just how steeply the uranium demand curves will go on rising. We must decide at what point - now "guestimated" at around 200 000-300 000 tonnes a year and the year 2 000 - the demand curve will flatten from the influence of the fast "breeder" type of reactor. This is one reason why customers such as the major electrical utilities and the nuclear fuel companies must be associated with the effort to estimate demand for uranium 15 years and more ahead. Even so, huge uncertainties are unavoidable. The Japanese, for example, have already trimmed a crash nuclear programme aimed at achieving 60 000 MW by 1985 to 49 000 MW by that date. Informed onservers suggest that domestic obstacles to the licensing of new plants may keep the figure actually achieved as low as 35 000 MW. Again, the USA where President Nixon proclaimed Project Independence in 1973, with the target of achieving independence of fuel imports by 1980, has recently revised it to 1985 - a slippage of five years in less than two. South Africa's own nuclear plans have slipped back a year or two.

Let us turn now to my second issue, finding and winning more uranium. Finding and winning uranium, the mining companies stress, is an inordinately long-lead-time business - "at least 10 years, more probably 12 or 15, so that we need to be thinking now of the requirements for 1990 and beyond," as a Canadian mining chief has put it.

Uranium lies somewhere between copper, which is relatively easy to find, and oil, which is now very hard to locate. Its radioactivity is of limited help because of the much greater abundance of thorium, also radio-active and fissile - but unfortunately still only a pipedream as a reactor fuel.

It can occur in frustratingly elusive forms, such as the vertical plates only a metre or two in width but about 500 metres deep at Limoges in France. The relative solubility of urabium ore means that once-rich deposits may now be very widely dispersed through a region. The upshot is that the search for uranium has to be highly systematic, and that means expensive.

Let me quote the view of an RTZ director. "Ideally, a mine should be in an environment which is sophisticated, free enterprise in outlook, politically and fiscally stable with a sound local currency and the minimum of local restrictions," Mr A E Buxton told bankers at a conference on nuclear finance that I attended in Copenhagen last April. But ideal conditions, he admitted ruefully, were becoming increasingly rare. It remains to be seen how far co-operative efforts and joint ventures can reduce the costs and the risks of the first 10-15 years of a new uranium project, and so help to convince bankers and others that uranium mining could still be a rewarding investment.

Miners reckons that the cost of open-cast mining of any ore nowadays works out at $10 to $15 per tonne - that is, more than yellow-cake was fetching in world markets until last year. The capital cost has doubled in two or three years. Moreover, uranium mining is undisputably a high risk [illegible] during the exploratory phase. The total expenditure on a new mine is unlikely to be less than $200m.

On the other hand, there is only a small spot market at present for uranium. A nuclear power station is totally dependent on its uranium supplies, so the electrical utility and the mining company have a mutual interest in the security of supply and demand, which in turn affords guarantees that tend to facilitate financing. On balance, the financing of a uranium mine probably works out neither better nor worse than any other ore, except for the restrictions some producer nations have begun to put on uranium exploitation.

So we have come to a third issue which concerns us all - and not least the producers - namely government policies. Both Australia and Canada as uranium-producing nations, have clearly spelled out their intention of keeping a much tighter rein on uranium resources than in the past. Of paramount interest to them - and to South Africans too - are the attractions of the three-fold increase in product value if they could convert yellowcake into nuclear fuel. Mr Rex Connor, the Australian Minister for Materials and Energy, has gone so far as to say that his government, as a matter of policy - and here I quote - "does not wish to see foreign participation in new uranium exploration in the future."

What the mining companies fear is that some of the government restrictions may impede speedy exploitation of new resources. They are apprehensive, for example, of the Canadian requirement that its own industry shall have a two-thirds majority in ownership of Canadian mines. They say frankly that few Canadian companies are strong enough to win the confidence of the bankers, while those that might be already have substantial foreign shareholdings. The Canadians themselves, of course, reject such a view. When I tried it on a senior government official from Ottawa, in London last week, he pointed out bluntly that the very fact that Canada's uranium was needed would guarantee that investment would be forthcoming, whatever constraints were put on foreign investors. Only last weekened it was disclosed that an international consortium which included the CEGB in Britain, and Swiss and Spanish as well as Canadian organisations, were planning to mount the biggest-ever search for uranium in Canada.

Fourth but by no means least of the issues I see facing the uranium industry are those arising from a growing body of opposition to nuclear energy in all its manifestations, and a concommitant concern by government regulatory agencies for tight controls. A burgeoning uranium exploitation programme can scarcely expect to escape the attentions of the critics. Targets

for attack are likely to include both mineworkers - where extravagant protective measures could add a heavy premium to the cost of extraction - and those living in the vicinity of new mines, whose amenities may be affected and whose fears may be fed by the critics. A UK nuclear fuel executive observed wryly to me recently that if the nuclear regulatory process continues on its present course, it will soon be illegal to live in Aberdeen, Scotland, because of its natural level of background radio-activity. Just think how much more scope for arousing fear there must be in those living and working near commercially useful uranium deposits.

Just in case anyone listening to me today should share some of these fears, I have tried to think of some grain of reassurance that I might offer. So I have brought along what must be the smallest nuclear engine developed so far. It is a heart pacemaker powered with a nuclear battery. The fuel in the battery is plutonium - enough to keep such a pacemaker running inside you for about 25 years. This one has been developed by Harwell, one of Britain's nuclear research centres, and about 70 people in the UK are being kept alive with its help today.

It seems to me sensible and necessary for the industry - perhaps through its new institute - to take a hard look at these four issues. That would reflect a realisation on the part of the uranium producers that, in an industry with such long lead times, a positive effort needs to be made to anticipate the future, and by such action to try to avoid the huge fluctuations, the damaging cyclicity which so often characterises a market economy. I am encouraged by what the "think-tank's chairman, Mr John Kostuik, chairman of Denison Mines in Canada, said in relation to the industry's customers at the Institute's inaugural meeting last June. He said he would be "getting in touch with a number of major organisations around the world, to discuss the form in which the two sides of the industry can most effectively collaborate in a study programme". This is a most important point on which I should very much like to spend a few minutes before ending my talk.

Both sides of the industry need assurance about the future trading position. The mutual interests of the two sides are clear and unambiguous. I know this from my own discussions with the electrical utilities, who have to face huge investments in nuclear plant - and over 90% of nuclear power programme goes into the power stations leaving less than 10% required to produce and dispose of the fuel - without at the moment the utilities having any real assurance that the fuel they will need will be forthcoming.

But I also see great difficulties. The estimates now being bandied around the nuclear conferences of the world speak (as I have already mentioned) of a seven-fold or ten-fold increase in the level of world uranium production before fast reactors stabilise the demand. That is a huge expansion. I do not say that it is impossible - in any case, being nearer to the scene, you will have more up-to-date views than I. But what I am inclined to assert is that such a major step cannot possibly be achieved smoothly, if all that can be relied on is the normal market mechanisms of information exchange coupled with producer competition. Ideally, some sort of collective planning for the medium and long-term is needed. But planning runs dead against the very strong legal constraints of highly important countries such as the USA - unless of course it is the governments which are doing the planning. The freedom of action of private industry to organise itself collectively is severely limited. I understand that even the phrase "orderly development" is anathema to the United States' courts. And in any international trade one does not take American law lightly.

Let us leave that point for a moment, for there is another equally difficult problem. The long lead times, 10 to 15 years, of the mining industry mean that uranium producers have got to be interested in what is going to happen - not just next year - but in 1985-90 (and thereafter). But no one knows! Or at least, no one knows to the accuracy that producers would wish.

For instance, as I mentioned earlier, the Japanese have just downgraded their plans from 60 000 MW by 1985 to 49 000; and there is every sign that the figure will come down further, not for lack of technical ability or industrial capacity but because of public objections to nuclear sites, which are now being admitted by their industry. Again, a British energy minister at the recent Nuclex meeting in Switzerland could do no better before the Press than to offer the very wide bracket of between 20 000 MW and 45 000 MW as his government's estimate of Britain's installed nuclear capacity by 1990. Questioned about this, he said there were two factors to take into account: the difficulty of forecasting the success of energy conservation policies, and the size of the errors in past energy forecasts, which had led every country to be less dogmatic nowadays.

What can the producers, faced with such huge uncertainties, try to do? No one can plan sensibly on this kind of information. What is more, I believe that many of the uncertainties are bound to be with us for a long time to come. Nuclear energy, for all the care that has been lavished upon it, is still in a very embryonic state. To use the analogy of the aircraft industry, it has achieved the "jumbo-jet era" in half the time it took aircraft scientists and engineers, with a far better record of safety, but only by postponing some very profound commercial and sociological questions.

Let me be frank - there will certainly be scares, and possibly accidents. There will also be new reactor systems, and bursts of enthusiasm for investment. There will be changes in the price structure of competing energy sources.

All this will push the pattern of nuclear investment around in ways which no one can possibly predict at the present time. We are speaking, as I am sure you are well aware, about a major field of political activity. It will probably be several decades before the situation stabilises.

The uranium producers obviously know that they are on to a very good thing. The market has swung sharply in their favour, as a result of the events in the Middle East in 1973. That might lead them to rejoice in their good fortune, and leave well alone. It would be a mistake, I believe. But in any case the consumers - the nuclear fuel ccmpanies and the electrical utilities - might welcome a more assertive approach from the producers, which goes out to meet the problem of matching supply and demand head-on.

This leads me to suggest that if the producers are serious about using their new "think-tank" they should set it to work on the problem. I cannot think of a body better placed - in principle that is - to make an authoritative appraisal of the issues involved. Especially since it is beginning to embrace both sides of the market, the consumer as well as the producer. It could come up with a report, from the industry's viewpoint, which governments - and investors too - might well find most valuable guidance.

Now I realise that it would be going against all legal trends for an industry itself to try to administer an international uranium stockpile. Or indeed for an industry in any other way to operate a regulatory mechanism. That is not what I have in mind. Control of this kind can only possibly be exercised by governments as is already the case with tin. In London, we also have the Tin Council, which has had great influence, through its buffer stockpile, in helping the market through times which otherwise would have been turbulent.

What I believe the uranium industry should be doing is looking into the future, appraising the difficulties, and suggesting mechanisms which need to be created in the common interest. There would be one very significant difference from the Tin Council, which exists to serve the interests of a handful of nations whose economics are heavily dependent on tin. The difference is that the uranium industry could be performing a

service no less vital to its customers than to its producers, if it could come up with an authoritative report forecasting the kind of fluctuations and perturbations that the market will surely experience, and must anticipate; and suggesting mechanisms that might help to damp them down. A central feature of those mechanisms could well be an international buffer stockpile of uranium, jointly administered - as in the case of tin - by the governments of both the producing and the consuming countries.

The nuclear power industry claims to be the only industry which has been regulated - from a safety standpoint - since Day One. As a result, its safety record is unsurpassed. Now it has the opportunity of being the first commodity market for a mineral to avoid from the outset what Dr Henry Kissinger, in a major speech to the United Nations last month (although read for him in fact by the US permanent representative Daniel Moynihan) described as a market "especially sensitive to the pendulum of boom and bust in the industrial countries...a cycle of scarcity and glut, of under-investment and over-capacity."