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NUCLEAR POWER AND THE ANTI-URANIUM MOVEMENT:

A modern social problem

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DEPARTMENT OF NUCLEAR PHYSICS

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STATING THE PROBLEM

The generation of electricity with nuclear power reactors is the cheapest, safest and cleanest means of power generation yet devised by man. It has been demonstrated to cause no more off-site nuclear radiation problems, and far less environmental damage, than the coal-fired electricity generating industry. In addition, the extraction of uranium from low-grade ores and its use in fast breeder power reactors, already successfully demonstrated, makes available an energy source greater in size than all of the world's remaining primary energy sources put together¹.

Nuclear technology has been proved to be capable of solving the so-called "energy crisis" alleged to be facing mankind.

With such a favourable situation it is reasonable to ask why, in the Western world, has a campaign been waged against uranium and the nuclear power industry? A well coordinated, international campaign has been pursued through the press, radio and television, and has been highlighted by marches, demonstrations, picketing, riots and all the modern-day avenues open to protesters. In some countries there have been pitched battles between anti-uranium protesters and the forces of law and order; injuries have been common and some deaths have occurred during such operations. Indeed the ludicrous position has been reached where the deaths, injuries and damage caused directly by sections of the anti-uranium movement now far exceed the possible deaths, injuries and accidental damage which could be caused by the nuclear power stations already operating and those coming into service in the world between now and the year 2000!

What is it that motivates widely divergent groups of people to oppose the development of nuclear power? These range from anxious persons with

vague fears that nuclear power has something to do with the atomic bomb and therefore could be dangerous, to strident and malevolent people (often politically motivated) who have demonstrated a willingness to injure and even kill those who get in their way during their often violent demonstrations.

There is no simple answer to such a question - rather there are many factors, each of which may carry weight with some persons. In this paper the complexity of the current social problem will be reviewed before inferences are drawn.

Background to the problem

Development and application of nuclear energy technology took place following World War II at a time when, more than ever before, environmental considerations had been brought to public consciousness and pursued vigorously by groups such as Friends of the Earth, the Conservation Society and certain professional organisations such as that headed by Ralph Nader in the USA.

Because of this, in many countries, nuclear power stations have become targets for attack leading to their becoming the only type of electric power plant for which detailed safety and environmental evaluations are required by Government Agencies. It is usual for such evaluations² to be open to direct public participation and they have been used frequently by the anti-nuclear lobby as platforms to launch attacks against the industry which reach the wider public through the media.

Such activities have led to what is often described as a public "debate" over nuclear power, an activity which, in large measure, was started and spread from the USA throughout the Western World. It is interesting to note that no such "debate" or discussion has evolved in the USSR or the nations of the Communist bloc. There, nuclear power has gone ahead as a crash programme to solve the energy crisis without any demonstrations or

protests. These have been confined to the Western democracies and Japan, a fact which appears all the stranger alongside the reality that the most militant operations which have been conducted there have been led, predominantly, by people of the left wing political views.

Probably no technological development in the history of mankind has been the subject of so many detailed studies, so many public inquiries, so much open discussion in the media, on public platforms, at conferences and all of it with broad public participation.

When the opposition first became manifest in the public area it was natural for those Governments who had already taken the decision to embark on nuclear power programmes on the best available technical and economic advice, and those charged with the technical responsibility for putting these decisions into practical form in the shape of nuclear generating stations, to believe that the problem was one of public relations - a need to replace fear based on ignorance with knowledge and understanding. It was thought that, by making all the facts available to the public concerning the new industry and the new technology, the soundness of the decisions to develop nuclear power stations would become obvious.

A forthright and wide-ranging programme was therefore instituted based on the scientific position and on the global energy situation, both authenticated by world experts in the relevant disciplines. Such programmes began some 12 years ago in the USA, 8 years ago in Europe and Japan and 5 years or so ago in Australia, and are still continuing.

They have been, at one and the same time, both effective and ineffective.

Thus in the USA, during the 1976 Presidential Election, referendums were held in a number of states covering some 25% of the total population, and the voters opted for nuclear power by a two-to-one majority. And this was in a nation which has experience of nuclear power systems - indeed

today the USA has some 70 nuclear power plants in operation, 75 in building and a further 60 on order. The result is very similar in the UK although there, the people with experience who work in or live near to nuclear power stations, and therefore have most knowledge and experience of them, turn out to be the strongest supporters of the new technology. The British Trades Union Council (TUC) at its 1977 general meeting passed a resolution urging the British Government to go ahead with the construction of more nuclear power stations and to start on the construction of the first full-scale power breeder generating station. Trade unions in the USA, also, have expressed themselves strongly in favour of nuclear power, whilst in West Germany trade union groups have organised counter demonstrations and marches in favour of nuclear power. Australian trade unions are therefore very much out of step with their brothers overseas in their attitudes to uranium mining and export and the development of the nuclear industry in other nations.

In Australia, where the "debate" is of much more recent vintage but where there are no nuclear power stations and therefore no direct experience, the result also is favourable. By a clear majority the opinion polls show the public to be in favour of uranium mining, exporting uranium, and in due course, to the building of nuclear power stations.

All this is very gratifying to the Governments concerned and to the nuclear power industry; but it hasn't silenced the anti-nuclear lobby, stopped marches and demonstrations, or even the physical clashes of militants with police at the sites of new nuclear power stations. Some sections of the anti-nuclear movement have made it plain that no amount of additional information or statistical data will alter their attitudes. Such groups often close their eyes and minds to the facts, however convincingly these are presented. It is much easier for opponents of nuclear power to play on emotions employing forceful rhetoric even when the

statements they make are incorrect - "unsafe, uneconomic, unreliable, unnecessary" and the like. To rebut such ill-informed and unsubstantiated criticisms requires a lengthy presentation of facts, not easy to understand and assimilate.

The problem of answering such critics is like having the first rebuttal to the cry of "fire" in a crowded restaurant or theatre - nobody wants to take the time to listen. But for those members of the public who are prepared to invest a modest effort, there is little difficulty in understanding the ramifications of the problem.

There can be no doubt that the demands of the anti-uranium lobbies for inquiries, additional information, environmental statements, tightened licensing arrangements, and so on, have led to a slowing-up of nuclear power station development. This slow-down has also been helped by a concurrent down-turn in the world economy which has meant that current demands for electrical power are considerably below the projections made some 5 years ago. There has been a cut back on earlier projections for coal-fired, and oil-fired as well as nuclear power stations. This situation has real dangers because it gives the public the impression that, despite all the talk, there is an energy surplus and no real energy crisis. This may well lead to a failure to take the essential steps now to guarantee the supply of energy the public will be demanding from the mid 1980's onwards.

A simplistic interpretation of this situation might be as follows:- First, there are still people without sufficient understanding of the issues, and the real facts, to make the logical choice in favour of nuclear power. They therefore play safe and opt against the development. Dissemination of information about the nuclear programme must therefore be continued in an attempt to reach this minority. Second, in spite of the provision of detailed information and the favourable results of inquiries and investigations, there are people who remain unconvinced and

who wish to deny or argue about the evidence. Some of these are genuine and therefore still open to logical argument; some are not and have no intention of being convinced by any evidence. In this latter case there are ulterior motives opposing nuclear energy and it becomes important, as far as possible, to understand these.

II

THE OPPOSING VIEWS

Uranium is found throughout the environment - it is everywhere in varying concentrations. It occurs in all sea water, in some ground waters (which are often human water supplies), in rocks, and other environmental matter. The very materials of dwellings where we live contain it (and other radioactive materials) so that man, since Adam and Eve, has always lived in a radiation field.

Until the last war very little use had been found for uranium - only for the colouring of glass mainly in Czechoslovakia. A second radioactive material found in nature - thorium (which also, in due course, will be employed as a nuclear fuel) - became very important in the Victorian era for the production of gas mantles which were the basis of the gas lighting which preceded the use of electricity.

During World War II Britain, Canada and the USA used uranium to develop the first nuclear weapons and, as is well known, these were used against Japan to finish the war. After the war scientists turned their attention to using the discovery of the vast energy release from the fission of uranium, and a man-made material plutonium, for the generation of electrical energy for peaceful civilian uses. These non-military developments were enormously successful and are the basis of the world-wide nuclear power industry as it exists today.

So uranium, like many other things in our experience, can be used for wreaking destruction in war or for the good of man by yielding cheap energy for homes and industries, and radioactive materials for medical diagnosis and treatment, as well as for agricultural and industrial use. In this sense it is no different from oil or coal whose energy can be used for chemical explosions and the manufacture of weapons of mass destruction - chemical and biological poisons - as well as for

the central heating and cooling of homes. Indeed all the wars of history, and especially the devastating wars of this century, have been based on energy sources such as coal and oil. But we still employ these commodities without qualm or feelings of guilt.

Why then does the anti-uranium movement see this new power source as so different? Their first argument is that because of the radioactivity and the high energy concentration of the source it cannot be controlled by man; they claim that the chances of human error or calculated misuse are so great that a catastrophic event is bound to happen. The only way to avoid this, in their view, is to refuse to mine or use uranium; they are protecting mankind from its own certain follies.

Anyone disagreeing with these views is classed as "pro-uranium" and that label therefore falls on the majority of the world's scientists and engineers as well as the Governments who have taken decisions to install nuclear power stations. This section of the community rebuts the anti-uranium argument by pointing out that it has already been demonstrated that man can control the new technology throughout the spectrum of operations including all by-products and the so-called "wastes". The 3000 or so reactor-years of safe power reactor operation achieved since the first nuclear station opened in 1956 at Calder Hall in England testifies to this - the safety record is, in fact, better than that of any other comparable industry. Although agreeing that accidents can and do happen in any activity - motoring, sport, mining or other occupations - the proponents produce analyses which show the chances of error, or even misuse, in the nuclear field are small and that even if such an untoward event occurred, because of the inbuilt safety precautions and the safeguards, the possibility of a catastrophic outcome is exceedingly small. On this view it would be indefensible for a nation possessing uranium, bearing in mind the demonstrated economic, environmental and social benefits of nuclear power, to refuse to make it available. Further, the proponents

say, to exercise such a resources strategy to deny other nations access to an essential power source would cause serious economic repercussions and international tensions.

The second argument of the anti-uranium lobby is that a centralised nuclear society such as is now developing spells doom for the race. They believe nuclear war would be inevitable even though the vain effort to avoid it would entail regimenting Society so severely as to make life unbearable. The pro-uranium group reject this view totally. They point out that natural resources, be they water, iron ore, arsenic or uranium, taken individually are neither good nor bad. It is the use by man himself of these materials which can be good or bad. The controlled use of arsenic in agricultural sprays is beneficial to man's needs but its use for murder is forbidden by man's laws. The future of all human endeavours, including the proper development of the nuclear energy source will be controlled by the political will of man based on the fullest possible data input. It should never be determined by emotive slogans based on ignorance and the fears which can be engendered from these. Further, the proponents point out 34 nations of the world already have nuclear power systems and six have nuclear weapon production facilities. But no restrictions on Society ("police state") have resulted or are even contemplated.

These two, main, anti-uranium views have been expressed widely in all countries of the Western World in a variety of forms. In Australia a third general argument is used which stems from the fact that the biggest uranium province lies in the Northern Territory and therefore involves a significant Aboriginal population. It is contended that mining developments, even though safe, will bring the evils of modernity and industrialisation to the Territory and lead to the destruction of the Aboriginal way of life. Proponents of uranium mining in Australia would say that the development can be controlled and orderly as recommended by the Fox Inquiry and indeed, can open up much-needed opportunities for employment among the

Aboriginal population. In fact the Government has legislated to protect Aboriginal sites, to preserve the general environment, and further the rights of the Aborigines as well as insisting on fair royalty payments to the groups concerned.

But, in any case, the argument cannot be one-sided. The rights of the Aborigines should most certainly be respected and protected. But so should those of all other Australians who will share in the benefits to the nation of uranium mining - increased employment in the Northern Territory, opening up of the Northern Territory, the demands for goods and services by those employed in the new industry and the obvious benefits that will arise to the Nation through earning large sums in foreign exchange.

It is instructive to consider the people and personalities comprising the "opponents" and "proponents" of nuclear power. Opponents, on the world scene, include some eminent scientists but these, in general, are in disciplines not associated with the technology they oppose. They also include organisations like Friends of the Earth, the Conservation Society and many Church groups as well as professionals like Ralph Nader. Many young people, under 30 years of age, are committed to the "cause". They often have University training, are intelligent, sincere, idealistic and articulate. Political activists trying to force personal views of human betterment on their fellow men also find an outlet within the anti-uranium movement.

These people contrast notably with the proponents of nuclear power who can count on their side most of the pre-eminent nuclear scientists and engineers in the world, together with the majority of others in allied fields. The group also contains the large majority of political leaders of all colours as is indicated by the fact that 44 nations including all the leading nations of the West, many from behind the Iron Curtain and some from within the Third World have opted for the new power source. The proponents, generally, are older than the opponents, are established

in their fields of endeavour and are quantitative and practical in their discussion of the problems. They, of course, include the professionals working in the nuclear industry itself both in national research centres and in the enterprises building and selling nuclear systems. There can be no question that the overwhelming weight of technical authority resides with the pro-nuclear power group hence the emotive parrot-cry of the opponents "don't trust the experts". The pro-assessment is, in fact, reinforced by the plethora of independent inquiries held around the world in the USA, Canada, UK and Australia all of which agree that properly controlled uranium mining is as safe or safer than other forms of mining, and that nuclear power operations as we know them today are safer than equivalent coal-fired power operations. Such inquiries all conclude that nuclear power will be an essential contributor to the energy mix at least for the next few decades and for very much longer unless some as yet unproved large energy source should become available in the future. These realities are ignored by the anti-groups who instead, select from such reports comments on the need for caution in choosing safe disposal methods, the protection of highly fissile material in transit and the need for political controls against too rapid proliferation of nuclear weaponry or terrorist attacks and generate emotional propaganda based on these.

All of this tends to confuse the third group - the vast majority of the population who, generally, are just onlookers of the scene. Certain sections within this group are genuinely interested and concerned but feel that they lack sufficient knowledge about the issues for them to make a firm commitment one way or the other. They are influenced by doubts cast by the opposition that the scientific community does not have the answers to all outstanding questions - again "don't trust the experts". Some of the more sincere organisations - notably Church groups fall into this category. They make a genuine plea for more time to study the issues

and the proposed solutions to outstanding problems. They are therefore prone to suggestions that a moratorium on uranium mining and/or nuclear power development would be a good solution. Such persons, living in Australian affluence, find it difficult to equate nuclear energy with the very survival of human beings in a Canadian or Russian winter or with the collapse of the Japanese economy and the devastating unemployment which would eventuate unless Japan has access to plentiful energy supplies to turn the wheels of its industry. And they do not fully appreciate that the "leadtime" to build large power stations is 10 years upwards and the energy gap will appear all around the world on a time scale of 10-20 years. There simply is no time for moratoriums if we are to avoid the looming crisis. This idea of a moratorium was strongly supported by the anti-uranium activists but not for the same reasons. They felt that a moratorium would provide more time for them to convert the uncommitted to their way of thinking.

The lack of knowledge among the general public about energy questions in general and the nuclear option in particular is a cause for concern. Coupled with the inherent suspicion with which new developments have always been greeted, and the carefully cultivated suggestion that the new technology will be controlled by an elite cadre of persons, fears and anxieties are aroused. The suggestions that nuclear energy and nuclear bombs are inevitably associated, and that radioactivity is bound to cause a great increase of cancers and genetic damage exacerbates the situation. Although it is easy to show that such fears are without foundation, and are illogical, it is difficult to get this message across in the face of continuous propaganda to the contrary.

Acceptance of nuclear power will increase slowly as more and more nuclear stations come into operation with great advantages to the environments and economies of the nations concerned. The threats of disaster and catastrophe will look hollow and hollow to the public as the years go by and they fail to occur.

III

THE "DEBATE" AND SOME INTERNATIONAL VIEWS

The "Public Debate" in Australia

Anyone who has participated in one of the many discussions or debates on nuclear power held in Australia, particularly before the 1977 Federal election, cannot have failed to notice

- (i) the small public attendance at such meetings, which may be interpreted as indicating public indifference
- (ii) the lack of involvement of members of the public in discussions at such meetings
- (iii) that the meetings, traditionally, have been arranged as a sort of gladiatorial confrontation between an expert (or two) on what is labelled "the pro-nuclear" side and a similar number on "the anti-nuclear" side. This has been very much the pattern of presentations on radio and television too
- (iv) that such discussion which does eventuate after the main speakers have had their say is usually initiated by supporters of one side or the other and not by the public. Usually interventions from supporters of the anti-nuclear side predominate as their policy, being a minority group, is to be present and argue their case at every opportunity.

Although any increase in public understanding is welcome it is difficult to see how the presentation of a pre-polarised argument between two supposed experts, often giving unsupported and diametrically opposed views do other than confuse even an intelligent audience. Mr. Justice Fox, the president of the Ranger Uranium Inquiry, which recommended public

debate before the Government initiated action is on record, some months later, expressing his disappointment at the amount and quality of the debate³.

Indeed, what has occurred so far (and this is true in the USA, Canada and the UK also) is not a debate involving the public at all. It has been an argument between scientists with a close knowledge and understanding of the new technologies (including, necessarily, an establishment group of experts) and minority groups, who are sometimes technically well informed although lacking first-hand experience. These latter groups oppose nuclear power, sometimes because it is their job, sometimes because they genuinely believe there are problems, and sometimes for wholly political reasons.

International Views on the Situation.

In the Soviet Union the "New Times" staff reporter Elena Knorre interviewed the Chairman of the USSR Atomic Energy Committee, Dr. Andranik Petrosyants⁴ on the overall problem. He gave a detailed description of the programme of nuclear power station development in the Soviet Union. It was pointed out that the 25th Congress of the CPSU had "laid emphasis on the accelerated development of the atomic power industry as an area of scientific and technological progress destined to play a signal role in the country's economic advance during the current five-year-plan as well as in the long term". Questioned about the "fears" expressed outside the Soviet Union by the anti-nuclear movement and the "the scare-mongering (is) setting people on edge". Knorre said

" ... I should like to draw your attention to the extraordinary coincidence in time of the peak of the anti-atom campaign and the energy crisis in the capitalist countries. One cannot help thinking that some of the most violent opponents of atomic electric power stations are consciously or unconsciously championing the interests of powerful monopolies, and above all, of the giant oil corporations."

Petrosyants replied

"In one of Conan Doyle's stories Sherlock Holmes advises Dr. Watson that the way to begin unravelling the mystery of a crime is to establish who gained by it. I will not undertake to judge of the motives underlying the campaign played up in the Western press, but I have not the slightest doubt that the march of progress cannot be halted. The future belongs to the progressive. The peaceful atom will serve man faithfully and reliably."

Dr. Jan M. Døderlein of the Institute for Atomenergi Norway⁵ considers the "debate" or controversy to be a natural outlet for many irrational needs of our present society. He says

"The emotional and ethical aspects of nuclear power are trumpeted particularly by two groups of critics having the common denominator of emotionalism. One group consists of people for whom nuclear power is a vehicle of self-realisation. They play out some of their inner and emotional needs by taking an active part in the nuclear controversy, and the factual nuclear issues seem to play a secondary role. The other emotional group of nuclear critics is composed of professional and amateur politicians, notably leftist groups, anarchists, some populists and some environmentalists. Nuclear questions, real or imagined, are a means by which they further their own political goals, sometimes clandestinely, sometimes openly. A very different group of critics, the opportunists and malcontents, is cynically achieving fame and prominence by going into the nuclear debate, writing in the newspapers, giving lectures, going on television and so on. Needless to say, similar people are also found in the so-called nuclear community.

"All three groups of nuclear critics share one characteristic: they seem to accept authoritarianism as a road to knowledge, often to the exclusion of other sources of knowledge. They rarely support their assertions

with reasoned arguments or with facts, and they consistently invoke the opinions of some distinguished scientists, some Nobel-prize winners, or some professional societies, ignoring others who disagree with their views. By confusing technical facts which can never be argued, the critics have in some countries succeeded in misleading sections of the public, causing them to believe that everything is open to argument and that the experts are confused in their own field of expertise. Outside their own field they are not experts.

"In the past two years we have seen a plethora of manifestos and statements for or against nuclear power by Nobel-prize winners, by groups of scientists and by various professional societies. In connection with the statements, the eminent or special qualifications of the participants are always emphasised. While possibly not without merit, such statements should be viewed very critically. Practically without exception the participants in the anti-nuclear manifestos have no technical background in fields relevant to nuclear technology. Against the participants in pro-nuclear manifestos, this criticism is less relevant.

"One criticism is valid against all manifestos on nuclear power. The scale and timing of the introduction of nuclear power is a major and complex decision, resting on technical, economical, political and other social considerations. In a democratic society such decisions are not left to technological experts but to elected political officials. A professional using his specialist background in support of personal views on social questions tries to carry his professional authority over into fields where he should no longer have such authority, into fields where his opinions should be weighted on the "one man, one vote" principle.

"Members of some professions believe they have more specialised knowledge, and that their political conclusions are based on sounder analysis of the evidence than the public. If one expects the public to have confidence in the role of professionals in decisions, the opinions of highly-

regarded experts within their chosen profession must be accorded a certain authority. But it is equally important not to support a carry-over of professional authority to political and ethical questions, a carry-over which may indicate a certain intellectual arrogance."

In the USA Professor Petr Beckmann of the University of Colorado, author of the book "Health Hazards of NOT Going Nuclear"⁶ sees the position much more starkly. He warns his readers to beware of environmentalists and persons arguing for new life-styles of lower energy content and especially those who suggest that scientists are "deeply split about nuclear power". This so-called "deep split" he points out, is between nuclear scientists and engineers on the one side and, on the other, persons from many "softer" sciences such as biology, sociology and medicine. These people may know a great deal about their own fields, but not necessarily much about nuclear matters.

"The division among scientists on nuclear power, then, is a peculiar one", he says. "To put it brutally, but fairly accurately, it is a division between those who know what they are talking about and those who don't".

In a recent book "Energy or Extinction" published in England⁷, Professor Sir Fred Hoyle makes a strong case for nuclear energy and considers that the motivation behind the anti-nuclear movement is connected with the Soviet union and the coming world struggle for energy. He says

"The economic system of the Soviet Union has many disadvantages. It is not technically very innovative. It does not produce consumer goods efficiently. But the Soviet system is not entirely besotted, as the Western democracies are, with the illusory importance of paper money. The crucial principle, that energy is more important than money, would be more easily seen in the Soviet Union, perhaps very easily seen, than it is here in the West. So I would expect the geographical distribution of

world energy reserves (of the kind that dominate our present day energy use) to be of great interest to a Russian."

He points to the reserves of coal in the world where Russian reserves dominate all others; to the fact that near to 70% of known world oil reserves are within close proximity to the USSR; to a situation where oil required by the West and Japan has to be transported over huge distance via tenuous and vulnerable shipping lanes. He draws obvious conclusions and he sees Russia as already dominating energy supplies with the exception of nuclear energy - "the fly in this otherwise smooth ointment". Nuclear energy is such a powerful technology that "it would not be outstandingly difficult for them (the West) to obtain access to all the energy they need". Full development of nuclear power would thus deny Russia the opportunity to completely dominate world energy reserves. Hoyle believes, therefore, that a lot of the anti-nuclear opposition is politically inspired, through people within Western nations who have leanings to the far-left.

An interesting viewpoint has been presented here in Australia by Professor H.W. Arndt in a paper⁸ on economic aspects of the uranium debate.

He comments

"Conscience radicalism is an honoured tradition in Western, and especially the English-speaking, democracies. To take up the cudgels against the Establishment of church or state, to protest in the name of conscience and humanity against some course of action that is recommended by experts and accepted by majority opinion is the right of every citizen. At worst, it adds an element of crusading excitement and virtue to otherwise humdrum lives. At best, it stops or prevents an avoidable wrong. British history is full of such protests, from great and successful movements such as that for the abolition of the slave trade to vain battles such as those for unilateral nuclear disarmament or against smallpox vaccination, vivisection and fluoridation. The unsuccessful ones failed

not because the campaigners were proved conclusively wrong but partly because the facts spoke increasingly against them and partly because the majority of adherents became doubtful or bored and fell away. But a small band of enthusiasts remained, and remains, unconvinced.

"The long campaign against fluoridation of the water supply is a good example. Scores of enquiries had been held, hundreds of reports written, expert testimony carefully sifted. The overwhelming evidence was that fluoridation greatly improved dental health without any adverse side effects. It all made no difference to the opponents. If they could find one dentist to take the opposite view, they dismissed all other professional opinion on the ground that "the experts disagree". In the 1950's an exasperated city engineer in a mid-Western city in the USA announced that the city's water supply would be fluoridated as from the first of March. All through March the letters of protest poured in: people's hair was falling out, pregnant women lost their babies, virgins became pregnant, fractures would not heal, bones became brittle, etc., etc. At the end of March the engineer announced that the water had never been fluoridated. In May fluoridation was carried out with overwhelming public support in that city. But anti-fluoridation fanatics elsewhere continued the good fight, unmoved, and do so still.

"The anti-fluoridation campaign is rather an extreme case, though an obsessional, almost paranoid, streak has characterised many such protest movements. But it illustrates two features which are common to most of them. One is that the questions at issue are seen as matters of conscience, involving value judgements which cannot be proved right or wrong. The other is that they often turn, in part, on highly technical matters which laymen find it hard to understand let alone assess, while the experts, as in all matters of applied science, can never be absolutely certain but have to base their opinions on the weight of evidence."

* * * * *

These few examples of views, taken over the international scene, are by no means exhaustive but are sufficient to illuminate the situation. The anti-nuclear position now openly advocates that standards of living should be changed. The West should make a transition from its present affluent, high consumption society to a low-energy one, with low-consumption objectives. Although this could well raise living standards in the case of the poorer nations of the world it would certainly lower them for most of the Western World. There would, therefore, be great opposition and, on the time scale facing us, such demands for self sacrifice, foresight and altruism make this option a non-starter. Especially is this so when it is being recognised increasingly that proved technology already exists which can provide all the energy man may need, so rendering such sacrifice and the accompanying social upheavals unnecessary.

It would seem a much better policy to accept the fact that we have already entered the nuclear energy era and continue to develop this technology to supply plentiful energy to enable standards of living all over the world to be raised and equalised among the nations.

This would make it possible to extend the lifetimes of fossil fuel reserves and allow their conservation for those purposes where substitutes are either difficult or impossible such as air transportation, farming land in remote country, or petrochemical source materials.

Further, and perhaps more importantly, such a policy would help the underdeveloped nations to retain access to fossil fuels and obtain value from them for far longer than would otherwise be the case.

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