mally, over the long-distance phone."

The problem has been that DuBridge, president of Cal Tech since 1946, has been most concerned in recent years with the strength of universities generally and of university research more specifically.

"The only reason he wasn't more deeply involved is because I didn't want to ask a university president to speak in his own cause," says Hornig.

In California, DuBridge has used Cal Tech's management of the Jet Propulsion Laboratory and other major contracting installations as a way to strengthen the university's science programs. He has tended to restrict Cal Tech's classified research to them. He was an advocate of civilian control of the space program in 1958, and still believes the space effort is important principally for the scientific contributions it can make.

He has been an advocate of the centers of excellence program, by which Federal agencies have attempted to establish new first-rate centers of university science by adding a modicum of support to already good centers. But in a pinch, such as the one currently being felt in all university laboratories, his longstanding predilection for supporting the best research first could shape policy in the next few years.

"He believes," says Dr. Haworth, "that the progress of science is determined by what the real leaders do, and in their having adequate support." ◇

FRANCE

Austerity and research

Although it is still too soon to tell just how damaging the combined effect of university reorganization and severe fiscal austerity will prove to be on French science, clearly there is going to be considerable turmoil in French research until the franc crisis is resolved.

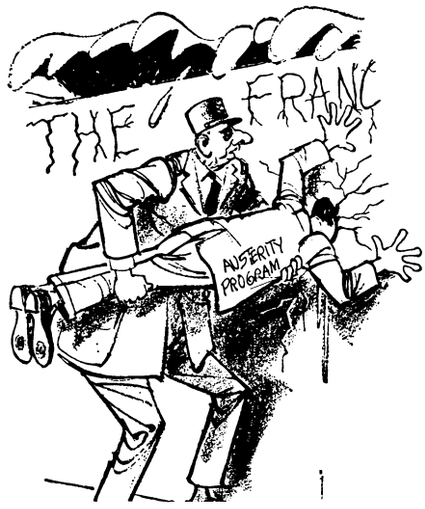
While no significant decrease in Government science spending had been ordered, a rigid limitation on the utilization of already allocated funds is expected.

President DeGaulle's refusal to devalue the franc carried with it the threat of real cutbacks in both the military and civil sectors of French scientific research. The force de frappe, DeGaulle's nuclear missile program, will be curtailed, but no official Government statement regarding nonmilitary research expenditures has been made.

Nonmilitary scientific research is another field of combat in DeGaulle's resistance of the American technological invasion. The universities themselves, already under pressure from the two higher education unions (one for instructional staff, the other for researchers), and obliged to comply with the university reform law by integrating students from all disciplines, now will have to carry on with less money.

University reform, stimulated by the student upheavals of last May, was pushed through the French National Assembly by the DeGaulle majority with wide liberal support. It has been called the most sweeping educational revolution since the present system was set up under Napoleon.

In effect, it takes away the autocratic power which the Minister of Education held over most French universities and gives control of budget, faculty and curriculum to local university councils elected by faculty and students.



Gene Basset

In research laboratories the most important effect will be in the purchase and leasing of major equipment. There will be more vigorous competition for the funds still available.

The French left has already called the impending reduction in these areas the latest in the series of Gaullist contradictions proving the need for changes more fundamental than the university reform and the quickly neutralized salary increases of last summer.

Individual researchers and investigators are aware that if funds are blocked or parsimoniously distributed, successful candidates for the 400 new research posts scheduled to begin in 1969 might find their starting dates postponed or their jobs canceled. Already there are frequent trips by highly trained and experienced scientific workers seeking work in Paris laboratories. At least one director of research at a Government center foresees a good amount of intellectual unemployment in 1969.

BROOKINGS STUDY

Nixon's choices

"What we do in the next 10 years will depend on our will, not our ability. . . . The United States adds the equivalent of a West Germany to its economic base every five years. . . . We can use our growth the way we want to use it. There will be no excuse in an economic sense for failing to attack social problems."

In these words, Charles L. Schultze, former director of the U.S. Bureau of the Budget, draws out the implications of an Agenda for the Nation, published by the Brookings Institution as a guide to the coming Administration.

Full of facts, figures, projections and estimates by 18 authors, the book describes the choices before the nation on domestic and foreign issues. Those choices, as Schultze and other Brookings economists make clear, are not economic but political and philosophical.

Economic policy can adjust the economy to the choice we make, says Schultze. Within limits, it can give as little or as much as the nation wants in public money without risking inflation or recession.

The overriding choice, however, and the one that will shape the 1970's, deals with post-Vietnam military spending. The Brookings authors point out that a decision in favor of full-scale expansion of the antiballistic missile system, combined with new offensive weapons, would eat up most of the revenue growth the Government can expect from future economic expansion. Schultze estimates that this increase in new, uncommitted revenue—which will not be available before 1974—will amount to about $35 billion to $40 billion, assuming a Vietnam ceasefire. Dr. Schultze does not expect much money to become available in the first few years following a ceasefire (SN: 7/20, p. 57).

"You can do a lot with $40 billion," says Schultze, but the potential claims on this money exceed its sum.

"The combination of a full ABM system with the possible attempt to gain nuclear superiority can bring back the whole balance of terror and determine the shape of the 1970's," he says. "This is the single most important critical decision."

The Brookings publication hints at the scope and magnitude of social issues and the kind of money needed to attack the so-called urban problem. While there has been a good deal of debate over specific programs such as Model Cities and the poverty war, the entire picture has never been laid out.

In his essay on jobs, training and welfare, James L. Sundquist, a former deputy under secretary of agriculture now at Brookings, accuses the Johnson Administration of "scrupulously refraining from even hinting at the ultimate cost" of its Great Society social welfare programs.

It is time to end the secrecy, says Sundquist, and lay out the long-range budget choices, "so that the great debate can begin."

Brookings authors who deal with the subject unanimously condemn the current welfare program for its inequities and destructive policies. Administered through states, the welfare system provides grossly different payment schedules in different parts of the country, many far below subsistence levels. While a family in a Southern state receives $35 a month, the same family in New York City would get $220. More than half the 34 million people in poverty receive no welfare at all. Welfare policies, as practiced in all but 21 states, foster desertion by unemployed fathers, destroy incentives to work and encourage rapid migration from Southern rural areas to overcrowded Northern cities.

"Reform of this insane piece of social engineering has become a first order of business on the national agenda," states Yale economist James Tobin.

Nationalizing and upgrading welfare systems is an alternative; instituting a negative income tax is another. Either choice would cost roughly the same, says Schultze: from $5 billion to $50 billion, depending on the level of income guaranteed and the rate of taxation people pay as they earn their own money (SN: 11/16, p. 497).

At the moment, Negroes are leaving the South at the rate of 100,000 a year, increasing metropolitan populations by 3.1 percent a year. This emigration plus natural increase will create problems in the cities for years to come, says Dr. Tobin.

To attack the hard-core unemployed problem, Dr. Sundquist believes a public works program is essential, along with energetic job training programs, locally based and federally assisted. If private employment expands, the public jobs can be easily retrenched, he says, but it is wishful thinking to believe that industry alone can solve the job training problem.

Neither will black capitalism provide an answer. Negro entrepreneurship should be encouraged, Dr. Sundquist adds, but to suggest that it can provide more than a token number of jobs for the hard-core is "pure romanticism." The black market is simply not big enough. Black capitalism was a theme of the Nixon presidential campaign. ◇

FERTILIZATION

Mice in a test tube

For all scientists know about animal reproduction, and for all they can do to control it, the process of mammalian fertilization remains an enigma. Unable to get mammalian eggs and sperm to mate in a test tube, researchers have been able only to speculate about what takes place when a sperm fertilizes an egg in the uterus.

Now a Massachusetts researcher reports the first case of partial test tube fertilization of rat germ cells, and a Welsh scientist working in Australia announces the first true test tube fertilization of mouse eggs.

According to Dr. David G. Whittingham of the University of Sydney, there is no basic difference between human and mouse eggs. Though few American workers in the field will say so directly, Dr. Whittingham's work opens the door to fertilization of human eggs in the test tube.

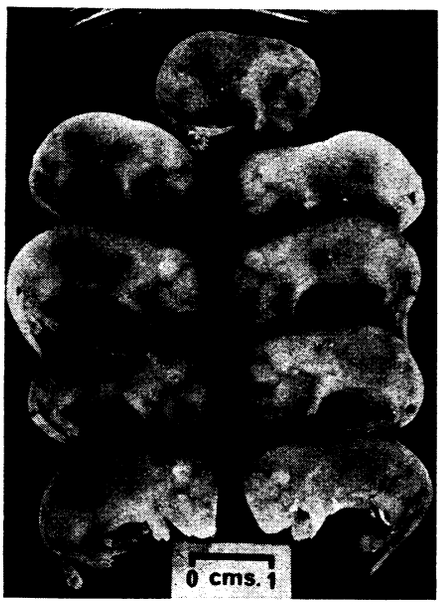
To fundamental research it means new and more relevant studies of the process of fertilization, the uterine environment, the growth of embryos and the possibility of altering them at any point.

The major stumbling block to achieving test tube fertilization has been persuading the sperm to penetrate the eggs. Sperm taken directly from the male and mixed with eggs in a test tube are impotent. In fact, they may be impotent for the first few hours even in natural mating. The work of Dr. Whittingham, and that of Dr. M. C. Chang of the Worcester Foundation for Experimental Biology, Shrewsbury, Mass., who reported the rat studies, lends considerable support to the capacitation theory. That says some factor in the uterus is necessary to activate the sperm.

Dr. Whittingham took eggs from unbred female mice 14 hours after injecting them with hormones that induce ovulation. He placed them on a watchglass in a growth medium and covered it with oil. Then sperm were collected from the uterus of a female that had been mated to a fertile male two hours earlier. The capacitated sperm cells were introduced to the eggs, placed under the oil cover through a glass pipette, and the mixture was incubated for four to five hours at 99 degrees F.

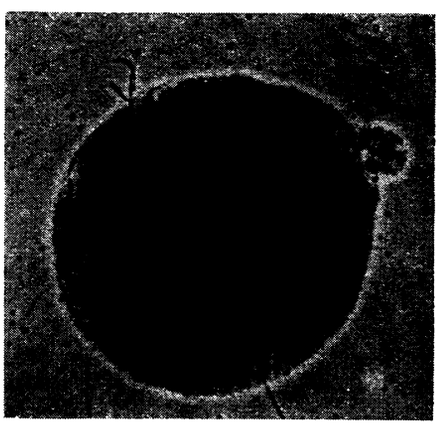
In 7 experiments 10 to 40 percent of the eggs were fertilized and cleaved or divided into two cells, which were placed in the womb of a third female, made physiologically ready for the fertilized eggs by mating with a sterile male. Nine fetuses developed and were removed from the womb on the 17th day.

Using methods similar to Dr. Whittingham's, Dr. Chang and his co-workers failed to recover a single fertilized egg in 844 tries. Success came when they added to their experimental medium an enzyme that dissolves the membrane envelope surrounding the eggs. Thereafter, fertilization took place, but because eggs cannot survive without that envelope, no baby rats developed.



Whittingham

Mouse fetuses fertilized in test tube.


Chang

Sperm (arrow) penetrates rat egg.

Creating conditions favorable to fertilization will continue to be a problem, scientists expect, because individual techniques are required for each species.

And biologists still have a long way to go before creating an animal that has been grown, as well as fertilized, in a test tube. The success with mice, and previous partial success with hamsters, shows that the fertilized eggs must be implanted in a foster mother for nourishment after only a few cell divisions. This will continue to be the case until researchers create an artificial womb.