

state & society

Scientists in the House: Five seek election this year



GEORGE BROWN JR



MARTIN



MCCORMACK



SEIELSTAD



WOOD

While it is not likely that scientists will soon out-number lawyers in Congress, it is encouraging that several candidates for the House of Representatives in the upcoming election have worked as scientists for a substantial part of their careers and potentially bring their scientific training and experience to bear on problems facing the nation. In the last two years there have been increasing numbers of scientists working on the staffs of Congressmen including Congressional fellows sponsored by the American Physical Society, ASME, IEEE and AAAS. Why should not

Congressmen also have technical backgrounds, especially to help when they deal with problems such as energy and the oceans?

Five scientists in the running for Congressional seats that are known to us at this writing include three incumbents—Mike McCormack (D-Wash.), James Martin (R-N. C.) and George Brown Jr (D-Cal.) Two other scientist-candidates are Lloyd A. Wood, a Democrat from the sixth Congressional District in Ohio and George A. Seielstad, also a Democrat from the California 18th C. D. All have their parties' offi-

cial endorsements, except for McCormack who faced a primary on 17 September. Another scientist who ran for but did not receive the Democratic Party nomination for the seventh C. D. seat in Tennessee was G. Wayne Brown, a radio astronomer and vice-president for academic affairs at Union University in Jackson, Tenn.

The incumbents. McCormack is seeking his third term in Congress. He is chairman of the Subcommittee on Energy of the House Committee on Science and Astronautics and a member of the Joint Committee on Atomic En-

continued on page 80

AEC approves Princeton Tokamak and compares designs

An AEC committee has recommended that a Tokamak Fusion Test Reactor be built at Princeton University, with funds for its construction to be included in the fiscal year 1976 budget. The TFTR would be the so-called "D-T burner" advocated by the AEC in hearings before the Joint Committee on Atomic Energy in July 1973 (PHYSICS TODAY, October 1973, page 77). Even if the TFTR is included in the Presidential budget for FY 1976, it would still need Congressional approval, of course. If approved for that year, the \$200-million facility could be completed in 1980.

Since last year's hearings, the AEC Division of Controlled Thermonuclear Research, headed by Robert L. Hirsch, has been studying the possibility of deuterium-tritium burning systems. Oak Ridge National Laboratory began working on a design for a test reactor with a

very large-diameter chamber that would be expected to reach the Lawson criterion, $n\tau$ (where n is particle density and τ is confinement time) of 10^{14} cm⁻³ sec at 6 keV. When the Lawson criterion is reached, one has obtained breakeven conditions, with the power produced by the fusion device being equal to the power applied.

Meanwhile most leading members of the plasma-physics community became concerned about the desirability of building the D-T burner as proposed and some wanted to consider alternative designs. Many were concerned that the machine was too large. Some thought the magnitude of the extrapolation from present experiments ($n\tau$ of 10^{12} cm⁻³ sec at 2 keV) to the Lawson criterion was so great that one could not be certain that significant D-T burning conditions could in fact be reached. Skeptics included Marshall Rosenbluth

(Institute for Advanced Study), Bruno Coppi (MIT), Melvin Gottlieb and T. Kenneth Fowler (Livermore). At a meeting in Washington last December, much of this concern was aired. The following month Hirsch initiated two design efforts to study a different scheme for the TFTR, employing the two-component concept proposed by John Dawson, Harold Furth and F. H. Tenney of Princeton in 1971 (Phys. Rev. Letters 26, 1156, 1971). The studies were performed by Oak Ridge and a Princeton-Westinghouse team. These design teams submitted proposals to the AEC in June. In parallel with that, independent studies of problems connected with the TFTR were conducted by groups such as Gulf General Atomic, the Naval Research Laboratory, Lawrence Livermore Laboratory and the University of Wisconsin.

During 9-11 July a large meeting of

the fusion community took place in Washington to hear reports on the studies. Then the AEC Fusion Power Coordinating Committee, which is a successor to the CTR Standing Committee, had to decide whether or not to go ahead with the TFTR for the FY 1976 budget. The decision was to go, Hirsch told us, a decision that was heartily endorsed by the fusion audience, including former skeptics such as Rosenbluth, Coppi, Gottlieb and Fowler. Coppi felt encouraged by the tone in which the TFTR program was being proposed—that it would be undertaken in a realistic and scientific spirit.

The Fusion Power Coordinating Committee, headed by Hirsch, consists of his three technical assistant directors, and the fusion directors of the four major fusion laboratories: Fowler (Livermore), John F. Clarke (Oak Ridge), Gottlieb (Princeton) and Fred Ribe (Los Alamos). In addition, acting as consultants were Tihoro Ohkawa (Gulf General Atomic), Zalman Shapiro (Westinghouse), Sidney Fernbach (Livermore), Robert W. Bussard (Cerberonics Corp, San Diego), Solomon J. Buchsbaum (Bell Labs) and Edward Creutz (NSF).

The two-component scheme employs heating by an energetic neutral beam—one component is the resulting energetic ion component and the other component is the lower-energy bulk plasma. The energetic ion component reacts with the bulk ions as they thermalize, and, according to calculations, one can achieve breakeven with an $n\tau$ of 10^{13} cm⁻³ sec.

Both the Oak Ridge and Princeton-Westinghouse design studies called for a tokamak with neutral-beam heating. Oak Ridge proposed using superconducting coils, whereas Princeton-Westinghouse proposed water-cooled copper coils. The Oak Ridge design called for a larger torus than Princeton-Westinghouse and a somewhat lower plasma current at roughly the same cost. In the Oak Ridge proposal, it was emphasized that one could hope to obtain half the thermonuclear reactions from the bulk plasma and half coming from the energetic ion component. The Princeton-Westinghouse proposal, on the other hand, stressed that breakeven could be obtained entirely with two-component reactions or alternatively in the mode proposed by Oak Ridge.

Subsequent to the committee's recommendation, the Division of Controlled Thermonuclear Research chose to build the machine at Princeton, and have the university act as principal contractor, with most of the construction being done by industry, not necessarily Westinghouse. Estimated cost is about \$200 million, including escalation.

The Princeton design in many ways is a bigger version of the Princeton Large

Project Sherwood

Project Sherwood was one of the early names for the AEC's controlled thermonuclear fusion program. According to Paul McDaniel, who was formerly head of the AEC Division of Physical Research, about 1951, when the project was still new, James Tuck asked for more money to support a small CTR project at Los Alamos. By reallocating money from a project that was being phased out at MIT's Hood Laboratory, McDaniel thought he could give Tuck the additional funds. When McDaniel suggested this approach to Thomas Johnson, then director of the Division of Physical Research, Johnson remarked, "We are obviously robbing Hood to pay Friar Tuck; so we must be operating in Sherwood Forest. So let's call this Project Sherwood."

Torus, which is expected to be completed in September 1975. The TFTR would have a major plasma radius of 270 cm. Its minor radius would be 95 cm, slightly more than twice the radius of PLT. The biggest discharge the TFTR could achieve is 2.5 megamps. In practice, because the experimenters want to achieve the highest temperatures, they plan to run at 1–1.5 megamps, thus reducing the plasma radius to about 60 cm, keeping the plasma away from the walls. At first, experiments would be done with a hydrogen plasma at 5–10 kV, where it is expected that an $n\tau$ of 10^{13} cm⁻³ sec would be achieved. At this time, the plasma transport and its gross stability would be studied.

At a later stage, the experimenters would work with a bulk plasma of tritons heated by ohmic heating to about 5 kV (with peak temperature of 8 kV) to prevent the tritons from being slowed down by the electrons before they can interact with the deuterons. Then neutral beams of 150-kV deuterons would be shot into the bulk plasma. Furth notes that one can also experiment with D-D and D-He³ reactions. But the reaction that gives the biggest power is D-T. He expects that the power density would be about the same as that in a full-fledged reactor—3 W/cm³. One would expect roughly 10 MW of neutrons in power output (and about 2 MW of alpha particles) for an input of 10 MW in neutral beams. This output would occur for a few tenths of a second every five minutes. If one counts the required magnet power, however, which is several hundred megawatts, one is far from breakeven. In a working reactor, Furth says, superconducting coils would surely be used.

Beyond the tokamak torus would be neutron shielding. The building to house the TFTR would be shielded, and

have a remote-handling capability so that D-T can be run on a regular basis, to study burning physics. The amount of tritium on the site is expected to present no radioactivity problems—about 1 gram (10^4 curies) at any one time.

"Why build the TFTR before the PLT is finished?" we asked Furth. The TFTR is a mild extrapolation beyond PLT (PLT is expected to have an $n\tau$ of 10^{13} cm⁻³ sec at 2–3 keV)—both machines are expected to run at about 1 megamp. TFTR, however, will be bigger so that the plasma will be hotter and have less impurities. Its hardware is very similar to PLT. Detailed experimental results from PLT will be available while the TFTR is still in the design stage and can be taken into account in optimizing the design. Furth is optimistic about the prospects. In fact, the TFTR design is such that it would be possible to handle plasmas with an $n\tau$ of 10^{14} cm⁻³ sec should the physics be very favorable. —GBL

Institute of Acoustics formed from two UK groups

An Institute of Acoustics has been established in the UK upon the merger of the British Acoustical Society and the Acoustics Group of the Institute of Physics. R. W. B. Stephens of Imperial College London is the first president.

Although the Institute of Acoustics is independent in every respect, its headquarters is located at the IOP headquarters (47 Belgrave Square, London SW1X 8QX, UK), and secretarial and other services are provided by the IOP for a fee. Initially, the membership of the Institute is expected to be around 800.

Noel Hinners succeeds Naugle in NASA post

Noel W. Hinners has been appointed associate administrator for space science at NASA, succeeding John E. Naugle. Hinners has served at NASA since 1972, first as deputy director and chief scientist for Apollo Lunar Exploration in the Office of Manned Space Flight and then as director of Lunar Programs in the Office of Space Sciences. The latter office, with an annual budget of approximately \$550 million oversees 25 unmanned spaceflight programs. There are three sections of the office—physics and astronomy, planetary programs, and lunar programs. Some of the projects include Pioneer and Mariner planetary satellites, the High Energy Astronomical Observatory, Small Astronomy and Small Scientific Satellites and the Orbiting Solar

continued on page 80