Her research interests include solid-state physics, plasmas in solids, microwaves and molecular electronics, ferrimagnetism and nonreciprocal effects, and x-ray studies of imperfections in nearly perfect crystals. For the past year she has been manager of a small group studying the application of science and technology to large-scale societal needs.

Ancker-Johnson is a Councillor at Large of the American Physical Society, a member of its Executive Committee and a member of its Committee on Minorities. She is also a member of the National Advisory Committee on Oceans and Atmospheres, a member of the National Academy of Sciences Advisory Committee on the USSR and Eastern Europe, and a senior member of the Institute of Electrical and Electronic Engineers.

Roberts takes over as director of NBS

Richard W. Roberts has become the seventh director of the National Bureau of Standards. He succeeds Lewis M. Branscomb, who resigned last May. Prior to his appointment Roberts was research and development manager of materials science and engineering at the General Electric Research and Development Center in Schenectady, New York.

After completing his PhD in physical chemistry at Brown University (1959), Roberts served for a year as a National Academy of Sciences postdoctoral fellow at NBS. He joined the GE research laboratory in 1960. During these years of research he worked with ultrahigh vacuum technology, the physical and chemical properties of atomically clean metal and semiconductor surfaces, chemical kinetics and the lubrication of space-age metals.

Roberts began his career in technical management with his promotion to manager of the Center's structures and reactions branch in 1965. By 1968 he was made manager of the Center's physical-chemistry laboratory and, later that year, also became manager of materials science and engineering. Roberts is the first chemist to head NBS.

ROBERTS

Uranium enrichment

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future path of development for a major capital investment fundamental to the economy. By the year 2000 the investment in enrichment facilities may total some $20 billion—about the size of the plant investment owned by General Motors.

The AEC has already taken some initial steps to encourage private participation in the enrichment business. In January the AEC announced that it had accepted seven proposals from private firms in response to a government offer to provide access to this still highly classified area for the purpose of conducting privately sponsored research and development on uranium enrichment technology. The companies accepted were Electro-Nucleonics, General Electric, Goodyear Tire and Rubber, Exxon Nuclear, Reynolds Metals, United Aircraft and Westinghouse Electric. Apparently these firms are seriously interested in competing to develop the technology needed to build enrichment facilities under contracts for customers. But it is not so clear they are eager to arrange financing themselves to own and operate new enrichment plants. An officer of one of the companies granted access by AEC explained, "The problem is essentially a financial one. The AEC is asking industry to make a capital investment of billions of dollars in a situation that still contains many uncertainties."

One problem that worries industry is that private plants would have to compete for long-term enriched fuel supply contracts with the existing government enrichment facilities, whose prices have the advantage of indirect subsidies. Also there is concern that private plants would be subject to the government's antitrust regulations, which among other things gives the government the power to control prices.

Equally uncertain is the question of whether to switch from diffusion to centrifuge separation. Of the seven companies making successful proposals, only one (Reynolds Metals) expressed interest in the gaseous-diffusion process; the other six all have emphasized work on developing the gas-centrifuge process, which has never been used by the AEC to produce enriched uranium.

This does not mean, in Quinn's view, that these six companies necessarily favor the centrifuge approach to the exclusion of diffusion but rather that they feel there is more to be gained in doing research on the relatively young centrifuge process in contrast to the thoroughly developed diffusion method.

In either process, natural uranium (having a concentration of 0.711% U^{235}) is piped as gaseous UF_6 through the enrichment plant to bring the concentration of U^{235} up to 2–4%. In the diffusion process the uranium gas is pumped through a cascade of porous diffusion barriers, and enrichment is achieved by the slightly higher diffusion rate of U^{235} compared to U^{238}. This difference gives a theoretical separation factor per stage of only 0.4%; hence, large numbers of stages are required in series leading to the massive plant size typical of the diffusion process. (The AEC's three plants cover a total area of 270 acres.) A diffusion plant designed to enrich uranium to 4% would contain about 1200 stages in series. In addition a considerable amount of energy is consumed in maintaining the needed pressure difference across the porous barriers. The combined power level of the three AEC plants is 6100 MW at full capacity.

In the centrifuge process, the uranium gas is fed into a cylindrical rotor spinning at extremely high speeds. In this centrifugal force field the U^{238} component tends to concentrate nearer the rim of the centrifuge and the U^{235} nearer the axis. The separation factor per stage is 20–100 times that for the diffusion process, so that only 10–50 stages would be needed in a centrifuge cascade to produce 4% uranium instead of the 1200 needed for the diffusion process.

The power requirement is also less. In principle the centrifuge is a reversible process whereas the diffusion process is irreversible. In practice this means that the centrifuge process can perform the same amount of separative work by consuming only one-tenth the energy needed for the diffusion process.

The AEC and some private companies feel it is not clear yet whether the diffusion process should give way to the centrifuges. But others have more definite opinions. One of the companies granted access, Reynolds Metals, is studying the feasibility of a full-scale diffusion plant to be sited in Wyoming in the vicinity of coal fields and hence cheap electricity. In favor of centrifuges is another company with access, Electro-Nucleonics, which had been doing research and development work on gas centrifuges for several years before the AEC prohibited all private work in this area in 1967 for security reasons. "We believe there is little doubt that centrifuge separation will prove to be the most economical way to enrich