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WORLD -- THE NUCLEAR DILEMMA (THREE PARTS)

1978 PART ONE: THE FISSION REVOLUTION

MUNICH, OCTOBER 12 (CND/IM) -- THAT FIRST RADIOACTIVE CLOUD WHICH SLOWLY MUSHROOMED ABOVE THE NEW MEXICO DESERT ON A JULY MORNING IN 1945 STILL CASTS ITS SHADOW OVER THE WHOLE QUESTION OF NUCLEAR ENERGY.

IT IS IMPOSSIBLE TO ERASE THE MEMORY THAT THE SPLITTING OF THE ATOM UNLEASHED THE GREATEST POWER OF DESTRUCTION EVER KNOWN. HIROSHIMA AND NAGASAKI REMAIN AWESOME MEMORIALS TO SCIENCE TURNED BY MAN AGAINST MAN.

YET, NUCLEAR FISSION IS NOT IN ITSELF INTRINSICALLY GOOD OR EVIL. WHEN AN ATOMIC NUCLEUS IS DIVIDED INTO TWO PARTS, WHAT IS RELEASED IS ENERGY. AND ENERGY CAN BE PUT TO POSITIVE AS WELL AS TO NEGATIVE USE.

"THEY SHALL BEAT THEIR SWORDS INTO PLOUGHSHARES AND THEIR SPEARS INTO PRUNING-FORKS," THE PROPHET ISAIAH FORECAST IN AN OPTIMISTIC MOMENT 2,600 YEARS AGO, AND IT WAS IN THIS SPIRIT THAT U.S. PRESIDENT DWIGHT EISENHOWER LAUNCHED HIS "ATOMS FOR PEACE" PROGRAM IN 1953. TAMED AND HARNESSSED, THE FORCES OF THE ATOM WOULD ERADICATE HUNGER, ABOLISH POVERTY AND PROMOTE UNIVERSAL PEACE. CONTROLLED NUCLEAR EXPLOSIONS WOULD BORE TUNNELS THROUGH MOUNTAINS AND CARVE CANALS ACROSS CONTINENTS. A CLEAN AND LIMITLESS SOURCE OF ELECTRIC POWER WOULD BE AVAILABLE TO ALL. THE MILLENIUM SEEMED AT HAND. NOW, A QUARTER-CENTURY AND FIVE AMERICAN PRESIDENTS LATER, THE VISION LOOKS LESS EUPHORIC.

IT WAS NOT, IN FACT, IN THE UNITED STATES BUT IN THE SOVIET UNION THAT THE WORLD'S FIRST NUCLEAR POWER PLANT WENT INTO OPERATION A YEAR LATER. EQUIPPED WITH A GRAPHITE REACTOR, THIS EXPERIMENTAL PLANT HAD AN OUTPUT OF ONLY 5,000 KILOWATTS. BRITAIN BECAME THE FIRST COUNTRY TO FEED NUCLEAR POWER INTO ITS ELECTRIC GRID WHEN THE CALDER HALL REACTOR, WITH A CAPACITY OF 150 MEGAWATTS, WAS OPENED IN OCTOBER 1956.

TODAY, THROUGHOUT THE WORLD, THERE ARE WELL OVER 200 REACTORS WHICH, TAKEN TOGETHER, HAVE AN ESTIMATED CAPACITY IN THE REGION OF 100,000 MEGAWATTS. ONE MEGAWATT IS EQUAL TO ONE MILLION WATTS OR 1,000 KILOWATTS.

THE MILLENIUM, HOWEVER, IS STILL FAR OFF. NUCLEAR PLANTS ACCOUNT FOR CONSIDERABLY LESS THAN ONE-TENTH OF ALL THE ELECTRIC POWER GENERATED IN THE WORLD. ONE OUT OF EVERY THREE REACTORS IS TO BE FOUND IN THE U.S. BUT THE COUNTRY MOST DEPENDENT ON NUCLEAR STATIONS FOR ITS ELECTRIC SUPPLIES IS SWEDEN, WHERE THE GOVERNMENT FELL APART LAST WEEK OVER THE QUESTION OF PUTTING A NEW REACTOR INTO OPERATION. THERE, ATOMIC FISSION PROVIDES NEARLY 15 PER CENT OF POWER CONSUMED.

THE WORLD STILL DEPENDS PRIMARILY ON FOSSIL FUELS -- OIL, COAL AND NATURAL GAS -- TO MEET ITS ENERGY NEEDS.

THESE NEEDS ARE GROWING RAPIDLY. LAST YEAR'S 10TH WORLD ENERGY CONFERENCE, HELD IN TURKEY, ESTIMATED THAT BY THE YEAR 2020 THE TOTAL CONSUMPTION OF ENERGY MAY INCREASE BETWEEN THREE AND FOUR TIMES. THIS IS NOT ONLY BECAUSE THE INDUSTRIALISED COUNTRIES OF EAST AND WEST ARE BENT ON CONTINUED ECONOMIC EXPANSION BUT ALSO BECAUSE THE THIRD WORLD WILL TRY TO REDUCE THE GAP BETWEEN IT AND THE INDUSTRIALIZED WORLD. AT PRESENT THE DEVELOPING COUNTRIES, WITH HALF THE WORLD'S FOUR BILLION POPULATION, CONSUME ONLY 15 PER CENT OF WORLD ENERGY. IN 40 YEARS TIME, IT IS CALCULATED, TWO-THIRDS OF WHAT WILL PROBABLY BY THEN BY THE SIX BILLION INHABITANTS OF THE EARTH WILL LIVE IN THESE COUNTRIES AND WILL USE AT LEAST ONE-QUARTER OF ALL THE ENERGY PRODUCED. (PTO) BG

WORLD -- (1) THE NUCLEAR DILEMMA

FOSSIL FUELS ARE FINITE AND, IF PRESENT ESTIMATES ABOUT THE RESERVES OF COAL AND OIL ARE EVEN APPROXIMATELY ACCURATE, MOST OF THEM WILL BE NEAR EXHAUSTION IN ANOTHER 40 YEARS. THAT IS WHY, IN EAST AS WELL AS WEST, GOVERNMENTS HAVE BEEN LOOKING INCREASINGLY AT NUCLEAR ENERGY AS THE LONG-TERM ANSWER TO THEIR PROBLEMS.

WHAT KIND OF NUCLEAR ENERGY? A NUMBER OF TYPES OF NUCLEAR REACTOR ARE IN OPERATION BUT, WITH VERY FEW EXCEPTIONS, THEY HAVE ONE THING IN COMMON: THEY USE URANIUM.

URANIUM IS THE HEAVIEST OF THE 92 NATURAL ELEMENTS KNOWN TO SCIENCE. IT EXISTS ALMOST EVERYWHERE IN THE WORLD -- IN SEA WATER, FOR EXAMPLE -- BUT MAINLY IN SUCH DISPERSED QUANTITIES THAT IT IS NEITHER TECHNICALLY NOR ECONOMICALLY FEASIBLE TO RECOVER IT.

AS IT IS MINED, URANIUM IS NOT SUITABLE FOR REACTORS BECAUSE IT NORMALLY HAS A CONCENTRATION OF ONLY ABOUT 0.7 PER CENT OF THE VITAL ISOTOPE U-235. TO PRODUCE A CHAIN REACTION, IT HAS TO BE "ENRICHED" TO ABOUT THREE PER CENT U-235. THIS CAN BE DONE IN SEVERAL WAYS, ALL OF WHICH ARE EXTREMELY EXPENSIVE. FOR USE IN NUCLEAR WEAPONS, URANIUM HAS TO BE ENRICHED TO A CONCENTRATION OF MORE THAN 90 PER CENT.

ACCORDING TO THE ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT, THE KNOWN URANIUM RESERVES IN WORKABLE QUANTITIES IN THE NON-COMMUNIST WORLD AMOUNT TO A LITTLE OVER TWO MILLION TONS. THE OECD ESTIMATES THAT THERE ARE PROBABLY ADDITIONAL RESOURCES OF ABOUT THE SAME AMOUNT.

THE COUNTRIES WITH THE BIGGEST KNOWN QUANTITIES OF URANIUM -- OUTSIDE THE SOVIET UNION AND CHINA -- ARE THE U.S., SOUTH AFRICA, SWEDEN, AUSTRALIA, CANADA AND NIGER. THE EXTENT OF SOVIET AND CHINESE RESERVES IS NOT KNOWN.

THIS YEAR NUCLEAR POWER STATIONS WILL USE AROUND 29,000 TONS OF FRESHLY-MINED URANIUM. NEXT YEAR IT WILL BE SOME 35,000 TONS, BY 1985 PROBABLY 88,000 TONS. AT THE EXPECTED RATE OF NUCLEAR GROWTH, THE KNOWN RESERVES ARE ENOUGH TO KEEP THE WORLD'S REACTORS GOING FOR BETWEEN 20 AND 30 YEARS. THE LIMITATION OF SUPPLY HAS ALSO PUSHED THE MARKET PRICE OF URANIUM UP BY APPROXIMATELY 800 PER CENT IN THE PAST SIX YEARS.

BY THE TIME SUPPLIES OF FOSSIL FUELS ARE DRYING UP, URANIUM WILL ALSO BE RUNNING OUT AND, IF THAT WERE THE WHOLE STORY, THERE WOULD NOT BE MUCH INTEREST IN NUCLEAR ENERGY. BUT IT IS NOT THE WHOLE STORY. THERE IS THE RECYCLING PROCESS. ONCE ENRICHED URANIUM HAS BEEN CONSUMED IN THE REACTOR, NUCLEAR WASTE OR ASH IS LEFT OVER, CONSISTING OF MANY RADIOACTIVE AND TOXIC MATERIALS. SOME -- PRIMARILY URANIUM ITSELF AND PLUTONIUM -- CAN BE CHEMICALLY SEPARATED AND USED AGAIN AS FUEL IN THE REACTOR.

PLUTONIUM IS ALSO A HIGHLY RADIOACTIVE SUBSTANCE WHICH LENDS ITSELF TO THE FISSION PROCESS. UNLIKE URANIUM, IT IS NOT A NATURAL BUT A MAN-MADE ELEMENT AND IT NEEDS NO ENRICHMENT EITHER FOR PEACEFUL OR WARLIKE PURPOSES. THE BOMB WHICH LEVELLED HIROSHIMA USED URANIUM; THE BOMB WHICH DESTROYED NAGASAKI USED PLUTONIUM. IT IS, MORE THAN ANYTHING ELSE, THIS READY-TO-USE QUALITY WHICH PUTS PLUTONIUM AT THE CENTRE OF THE ENTIRE ARGUMENT ABOUT NUCLEAR ENERGY. BG/ *ll*

PART TWO: FIEND OR FRIEND?

PLUTONIUM IS THE ANSWER TO THE ALCHEMIST'S PRAYER: THE MORE IT IS CONSUMED, THE MORE IT REPRODUCES ITSELF.

TO EXPLOIT THIS APPARENTLY MAGIC PROPERTY, SCIENTISTS HAVE DEVISED A NEW TYPE OF REACTOR FOR PLUTONIUM. IT IS CALLED THE FAST BREEDER. IN OTHER REACTORS, THE NATURAL SPEED OF THE NEUTRONS USED TO BOMBARD AND SPLIT THE ATOM IS BRAKED BUT IN THE FAST BREEDER THEY ARE ALLOWED TO REACH THEIR FULL SPEED.

THE FAST BREEDER CAN BE FED WITH EITHER URANIUM OR PLUTONIUM, BUT ITS FINAL WASTE CONTAINS MORE PLUTONIUM THAN IT STARTED OUT WITH. IT THEREFORE PROVIDES ITS OWN FUEL SUPPLY -- WITH SOMETHING TO SPARE. THIS PHENOMENON SHOULD, IN THEORY AT LEAST, SOLVE THE PROBLEM OF LIMITED URANIUM RESERVES; IF THE WORLD WENT OVER TO A SYSTEM OF FAST BREEDERS, IT COULD PRODUCE ALL THE ELECTRIC POWER IT NEEDS FOREVER.

THIS, IN FACT, IS THE WAY SOME GOVERNMENTS LOOK AT IT. THE SOVIET UNION AND FRANCE, FOR EXAMPLE, HAVE EMBARKED ON AMBITIOUS PROGRAMS FOR THE DEVELOPMENT OF FAST BREEDER REACTORS. THE FIRST SOVIET FAST BREEDER WENT INTO OPERATION IN 1973 AT SHEVCHENKO ON THE CASPIAN SEA BUT IS STILL OPERATING AT ONLY 65 PER CENT OF CAPACITY; A SECOND IS UNDER CONSTRUCTION AT BELYOYARSK IN THE URALS AND IS EXPECTED TO BE COMPLETED NEXT YEAR -- SIX YEARS BEHIND SCHEDULE. BY 1980 THE SOVIET UNION HOPES TO BE PRODUCING ABOUT 720,000 KILOWATTS OF ELECTRIC POWER FROM THESE TWO FAST BREEDERS. FRANCE ALSO HAS ONE FAST BREEDER IN OPERATION AND PLANS MORE.

OTHER GOVERNMENTS ARE MORE SCEPTICAL OR HAVE BEEN FORCED BY PUBLIC OPINION TO HOLD BACK. THE FIRST U.S. EXPERIMENTAL FAST BREEDER WAS DESTROYED BY AN ACCIDENT IN 1955 AND THE SECOND WAS ABANDONED IN 1972 AFTER TECHNICAL PROBLEMS. LAST YEAR PRESIDENT CARTER CANCELLED THE WHOLE AMERICAN PROGRAM TO BUILD 128 FAST BREEDERS. BRITAIN HAS ONE SMALL FAST BREEDER IN ACTION BUT FUTURE POLICY IS STILL A MATTER OF ARGUMENT FOLLOWING A HOSTILE REPORT BY A ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION. WEST GERMANY, BELGIUM AND HOLLAND ARE BUILDING A FAST BREEDER AT KALKAR ON THE LOWER RHINE, BUT ITS COMPLETION IS A SUBJECT OF DISPUTE BETWEEN THE FEDERAL GOVERNMENT IN BONN AND THE STATE GOVERNMENT OF NORTH RHINE-WESTPHALIA.

WHY IS THERE SO MUCH RESISTANCE TO PLUTONIUM POWER?

ONE REASON IS COST. THE CURRENT ESTIMATE FOR A HIGH CAPACITY FAST BREEDER IS AROUND THREE BILLION DOLLARS -- THREE TIMES THE PRICE OF A CONVENTIONAL REACTOR WITH THE SAME OUTPUT.

THERE ARE, HOWEVER, MORE COMPELLING ARGUMENTS. ALTHOUGH PLUTONIUM IS NAMED AFTER THE PLANET PLUTO (WHICH LIES BEYOND URANUS) AND NOT AFTER THE GOD OF THE UNDERWORLD, SOME OF ITS OPPONENTS SEE THIS ELEMENT AS THE WORK OF THE DEVIL HIMSELF.

BIOLOGICALLY IT IS INFINITELY MORE DEADLY THAN URANIUM. THE INHALATION OF A TINY QUANTITY OF PLUTONIUM DUST MAY CAUSE DEATH WITHIN A FEW HOURS OR, AT BEST, KILL THE VICTIM SLOWLY THROUGH LEUKAEMIA. THIS WAS THE FATE OF MANY THOUSANDS OF THE INHABITANTS OF NAGASAKI.

WITH RIGID (BUT EXPENSIVE) SAFETY PRECAUTIONS, THE RISK OF ACCIDENT OR CONTAMINATION CAN BE REDUCED TO A MINIMUM AND ONE OF THE REMARKABLE ASPECTS OF NUCLEAR POWER PROGRAMS UP TO NOW IS THE VERY SMALL NUMBER OF FATAL ACCIDENTS. THE BRITISH ROYAL COMMISSION WARNED, HOWEVER, THAT, IF A REAL "BLOW-OUT" SHOULD OCCUR, THE RESULTS WOULD BE DISASTROUS. A WEST GERMAN COURT STOPPED ONE NUCLEAR PLANT PROJECT LAST YEAR ON THE SAME GROUNDS.

THE DANGER WHICH MOST CONCERNED BOTH THE ROYAL COMMISSION IN BRITAIN AND PRESIDENT CARTER IN THE U.S. IS OF A DIFFERENT NATURE. FOR WHAT THE PROPHET ISAIAH OVERLOOKED IS THE POSSIBILITY THAT PLOUGHSHARES CAN ALSO BE BEATEN INTO SWORDS. (PTO) BG/

THE PLUTONIUM PRODUCED BY A REACTOR IS THE SAME PLUTONIUM USED IN A NUCLEAR WARHEAD. IT NEEDS NO COMPLICATED TREATMENT IN ONE OF THE WORLD'S FEW ENRICHMENT PLANTS. SO A COUNTRY WITH A FAST BREEDER, CAN MANUFACTURE NUCLEAR WEAPONS WITH A MINIMUM OF DIFFICULTY.

THIS DANGER WAS BROUGHT HOME IN 1974 WHEN, WITH PLUTONIUM COLLECTED FROM THE WASTE OF A RESEARCH REACTOR SUPPLIED BY CANADA AND A HOME-MADE REPROCESSING PLANT, INDIA EXPLODED ITS FIRST NUCLEAR WEAPON. WITH IT WAS EXPLODED THE MYTH THAT THE PIONEERS IN NUCLEAR DEVELOPMENT COULD SAFELY RECOUP THE HIGH COST OF BUILDING FAST BREEDERS BY EXPORTING THEM TO OTHER COUNTRIES.

A CONCERNED CARTER ADMINISTRATION ABANDONED FAST BREEDERS, BANNED THE SALE OF REPROCESSING PLANTS AND PRESSURED ITS ALLIES, WITH ONLY PARTIAL SUCCESS, TO DO THE SAME. BUT DEVELOPING COUNTRIES WHICH WANTED TO BUY, LIKE PAKISTAN AND BRAZIL, DIDN'T SEE IT THIS WAY. THEY ARGUED THAT THEY NEEDED THIS TECHNOLOGY TO DEVELOP THEIR ECONOMIES AND HAD A RIGHT TO ACCESS TO IT. AND AMONG THE ALLIES, PARTICULARLY FRANCE AND WEST GERMANY, THERE WAS CONCERN ABOUT THE LOSS OF SALES AND SUSPICIONS VOICED THAT THE U.S. WAS ACTUALLY TRYING TO PRESERVE ITS OWN DOMINATION OF THE REPROCESSING MARKET.

THE BRITISH ROYAL COMMISSION ALSO DREW ATTENTION TO THE DANGER THAT TERRORISTS OR CRIMINALS (POSSIBLY HIRED BY SOME UNSCRUPULOUS FOREIGN POWER) COULD STEAL PLUTONIUM, ESPECIALLY DURING TRANSPORT. THIS NIGHTMARE WAS REINFORCED BY LAST YEAR'S DISCLOSURE THAT 200 TONS OF URANIUM MYSTERIOUSLY DISAPPEARED DURING SHIPMENT FROM WEST GERMANY TO ITALY IN THE EARLY 1960S AND PRESUMABLY FOUND ITS WAY TO ISRAEL.

A MORE CREDIBLE SCENARIO IS THAT TERRORISTS MIGHT TAKE OVER A NUCLEAR POWER STATION AND THREATEN TO BLOW IT UP, WITH ALL THE HORRENDOUS CONSEQUENCES INVOLVED, UNLESS THEIR DEMANDS WERE MET.

THESE AND OTHER FACTORS HAVE HELPED TO FAN A RISING WAVE OF POPULAR OPPOSITION IN THE WEST TO NUCLEAR ENERGY AS SUCH. THIS RESISTANCE HAS MADE ITSELF FELT IN MASS DEMONSTRATIONS -- SOME VIOLENT -- AGAINST NUCLEAR PROJECTS AND IN THE OCCUPATION OF SITES EARMARKED FOR NUCLEAR PLANTS TO PREVENT CONSTRUCTION TAKING PLACE. CITIZENS' GROUPS AND INDIVIDUALS HAVE GONE TO COURT AND OBTAINED INJUNCTIONS STOPPING WORK ON SOME PLANTS. ENVIRONMENTAL PARTIES HAVE PUT UP CANDIDATES IN ELECTIONS ON AN ANTI-NUCLEAR PLATFORM AND ACHIEVED ENOUGH SUCCESS TO ALARM THE BIG POLITICAL PARTIES.

ONE OF MOST PERSUASIVE ARGUMENTS OF THE OPPONENTS OF NUCLEAR POWER IS THAT THE PROBLEM OF DISPOSAL HAS NOT SO FAR BEEN SOLVED. THE AVERAGE NUCLEAR POWER STATION PRODUCES ABOUT 30 TONS OF RADIOACTIVE WASTE -- URANIUM, PLUTONIUM, STRONTIUM AND IODINE ISOTOPES -- EVERY YEAR. WHILE SOME OF THIS NUCLEAR GARBAGE CAN BE RECYCLED INTO NEW FUEL RODS, THE GREAT BULK OF IT HAS TO BE DUMPED IN A PLACE WHERE THERE IS NO RISK OF ITS LEAKING UNTIL IT GROWS HARMLESS; IN THE CASE OF PLUTONIUM, THAT MAY TAKE UP TO ONE MILLION YEARS.

MANY DEPOSIT IDEAS HAVE BEEN ADVANCED -- FROM DEEP FISSURES IN THE OCEAN BED THROUGH DISUSED SALT WORKINGS TO OUTER SPACE -- BUT NONE HAS YET PROVED SUFFICIENTLY FOOLPROOF TO CONVINCE PUBLIC OPINION. MUCH OF THE WASTE, IN FACT, IS AT PRESENT SEALED IN THICK METAL "DUSTBINS" AWAITING PERMANENT DISPOSAL.

IN THE COMMUNIST COUNTRIES THERE IS NO PUBLIC OUTLET FOR SUCH OBJECTIONS TO OFFICIAL POLICY, ALTHOUGH IT IS KNOWN THAT SOME INDIVIDUAL SCIENTISTS THERE HAVE EXPRESSED RESERVATIONS.

IN THE WEST, GOVERNMENTS IGNORE PUBLIC FEELING AT THEIR PERIL AND ONE OF THE SEQUELS TO THE POPULAR ANXIETY IS A SLOWDOWN IN THE SWITCHOVER TO NUCLEAR ENERGY ALMOST EVERYWHERE. WEST GERMANY HAS RESET ITS SIGHTS AT A TARGET OF 37,000 MEGAWATTS BY 1985 INSTEAD OF 45,000. FRANCE HAS CUT BACK FROM EIGHT NEW REACTORS A YEAR TO FIVE. AUSTRIA IS HOLDING A REFERENDUM NEXT MONTH TO DECIDE WHETHER ITS FIRST REACTOR, LONG READY FOR USE, SHOULD GO INTO OPERATION AT ALL. THE SOVIET UNION HAS ALSO LOWERED ITS SIGHTS AND BY 1990 ONLY ABOUT 20 PER CENT OF ITS ELECTRICITY WILL BE PRODUCED IN REACTORS. BG/

5

PART THREE: WHAT KIND OF FUTURE?

SOME EUROPEAN UNIVERSITIES HAVE ESTABLISHED CHAIRS IN FUTUROLOGY, BUT IT REMAINS THE MOST INEXACT OF SCIENCES AND CYNICS MAY BE HEARD COMPARING IT TO ASTROLOGY OR CRYSTAL BALL-GAZING.

FUTUROLOGISTS, WHOSE PROBLEM IS TO PROJECT TOMORROW'S TRENDS ON THE BASIS OF TODAY'S CRITERIA, ARE FOUND IN CONSIDERABLE NUMBERS IN THE JUNGLE OF INTERNATIONAL ORGANISATIONS DEALING WITH ENERGY IN GENERAL AND NUCLEAR ENERGY IN PARTICULAR. NOT ALL OF THEM CAN BE CONSIDERED WHOLLY DISINTERESTED AND THEIR FORECASTS HAVE THEREFORE TO BE EXAMINED CRITICALLY.

THE MOST IMPORTANT OF THESE BODIES IS THE INTERNATIONAL ATOMIC ENERGY AGENCY (KNOWN BY ITS INITIALS IAEA), AN INDEPENDENT, SPECIALISED UNITED NATIONS ORGANISATION ESTABLISHED IN 1957. ITS HEADQUARTERS ARE IN VIENNA AND IT NOW HAS 110 MEMBER STATES FROM ALL PARTS OF THE WORLD. ITS AVOWED AIMS ARE TO ENSURE THAT NUCLEAR ENERGY CONTRIBUTES TOWARDS WORLD PEACE, HEALTH AND PROSPERITY.

ANOTHER IS THE EUROPEAN ORGANISATION FOR NUCLEAR RESEARCH (KNOWN AS CERN), SET UP ON UNESCO INITIATIVE IN 1954 TO ENCOURAGE COLLABORATION IN RESEARCH INTO THE NON-MILITARY USE OF ATOMIC POWER. IT HAS 13 MEMBERS, ALL FROM THE WEST, BUT POLAND HAS OBSERVER STATUS.

THE EUROPEAN ATOMIC ENERGY COMMUNITY (BETTER KNOWN AS EURATOM) IS THE EEC'S NUCLEAR WING, DATING FROM 1958. ITS FUNCTION IS TO CREATE THE TECHNICAL AND INDUSTRIAL CONDITIONS FOR THE UTILISATION OF NUCLEAR DISCOVERIES AND TO PRODUCE NUCLEAR ENERGY FOR PEACEFUL PURPOSES ON A LARGE SCALE.

IN ADDITION THERE EXISTS, SINCE 1975, AN INFORMAL BUT IMPORTANT BODY CALLED THE LONDON NUCLEAR SUPPLIERS' GROUP (SOMETIMES KNOWN AS THE "CLUB OF LONDON"). IT BRINGS TOGETHER 15 ACTUAL OR POTENTIAL NUCLEAR-EXPORTING COUNTRIES, INCLUDING THE SOVIET UNION, CZECHOSLOVAKIA, POLAND AND EAST GERMANY AS WELL AS THE WESTERN NUCLEAR POWERS BUT NEITHER CHINA NOR INDIA. AMONG OTHER THINGS, THE CLUB HAS DRAWN UP GUIDELINES ON THE TRANSFER OF TECHNOLOGY DESIGNED TO CURB THE FURTHER SPREAD OF NUCLEAR WEAPONS.

WHEN THESE ORGANISATIONS LOOK INTO THE FUTURE, IT IS TO A FUTURE BASED INCREASINGLY ON A RAPIDLY-GROWING WORLDWIDE SUPPLY OF NUCLEAR POWER. IN THIS THEY ENJOY THE SUPPORT OF MANY PROMINENT SCIENTISTS. SIR FRED HOYLE, THE FAMOUS BRITISH ASTRONOMER, FOR INSTANCE, PUBLISHED A BOOK CALLED "ENERGY OR EXTINCTION?" LAST YEAR, IN WHICH HE ARGUED PASSIONATELY THAT NUCLEAR POWER WAS THE ONLY WAY OF PREVENTING MOST OF THE WORLD'S POPULATION DYING WHEN FOSSIL FUELS ARE EXHAUSTED.

ANOTHER PROTAGONIST OF MORE FISSION IS PROFESSOR ANDREI SAKHAROV, THE DISSIDENT SOVIET NUCLEAR PHYSICIST. IN AN ARTICLE WHICH APPEARED IN THE WESTERN PRESS LAST DECEMBER, HE WROTE: "AN ACCELERATED EXPANSION OF NUCLEAR ENERGY IS OBVIOUSLY VITALLY NECESSARY, FOR IT IS THE ONLY ECONOMIC SUBSTITUTE FOR MINERAL OIL IN THE COMING DECADES.....THE DEVELOPMENT OF NUCLEAR ENERGY IS ONE OF THE ESSENTIAL PRECONDITIONS FOR GUARANTEEING THE ECONOMIC AND POLITICAL INDEPENDENCE OF ANY COUNTRY, BOTH FOR A COUNTRY WHICH HAS REACHED A HIGH STAGE OF DEVELOPMENT AND ALSO FOR A DEVELOPING COUNTRY."

THE VIEWS OF HOYLE AND SAKHAROV ARE NOT UNIVERSALLY SHARED AND DISTINGUISHED SCIENTISTS, INCLUDING PHYSICISTS AS WELL AS ECOLOGISTS, ARE TO BE FOUND ON THE OTHER SIDE. AMONG THEM IS THE SWEDISH NOBEL PRIZE-WINNING PHYSICIST PROFESSOR HANNES ALFVEN, WHO CHALLENGES THE LINK BETWEEN ENERGY CONSUMPTION AND LIVING STANDARDS AND URGES THAT PRESENT ENERGY USE SHOULD BE REDUCED. (PTO) BG/

6

THE FUTUROLOGISTS, IN FACT, ARE NOW IN THE PROCESS OF REVISING THEIR EARLIER FORECASTS ABOUT ENERGY DEMAND. SINCE THE 1973 OIL CRISIS THE CONSUMPTION OF ENERGY HAS BEEN GROWING AT A MUCH SLOWER RATE THAN BEFORE.

THE INTERNATIONAL ENERGY AGENCY -- A SUBSIDIARY OF THE ORGANISATION FOR ECONOMIC COOPERATION AND DEVELOPMENT -- SAYS THAT IN ITS 19 MEMBER COUNTRIES ENERGY CONSUMPTION LAST YEAR REPRESENTED ONLY 1.41 PER CENT OF GROSS NATIONAL PRODUCT COMPARED WITH 1.51 PER CENT IN 1972 AND THAT IN ONE COUNTRY, BRITAIN, TOTAL CONSUMPTION OF ENERGY IN 1977 WAS ACTUALLY LESS THAN FIVE YEARS BEFORE.

THE IEA ATTRIBUTES THIS REDUCTION IN THE IMPORTANCE OF ENERGY AS A FACTOR OF ECONOMIC GROWTH TO SEVERAL DEVELOPMENTS. AMONG THESE ARE IMPROVED EFFICIENCY AS A RESULT OF CONSERVATION MEASURES, THE SPREAD OF NEW INDUSTRIAL METHODS THROUGH WHICH MORE GOODS CAN BE PRODUCED WITH LESS ENERGY, BETTER INSULATION OF BUILDINGS AGAINST HEAT LOSSES AND THE IMPOSITION OF SPEED LIMITS ON ROAD TRAFFIC.

IF THIS PROCESS CONTINUES, LIMITED ECONOMIC GROWTH MIGHT BECOME POSSIBLE WITH THE SAME OR EVEN LESS EXPENDITURE OF ENERGY AND THE FOSSIL FUELS MIGHT LAST LONGER THAN AT PRESENT BELIEVED.

CRITICS OF ALL-OUT NUCLEAR EXPANSION ALSO ARGUE THAT A MUCH LARGER SHARE OF THE DEMAND COULD BE MET FROM ALTERNATIVE SOURCES, SUCH AS THE HEAT OF THE SUN, THE FORCE OF WINDS AND THE MOVEMENT OF OCEAN WAVES. THEY COMPLAIN THAT THESE SOURCES HAVE REMAINED LARGELY UNTAPPED BECAUSE THE POWERFUL INDUSTRIAL NUCLEAR ENERGY LOBBY HAS SUCCEEDED IN CORNERING MOST OF THE MONEY AVAILABLE FOR INVESTMENT IN RESEARCH AND EXPERIMENT.

MORE RADICAL ENVIRONMENTALISTS QUESTION THE ENTIRE PHILOSOPHY OF PERMANENT GROWTH AND SUGGEST THAT FUTURE GENERATIONS MAY SHOW MORE INTEREST IN THE QUALITY OF LIFE THAN IN THE POSSESSION OF MATERIAL GOODS AND PLAYTHINGS.

BUT EVEN IF GROWTH IS HELD TO BE NECESSARY AND NUCLEAR POWER TO BE ITS ONLY POSSIBLE HANDMAIDEN, THERE IS NEW HOPE OF AN ALTERNATIVE TO THE PLUTONIUM CHAMBER OF HORRORS.

THIS IS NUCLEAR FUSION -- THE OPPOSITE OF NUCLEAR FISSION. IN THIS PROCESS LIGHT ATOMIC HYDROGEN NUCLEI ARE FUSED TOGETHER UNDER EXTREMELY HIGH TEMPERATURES AND IN FUSING RELEASE A LARGE QUANTITY OF NUCLEAR ENERGY.

FUSION IS THE PRINCIPLE USED IN THE HYDROGEN BOMB, WHICH WAS FIRST TESTED SUCCESSFULLY IN 1951 AND HAS AN EXPLOSIVE FORCE 1,000 TIMES GREATER THAN THE URANIUM OR PLUTONIUM BOMB.

FUSION RESEARCH IS BEING CARRIED OUT IN THE U.S., IN THE SOVIET UNION AND IN WESTERN EUROPE WHERE THE EEC COUNTRIES HAVE JOINED FORCES ON AN EXPERIMENTAL PROJECT BASED IN BRITAIN. SO FAR NO-ONE HAS SUCCEEDED IN ACHIEVING A CONTROLLED NUCLEAR FUSION AND UNTIL TWO MONTHS AGO IT WAS GENERALLY ACCEPTED THAT SUCH AN EVENT WAS STILL DECADES AWAY. THIS IS MAINLY BECAUSE OF THE PROBLEM OF REACHING THE NECESSARY TEMPERATURE OF 100 MILLION DEGREES CENTIGRADE IN A REACTOR.

IN AUGUST, HOWEVER, SCIENTISTS AT THE PRINCETON UNIVERSITY LABORATORY IN THE U.S. ACHIEVED A HISTORIC BREAKTHROUGH. FOR ONE-TENTH OF A SECOND THEY ATTAINED A TEMPERATURE OF 60 MILLION DEGREES -- FOUR TIMES THE TEMPERATURE IN THE INTERIOR OF THE SUN -- INSIDE A KIND OF MAGNETIC BOTTLE. THEY NOW HOPE THAT FUSION CAN BE BROUGHT ABOUT BY 1981 OR 1982 AND WORKING REACTORS DEVELOPED IN 10 TO 15 YEARS.

UNLIKE FISSION, FUSION IS CLEAN. IT CARRIES NO RISK OF A RUNAWAY NUCLEAR REACTION. THERE IS VIRTUALLY NO RADIOACTIVE WASTE TO BE DISPOSED OF. ABOVE ALL, THERE IS NO WEAPONS-GRADE NUCLEAR MATERIAL LIKE PLUTONIUM. AND SUPPLIES OF ITS RAW MATERIAL ARE UNLIMITED AND INEXPENSIVE SINCE THE HYDROGEN ISOTOPES CAN BE DRAWN FROM SEA WATER.

MANY DIFFICULT TECHNICAL PROBLEMS STILL HAVE TO BE OVERCOME, BUT FUSION MIGHT JUST TURN OUT TO BE THE PRUNING-FORK WHICH EVEN MAN CAN NOT REPROCESS INTO A SPEAR. BG/