considered to be "in" as a result of the change of administration. Formally signed up as a lobbyist for the six major tobacco firms is none other than former Senator Earle C. Clements of Kentucky, who was No. 2 man in the Democratic majority when Lyndon Johnson was Senate majority leader. Clements served as Johnson's campaign coordinator in the 1960 election. His daughter, Bess Abell, is appointments secretary to Mrs. Johnson, and his son-in-law, Tyler Abell, was recently appointed by Johnson to serve as an assistant postmaster general. In addition, Philip Morris, Inc., has engaged the services of the law firm of Arnold, Fortas & Porter, Fortas being Abe Fortas, who is a longtime friend and close adviser of the President.

While these developments have been taking place, the House of Representatives has been the scene of a curious legislative snarl concerning tobacco. Since "research" appears to be the principal path to salvation, the tobacco states quickly responded to the Surgeon General's report by proposing a $10-million research effort that presumably would look into such things as safer filters and carcinogen-free tobacco. The research program was quickly voted out of committee, but when it came to the Rules Committee to be scheduled for a floor vote, a coalition of liberal Democrats and Republicans blocked action. They were not against research, it appeared; rather, they were incensed that the very same Agriculture Committee that had promoted the proposal had earlier turned down a liberal-backed proposal for a food-stamp plan for the needy. Give us our stamp plan and we'll give you your tobacco research, was the message. Subsequently, the Agriculture Committee developed favorable sentiments toward the stamp plan, and it is now reasonable to expect that the Rules Committee will develop favorable sentiments toward the tobacco-research plan.

Meanwhile, those advocates of self-policing—the tobacco companies themselves—have been adjusting their advertising to the peculiar requirements of an industry that, in effect, has been branded a public health menace. The most ingenious outgrowth of this process has been a nationwide campaign which proclaims:

> No medical evidence or scientific endorsement has proved any other cigarette to be superior to Kent.

—D. S. GREENBERG

SLAC: Stanford-AEC Accelerator Is Coming Along on Schedule, But Creating Some High Tension

The most expensive piece of research apparatus financed to date by the federal government is now under construction on a 2-mile (3-kilometer) strip of Stanford University land. When it is completed, the Stanford Linear Accelerator (SLAC*) will be the most powerful electron accelerator in the world and, in testimony to the increasingly high price of high energy physics research, will have cost at least $114 million.

SLAC, which is scheduled to go into operation in 1967, will give physical scientists an important new tool to use in examining the fundamental constituents of matter. It is hoped it will also enable them to create new elementary particles. In the meantime, the advent of SLAC has raised speculation at Stanford about the long-range effect on the university's academic equilibrium of a big machine with an annual operating budget roughly equal to Stanford's current annual expenditure on instruction. A more immediate problem is a controversy over the route and style of the power supply to the accelerator.

SLAC will need a prodigious amount of power—the annual electric bill will run an estimated $1.5 to $2 million—and will have to get most of it from a new Pacific Gas and Electric Company loop line which runs through the relatively undeveloped hills west of the university.

The proposed tap line to the accelerator would run through choice rolling, wooded, countryside. Many citizens of the area and especially of Woodside, an extremely pleasant exurban community through which the line would run, saw the overhead power supply as an affront to esthetics, a defeat for conservation, and a threat to property values.

The university itself has not been directly involved in the conflict. The Atomic Energy Commission will own the accelerator, which Stanford will operate under contract, and has the responsibility for insuring that power is provided.

In January of 1963 the AEC contracted with the Pacific Gas and Electric Company for construction, operation, and maintenance of a line to meet the project's rather modest power requirements during the construction period and also for a 220-kilovolt tap line running from the company's primary feeder along the mountain ridges to the west to supply the accelerator's operational needs.

*Pronounced "slack."

Last June PG&E applied to the Woodside planning commission for a permit to construct an overhead transmission line.

The planning commission, with strong community backing, turned down that proposal and another one suggesting a somewhat longer line along the route of a proposed new freeway. The latter alternative included the possibility of running the lines on tubular metal poles rather than on the higher and more obtrusive towers conventionally used for such lines. The company later proposed, to both the Woodside and the San Mateo County planning commissions, use of the tubular poles on the original overland route, but was turned down, again on esthetic grounds.

Overhead versus Underground

Opponents of the overhead line argued that the 5 or 6 miles of tap line should be run underground. Accelerator planners said they needed a 300-megawatt power supply to satisfy foreseeable maximum needs for SLAC. Overhead lines on towers would cost an estimated $668,000, and a line on the comelier poles would cost about $1 million. Undergrounding would raise the cost of a 180-megawatt line, which would meet the power needs of the accelerator until about 1970, to an estimated $2.6 million. It would cost about $3.6 million for a 300-megawatt line underground.

A bargaining period ensued. PG&E declared itself willing to make available something over $1 million to finance the freeway-route line rather than the $668,000 for the original route. The AEC offered to contribute $220,000 toward putting the line underground if this meant no future additions to power bills and no other strings attached. The town of Woodside voted to tax itself extra in order to provide $150,000 for the undergrounding project. But a gap of more than $2 million remained, and this gap was not to be closed.

The Stanford trustees expressed sympathy with the idea of an underground line and asked the AEC to reconsider its stand on financing such a line. But the trustees declined to contribute Stanford funds to help pay the price. In a statement disposing of the subject the trustees said they had "always made it unequivocally clear that the university cannot justify devoting its own funds, held in trust for other educational purposes, to a national facility" like SLAC.

In hearings on SLAC before the Joint Committee on Atomic Energy in January, AEC manager A. R. Luedecke said the commission objected to putting the Woodside line underground because it would result in (i) much greater cost, (ii) more time necessary for construction, (iii) longer delays for repairs if power were interrupted on the line, and (iv) the creation of an expensive precedent that could be used against the government in future situations.

Bipartisan senatorial support for preserving the view from Woodside through federal financing of underground lines was reported from the offices of California's Engle and Kuchel. And a Stanford researcher asserted that radiotelescopy work at the university might be prejudiced by emissions from an overhead line. But prospects of a crack in government policy on the line seemed to go glimmering when Representatives Chet Holifield and Craig Hosmer, Democrat and Republican, respectively, of California, who are influential members of the Joint Committee, supported the commission stand at a meeting of federal, university, and local officials on the subject.

Last week saw the passing of the deadline on a 60-day period given the community in January for finding ways of financing the underground route. The compromise route along the freeway has been rejected by the county, and the commission decided to go ahead with the short-line route. Sources in Washington say the AEC will probably use the tubular poles, the highest of which are 89 feet (26 meters) and the lowest 60, rather than the towers, which average about 120 feet. And the route has been altered to take the shortest possible cut across town.

The news that the AEC would initiate condemnation proceedings if necessary to construct the line was met in Woodside by declaration that the fight would go on. Woodside has a new emergency ordinance prohibiting erection of transmission lines carrying 50,000 volts or more "unless they are underground and prosecution of violators is promised." And town officials say that if the government wins the condemnation suits, countersuits will be filed to force the government to pay up to $70,000 an acre in property and scenic damages. The AEC, for its part, says it is urgent that a start be made on the line, and it is going ahead.

Although it may be cold comfort to the Woodside Save Our Skyline Committee, the power poles marching across their landscape can be looked upon as part of the price Stanford and its environs must pay for remaining a world center of high-energy physics research. The SLAC machine is one of a new breed of leviathans, along with the new proton accelerators at Berkeley, Argonne, and Brookhaven. SLAC project director Wolfgang K. H. Panofsky put the case succintly when he said. "In high energy physics you have to have bigger and bigger machines to see smaller and smaller things." Both because the soaring costs of the big accelerators mean that fewer will be built and because it has been discovered that research brings regional rewards, the competition for accelerators has acquired new economic and political dimensions (*Science*, 31 January, p. 450).

Stanford's accelerator, however, earned its charter before the free-for-all really began. The idea of a long accelerator emerged in the mid-'fifties, in conversations among such Stanford physicists as Bloch, Ginzton, Hofstadter, Panofsky, and Schiff.

A Formal Proposal

A formal proposal was submitted in 1957, and, as one Stanford physicist put it, "years of politicking and maneuvering" intervened before the project won congressional approval in 1961.

Whether or not such a machine would be useful and, if it would be, where it should be located, had to be thrashed out in the research-supporting federal agencies and their advisory committees. There were doubts at Stanford over committing so much prime land to the machine. And there was a serious question about the suitability of the Stanford location, since the San Andreas fault passes within a mile of the site and any considerable displacement of earth could seriously affect the alignment of the accelerator tube. Intensive studies apparently satisfied the questioners that the local bedrock provided a firm enough foundation and that the seismic prognosis was acceptable. The anticipated useful life of the accelerator is some 15 to 20 years, with an extension of this term through advancing technology quite possible.

Strongly favoring selection of Stanford as a site was the university's experience with linear accelerators. SLAC is a lineal descendant of the first linear accelerator, the Mark I, built at the university after World War II by William W. Hansen. The Mark I was a 6-million-electron-volt (Mev) machine, and its successor, Mark II, which is still in use, is rated at 80 Mev. A Mark III machine was built in 1951, with Office of Naval Research funds, and recently given a $150,000 overhaul, which included installation of a new 93-meter (310-foot) accelerator tube. The renovation is expected to raise the machine's energy by at least 10 percent and to double the beam current, to put Mark III in the 1.2-billion-electron-volt (Bev). category.

April 1966 is the SLAC target for tests with an electron beam, and use of the machine for research is expected in early 1967 if things go according to plan.

The SLAC project (originally called Project M, or "the Monster") is a big and unusually exacting construction job. The 10-centimeter (4-in.) accelerator tube is to be encased in a concrete tunnel with walls 0.45 meter thick and a floor and roof 0.6 to 0.75 meter thick. In part because of the seismic characteristics of the site, the tunnel has no construction or expansion joints. This accelerator housing will be covered with 7½ meters of earth to shield against radiation emitted when the accelerator is in operation. A series of 240 klystron tubes, each delivering up to 24 megawatts of microwave power for the traveling-wave accelerator, will be housed along with other equipment, in a building on the surface, which will run the entire length of the accelerator.

In its first phase SLAC is expected to be a 10- to 20-Bev machine. A second phase of construction is contemplated in the 1970's in which the number of klystron tubes would be quadrupled to produce an expected doubling of both the energy and the number of accelerated electrons. But phase II would involve investment of an estimated $70 million, and a decision to boost SLAC into the 40-Bev range will depend in large part on the scientific harvest of phase I.

In testimony before the Joint Committee on Atomic Energy in January, Panofsky reported that the job was roughly on schedule and within budget. About a third of the 3000-meter accelerator housing was completed, 300 meters of this tunnel had been covered with earth, and a start had been made on the klystron-tube building. Four of eight major buildings at the business end of the accelerator have been finished and are occupied.

More than 700 people are employed

at the accelerator, exclusive of construction workers, and the staff is expected to level off at about 800. A large permanent staff will be required to operate and maintain the accelerator itself and to deal with experimentation equipment, which has become both complex and massive (a ratio of about eight technicians and administrative and maintenance workers to one researcher is anticipated). The large magnetic spectrometers, spark chambers, which will be used with the accelerator, are literally factory-sized machines.

SLAC's annual operating budget is expected to be about a $15- to $20-million item for the AEC.

With its big staff and budget, SLAC raised some misgivings on the Stanford campus. While the disquiet is mostly subsurface, there appear to be two main sorts of apprehension: (i) that emphasis on the accelerator will further enhance the position of science at the expense of the humanities and social sciences, and (ii) that the glamor of the accelerator will give high-energy physics research a privileged position among the sciences.

The university administration has taken pains to allay fears that substantial university resources are being diverted into the SLAC project. The recent statement on the power line, for example, said, "The trustees accepted the AEC accelerator on Stanford property upon the clear understanding and agreement that the university would not realize financial gain or loss from the installation or operation of the project."

Administration Guarantees

The Stanford presidency is traditionally a strong one, and the administration is committed to balance academic development. Under President Wallace Sterling, Stanford has recently completed a monumental fund-raising campaign which brought in over $100 million, and a lot of this money is earmarked for building up the humanities and social-sciences programs and for such things as bolstering the business school and expanding the medical school.

Administratively, Stanford has built some dikes against the tide of SLAC influence. SLAC's business operations have been separated from the university's and it will handle its own housekeeping, bookkeeping, personnel, and maintenance details. This should help prevent swamping of the university business operation with SLAC affairs.

What SLAC's effect on the physical sciences in the university, especially on the physics department, will be, remains a question for the future, but here, also, some applicable checks and balances are already a part of the Stanford system.

The existing high-energy physics lab has for some time been accorded separate status, and this is expected to serve as a precedent for SLAC. Key to the system is the rule that control of graduate students, both de jure and de facto, remains in the hands of their academic department, even should they do research on an off-campus facility. Faculty members control the admission of graduate students, approve their line of research, and directly supervise work for theses, and this arrangement is expected to prevent, for example, swarming of graduate students in physics to SLAC like bees to a new hive.

Physics department head Leonard Schiff, who appears untroubled by the possibility that SLAC will exert a strong centripetal force on grad students, says that Stanford has "a physics department, not a high-energy physics department," and cites the growing emphasis at Stanford in recent years on research in low-energy, low-temperature, solid-state, and theoretical physics.

Senior staff at the accelerator will get a kind of separate-but-equal treatment—that is, faculty status stopping technically short of tenure. There are expected to be about 40 senior researchers at SLAC—half of them permanent staff and half visiting researchers—and 40 graduate students and postdoctoral fellows.

Demands for time on the big machine are expected to be very heavy when research operations begin, and the decision, in the first instance, on which experiments to schedule will be up to Panofsky and his associates. Because it may take a scientific Solomon to satisfy the applicants, and because SLAC is a national facility, the director will be backed by a scientific policy committee, made up of eminent men in the field and charged with reviewing and approving SLAC policies and projects.

So even now, years before the first electron is accelerated, SLAC, with its cuts and fills and high-tension power controversy, has brought home to Stanford the problems, internal and external, which arise as Big Science gets bigger.—JOHN WALSH

Elliott Hearings Published

Testimony and statements from the first round of hearings of the House Select Committee on Government Research, chaired by Representative Carl Elliott (D–Ala.), were published last week: Title: *Federal Research and Development Programs,* Part 1, $2.50; Part 2, $1 (U.S. Government Printing Office, Washington, D.C. 20402).

Announcements

Norbert Wiener, emeritus professor of mathematics at the Massachusetts Institute of Technology, died 18 March while traveling in Europe with his wife.

Wiener was born in Columbia, Missouri, in 1894. He graduated from the Ayer, Massachusetts, public high school at the age of 11, received a B.A. from Tufts at 14 and a Ph.D. from Harvard at 19. He joined the M.I.T. faculty in 1919, became a full professor in 1932, and remained there until his retirement in 1960.

Wiener was a child prodigy who fulfilled early promises of brilliance. A talented linguist, philosopher, and literary scholar, he was best known to the public as the "father of automation," and to his professional colleagues as the father of the term *cybernetics.* He was quoted as using the word to define a field that "combines under one heading the study of what in a human context is sometimes loosely described as thinking and in engineering is known as control and communication." Wiener's book *Cybernetics; or, Control and Communication in the Animal and the Machine* was published in 1948, and evoked wide interest among laymen and scientists. Among his other books were *The Fourier Integral and Certain of Its Applications, Harmonic Analysis in Complex Domains,* and *The Human Use of Human Beings.* He also wrote two autobiographical books, *Ex-Prodigy* and *I Am a Mathematician,* and contributed numerous articles to mathematical and scientific journals.

The American Pharmaceutical Association has joined the American Medical Association and the United States Pharmacopeia in their program of selecting **nonproprietary names for drugs.** The AMA and USP had combined efforts for this project in 1961, and the APhA cooperated through its Committee on National Formulary. Names