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B-WIRE

27-JUL-86 05:18

ARMS - SOVIET UNION BUILDING WORLD'S MOST POWERFUL ATOM

SMASHER

BY WILLIAM J. BROAD

NEW YORK TIMES

SERPUKHOV, U.S.S.R., JULY 27 - OUTSIDE THIS SMALL RUSSIAN TOWN, SOVIET PHYSICISTS ARE BUSY CREATING THE WORLD'S MOST POWERFUL ATOM SMASHER, A SPRAWLING MACHINE EXPECTED TO GIVE THE SOVIET UNION A DOMINANT ROLE IN PARTICLE PHYSICS OVER THE NEXT DECADE.

AN AMERICAN PROPOSAL TO FORGE AHEAD WITH AN EVEN BIGGER DEVICE IS MIRED IN BUDGET TROUBLES, ITS PROSPECTS UNCERTAIN AT BEST.

SIGNS OF ACTIVITY ABOUND HERE, THE SITE ALIVE WITH THOUSANDS OF WORKERS. SCIENTISTS ARE MAKING PROTOTYPE PARTS FOR THE ATOM SMASHER. CONSTRUCTION CREWS ARE BUILDING A HUGE FACTORY WHERE ITS KEY COMPONENTS ARE TO BE MANUFACTURED. AND ENGINEERS, LABORING NEARLY 200 FEET BENEATH THE EARTH, ARE DRILLING AND BLASTING A TUNNEL 13 MILES IN CIRCUMFERENCE TO HOUSE THE GIANT DEVICE. TODAY THE WORLD'S LARGEST ATOM SMASHERS ARE FOUR MILES IN CIRCUMFERENCE.

IT IS THE FIRST TIME IN TWO DECADES THAT THE SOVIET UNION HAS ASPIRED TO PRE-EMINENCE IN THIS FIELD, WHICH IS DEVOTED TO UNLOCKING THE SECRETS OF THE ATOM AND SOLVING SOME OF THE ENIGMAS THAT HAVE LONG BAFFLED PHYSICISTS.

IN THE FIRST TOUR OF THE SITE BY A WESTERN JOURNALIST, AMID THE DIN OF BREAKING ROCK DEEP BENEATH THE EARTH, THE STARK IMPRESSION WAS OF HOW BIG SCIENCE HAS BECOME SINCE THE FIRST PALM-SIZE ATOM SMASHER WAS BUILT HALF A CENTURY AGO. HERE WAS A NEW MONUMENT TO THE IMPORTANCE OF INSTRUMENTS, NOT JUST SHEER INTELLECT, IN PUSHING BACK THE FRONTIERS OF SCIENCE.

"TWENTY YEARS AGO NOBODY THOUGHT WE COULD BUILD SUCH A BIG MACHINE," SAID DR. VIKTOR A. YARBA, HEAD OF THE SOVIET PROJECT. "AND IN FACT IT'S A VERY DIFFICULT TECHNOLOGY. BUT TODAY NO ONE DOUBTS THAT SUCH A MACHINE IS POSSIBLE." THE FIRST PHASE OF THE PROJECT IS SCHEDULED FOR COMPLETION IN 1993.

THE AMERICAN PROPOSAL IS EVEN MORE AMBITIOUS, THE MACHINE MEANT TO STRETCH 60 MILES AND BE COMPLETED BY 1995. BUT A FEDERAL DECISION, SCHEDULED FOR THIS SUMMER, ON WHETHER TO APPROVE THE \$6 BILLION PLAN IS CAUGHT IN THE POLITICS OF REDUCING THE DEFICIT, AND SOME AMERICAN PHYSICISTS SAY THE ONLY HOPE IS A DIRECT GO-AHEAD FROM PRESIDENT REAGAN.

ATOM SMASHERS ARE BASICALLY BIG TOOLS FOR ACCELERATING ATOMS AND THEIR CONSTITUENT PARTS TO NEARLY THE SPEED OF LIGHT, THEN SMASHING THEM INTO STATIONARY TARGETS OR ONE ANOTHER SO THEY FORM EVEN SMALLER PARTICLES. IN THE PAST 50 YEARS SUCH DEVICES HAVE UNDERGONE A REVOLUTION IN SIZE AND POWER AND HAVE BECOME STATUS SYMBOLS AS NATIONS HAVE VIED TO BUILD INCREASINGLY POWERFUL ONES, TO DISCOVER NEW PARTICLES AND TO DRAW PRESTIGE FROM RESULTING NOBEL PRIZES.

THE CURRENT SOVIET ENTRY IN THIS COMPETITION IS BEING BUILT BY THE INSTITUTE OF HIGH ENERGY PHYSICS HERE, WHICH HAS ABOUT 5,500 PHYSICISTS, ENGINEERS, TECHNICIANS AND LABORERS IN A CLUSTER OF BUILDINGS SET AMID A BIRCH FOREST 60 MILES SOUTH OF MOSCOW.

"WE ARE THE BIGGEST ACCELERATOR CENTER IN THE SOVIET UNION," YARBA SAID WITH PRIDE.

THIS WOODED SITE WAS SELECTED BECAUSE IT ALREADY HOLDS A CIRCULAR ACCELERATOR, BUILT IN THE LATE 1960S WITH A CIRCUMFERENCE OF ONE MILE, THAT WILL BE USED TO INJECT SPEEDING SUBATOMIC PARTICLES INTO THE NEW MACHINE. PART OF THE EXISTING ACCELERATOR IS COVERED BY A BUILDING LARGER THAN A FOOTBALL FIELD. INSIDE ITS CAVERNOUS SINGLE ROOM, HIGH ACROSS ONE WALL, IS A BANNER DRAWN IN THREE-FOOT-HIGH RED LETTERS: "GLORY TO SOVIET SCIENCE!"

INSIDE ANOTHER STRUCTURE ENGINEERS ARE FORGING A KEY ELEMENT OF THE BIG MACHINE: 19-FOOT SUPERCONDUCTING MAGNETS MEANT TO KEEP SUBATOMIC PARTICLES LOCKED IN A MAGNETIC PRISON. ROOMS HERE ARE FILLED WITH DEVICES TO WIND SPECIAL ELECTRICAL CABLES, TO FASHION PROTOTYPE MAGNETS, AND TO TEST THEIR QUALITY AND PRECISION. (PTO)

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ARMS - (1) SOVIET UNION BUILDING WORLD'S MOST POWERFUL ...

"WE'VE FINISHED WITH THE PROTOTYPE STAGE, AND THE ACCURACY HAS BEEN VERY HIGH," SAID DR. KIRILL P. MYZNIKOV, CHIEF SCIENTIST FOR THE ACCELERATOR PROJECT.

THE NEXT BIG CHALLENGE IS TO SET UP A PRODUCTION LINE TO FASHION THE 2,500 LARGE MAGNETS THAT WILL BE STRUNG LIKE PEARLS ON A NECKLACE, MAKING UP THE CORE OF THE BIG MACHINE. A FACTORY HERE FOR PRODUCING THE MAGNETS IS NEARLY COMPLETE.

SUCH PRODUCTION IS NO SMALL TASK. IN THE EARLY 1980S AN AMERICAN ACCELERATOR FAILED BECAUSE OF TROUBLES THAT DEVELOPED IN THE MASS PRODUCTION OF LARGE NUMBERS OF SUPERCONDUCTING MAGNETS. TODAY THERE IS ONLY ONE PARTICLE ACCELERATOR IN THE WORLD OF SUCH A DESIGN THAT IS A SUCCESS, THE FOUR-MILE SUPERCONDUCTING RING AT THE FERMI NATIONAL ACCELERATOR LABORATORY IN BATAVIA, ILL., 30 MILES WEST OF CHICAGO.

"FERMILAB PROVED THAT SUCH A THING CAN BE DONE," YARBA SAID. "NOW THE MAIN PROBLEM IS TO MAKE THE MAGNETS CHEAP, AND WITH SIMPLE TECHNOLOGY."

STRONG MAGNETS ARE KEY TO MAKING POWERFUL ACCELERATORS. AS SUBATOMIC PARTICLES ARE PUSHED TO INCREASINGLY HIGH ENERGIES, THEY ALSO INCREASE THEIR RESISTANCE TO BEING TURNED IN A CIRCLE. AS WITH ALL OBJECTS SET IN MOTION, THEIR TENDENCY IS TO MOVE IN A STRAIGHT LINE. A RESULT IS THAT IT TAKES LOTS OF ENERGY (IN THE FORM OF MAGNETIC FIELDS) TO FORCE SPEEDING PARTICLES INTO A CIRCULAR PATH WHERE THEY ARE ACCELERATED, AROUND AND AROUND, TO INCREASINGLY HIGH ENERGIES.

ACCORDING TO YARBA, THE BEAUTY OF SUPERCONDUCTING MAGNETS IS THAT THEY DO THE JOB INEXPENSIVELY. WHEN COOLED TO NEAR ABSOLUTE ZERO, THEORETICALLY THE LOWEST TEMPERATURE POSSIBLE, THESE MAGNETS LOSE ALL MEASURABLE RESISTANCE TO ELECTRICITY, ALLOWING A SHORT PULSE OF ELECTRICITY TO FLOW FOR A VERY LONG TIME.

"THIS WHOLE COMPLEX WILL USE ABOUT 100 MEGAWATTS" OF ELECTRICITY, YARBA SAID. "OUR OLD MACHINE USES ABOUT 35 MEGAWATTS. SO WE'RE GETTING 40 TIMES HIGHER ENERGY WITH ONLY THREE TIMES MORE POWER, ALL BECAUSE OF SUPERCONDUCTIVITY. IF WE DID NOT USE SUPERCONDUCTIVITY, THE PRICE OF OPERATION WOULD BE IMPOSSIBLY HIGH."

THE SUPERCONDUCTING MAGNETS, COOLED BY LIQUID HELIUM TO A TEMPERATURE OF MINUS 452 DEGREES FAHRENHEIT, ARE TO BE LINKED TOGETHER DEEP BENEATH THE EARTH, CREATING AN ELECTROMAGNETIC PRISON FOR SPEEDING PROTONS.

ON A SHORT TRIP DOWN A DIM SHAFT INTO THE EVER-LENGTHENING TUNNEL, THE HISS AND CLANG OF MACHINERY GREW LOUD. AT THE BASE OF THE VERTICAL SHAFT, RAIL CARS MOVED BACK AND FORTH ON LONG TRACKS, CARRYING OUT ROCK AND CARRYING FORWARD 10-INCH-THICK REINFORCED CONCRETE PANELS TO LINE THE TUNNEL'S SIDES. A BRIGHT LIGHT FLASHED AS WORKERS WELDED METAL SUPPORTS FOR THE PANELS.

"WE'RE TUNNELING AT SEVEN POINTS," DR. GENNADI G. GUROV, CHIEF ENGINEER FOR THE PROJECT, SHOUTED OVER THE DIN. "THIS TUNNEL IS EXPANDING AT TWO POINTS, ONE AT EITHER END."

AT THE FRONT OF THE TUNNEL, ENGINEERS WERE USING DRILLING RIGS AND EXPLOSIVE CHARGES TO BLAST AWAY TONS OF LIMESTONE, MOVING THE DARK CORRIDOR SLOWLY AHEAD. SO FAR, TUNNELS AT DIFFERENT POINTS ALONG THE PLANNED RING ADD UP TO LESS THAN TWO MILES.

"IT'S LONG, BUT NOT LONG ENOUGH," SHOUTED YARBA, WHO HAD JUST RETURNED FROM A VISIT TO FERMI LAB AND HAD ARRANGED FOR THE TOUR OF THE RUSSIAN PROJECT AT THE REQUEST OF AN AMERICAN REPORTER.

WHEN FINISHED IN 1993, THE 13-MILE SOVIET COMPLEX IS TO ACCELERATE PROTONS TO ENERGIES OF 3 TRILLION ELECTRON VOLTS, THE STANDARD UNIT OF MEASURE FOR THE POWER OF ATOM SMASHERS. THE FERMI LAB MACHINE OPERATES AT 1 TRILLION ELECTRON VOLTS, AND THE PROPOSED NEW AMERICAN MACHINE, THE SUPERCONDUCTING SUPER COLLIDER, WOULD BE RATED AT 20 TRILLION ELECTRON VOLTS. (MORE)

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ARMS - (2) SOVIET UNION BUILDING WORLD'S MOST POWERFUL ...
 FOR A SECOND PHASE, THE RUSSIANS ARE CONSIDERING THE ADDITION OF ANOTHER RING OF 2,500 MAGNETS TO SPEED PROTONS IN THE OPPOSITE DIRECTION, SLAMMING THE TWO COUNTERROTATING BEAMS TOGETHER IN A BURST OF ENERGY. THE SUPERCONDUCTING SUPER COLLIDER WOULD ALSO HAVE COUNTERROTATING BEAMS, SAID DR. LEON M. LEDERMAN, DIRECTOR OF FERMILAB, WHICH IS CONSIDERED A PRIME SITE FOR THE PROPOSED AMERICAN MACHINE.

"THE SOVIETS WOULD HAVE THE HIGHEST ENERGY BY A SUBSTANTIAL FACTOR" FOR A LONG TIME IF A LARGE NEW ATOM SMASHER IS NOT BUILT IN THE WEST, LEDERMAN SAID, ADDING, "MY ONLY CONCERN IS THAT THE RUSSIAN ACCELERATOR WOULD NOT BE NEARLY ENERGETIC ENOUGH TO ADDRESS ALL THE CURRENT QUESTIONS."

NO MATTER WHERE THE BIG MACHINES ARE SITUATED, THEY ARE INVARIABLY SHARED BY PHYSICISTS AROUND THE WORLD, FOREIGNERS EAGER TO USE THE MOST POWERFUL TOOLS AVAILABLE AND NATIONALS EAGER TO HAVE THE FAVOR OF COOPERATION RETURNED IN THE FUTURE. THE BUILDER OF HUGE MACHINES RETAINS GREAT ADVANTAGES, HOWEVER, BECAUSE OF THE ABILITY TO CONTROL OPPORTUNITIES FOR THE BEST EXPERIMENTS.

ECHOING THE CONSENSUS OF PHYSICISTS, YARBA SAID THE BIG SOVIET MACHINE WOULD BE A RESOUNDING SUCCESS IF IT CAME UP WITH THE BIGGEST PRIZE OF ALL: UNEXPECTED DISCOVERIES.

"WE DON'T KNOW EXACTLY WHAT WE MIGHT FIND," HE SAID. "WE WILL SEARCH FOR NEW PARTICLES AT THIS HIGHER ENERGY AND HOPE TO FIND SOME NEW PHENOMENA AS WELL. WE'LL WAIT UNTIL THE MACHINE IS FINISHED TO SEE WHAT IS THE MOST EXCITING AREA."
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