surviving until birth. Those which survive so long have abnormally small heads, hydrocephalus, structurally abnormal brains and spinal cord, extreme edema, but normal tails!

The first signs of abnormality which can be recognized in young t^{w1}/t^{w1} embryos appear at about 8 or 9 days of gestation. At this time pycnosis begins to appear in the *ventral* neural tube; the process of pycnosis begins most often in the cervical region and spreads both anteriorly and posteriorly. The distribution of cell death remains, however, strictly confined to the ventral regions of the neural tube and leads in many cases to the virtual death of the whole ventral portion. In some embryos, however, viable cells apparently remain, and in embryos which survive, a process of repair ensues which restores the integrity of the neural tube, although its architecture is not normal. Thus any one region in such embryos undergoes successively pycnosis, extreme degeneration, and repair. The brain in such embryos also undergoes degeneration of the ventral portion, and consequently is smaller and less well differentiated than normal. The skull is also retarded in differentiation, and in fact is smaller, in relative proportion, than the brain; thus these embryos are at the same time microcephalic and hydrocephalic. The relative disproportion of the skull might be taken as evidence for some inductive action of the ventral portions of the brain on the formation of skull cartilage.

In recapitulation, it can be said that the recessive alleles at the *T*-locus all appear to have effects on early and basic processes of axial organization, especially those which are concerned with increasingly complex differentiation of the ectoderm. As yet, no clear evidence is available on the matter of how the effects of alleles are related to one another, and whether they represent qualitative or quantitative differences. The fact that many of them, at least, must have some qualities in common is indicated by the abnormalities frequently found in animals of compound (t^x/t^n) genotype (*12*). As was shown in the preceding paper, complementation (meaning the production of at least some viable normal-tailed compounds of genotype t^x/t^n) exists between members of all these different groups. However, such complementation is not always complete or perfect, and animals of various compound genotypes are often poorly viable and morphologically abnormal. The interesting thing is that all such combinations of *t*-alleles seem to produce essentially the same types of abnormality. These are almost always abnormalities showing varying degrees of otocephalic characteristics, such as microcephaly, micrognathia, or microphthalmia.

The existence of such abnormal compounds gives additional evidence for the idea that the *t*-alleles control some common process which is involved with the differentiation of ectodermal and neural structures.

DOROTHEA BENNETT

References and Notes

1. L. C. Dunn, *Science*, this issue.
2. N. Dobrovolskaia-Zavadaskaia, *Compt. Rend. Soc. Biol.* **97**, 114 (1927).
3. P. Chesley, *J. Exptl. Zool.* **70**, 429 (1935); H. Grüneberg, *J. Embryol. Exptl. Morphol.* **6**, 424 (1958).
4. D. Bennett, *Nature* **181**, 1286 (1958).
5. C. Grobstein and H. Holtzer, *J. Exptl. Zool.* **128**, 333 (1955).
6. L. J. Smith, *ibid.* **132**, 51 (1956).
7. N. Dobrovolskaia-Zavadskaia and N. Kobozieff, *Compt. Rend. Soc. Biol.* **110**, 782 (1932).
8. S. Glueksohn-Shoenheimer, *Genetics* **25**, 391 (1940).
9. D. Bennett and L. C. Dunn, *J. Morphol.* **103**, 135 (1958); L. C. Dunn and D. Bennett, *Genetics* **45**, 1531 (1960).
10. D. Bennett and L. C. Dunn, *J. Exptl. Zool.* **143**, 219 (1960).
11. D. Bennett, L. C. Dunn, S. Badenhausen, *Genetics* **44**, 795 (1959); D. Bennett, S. Badenhausen, L. C. Dunn, *J. Morphol.* **105**, 105 (1959).
12. S. Silagi, *Develop. Biol.* **5**, 35 (1962).

13. Supported by AEC contract AT (30-1) 1804, NSF grant G-6132, and USPHS grant GM 09912.

SCIENCE AND PUBLIC AFFAIRS

The Political Good Fortune of Medical Research

Two strategically placed legislators regularly assure congressional generosity for the NIH budget.

Milton Viorst

Congress' generosity in the field of medical research stands in sharp contrast to its response to other domestic welfare needs. Every year, for example, little is done to meet the problems of unemployment, air pollution, urban congestion, and education. Though the existence of these problems is generally acknowledged, Congress continues to argue about how to resolve them but reaches no consensus. Since the war, however, medical research has been a congressional favorite, almost as sacrosanct as national defense. While the proponents of other good causes plead vainly for dollars, medical researchers have had no such problem.

The figures record the story:

In 1940 Congress voted $3 million for health-related research. By 1957 the figure had reached $186 million. Last year, it exceeded $916 million and will, in this year's budget, come close to $1 billion.

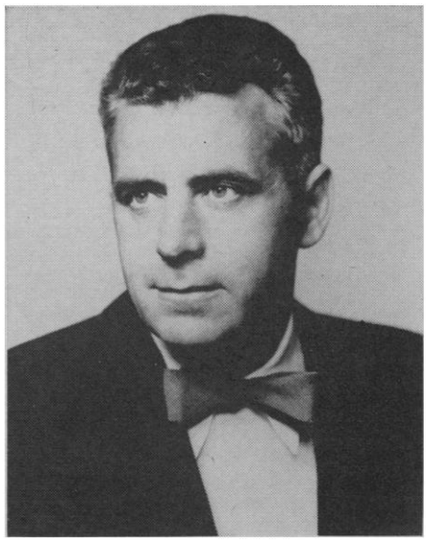
In 1957 private sources provided more funds than government for medical research. Last year, though private contributions had almost tripled, the government provided nearly twice as much money as private sources.

In other terms, $1 out of every $4000 of federal expenditures went to medical research in 1940; last year the proportion was almost $1 out of every $100.

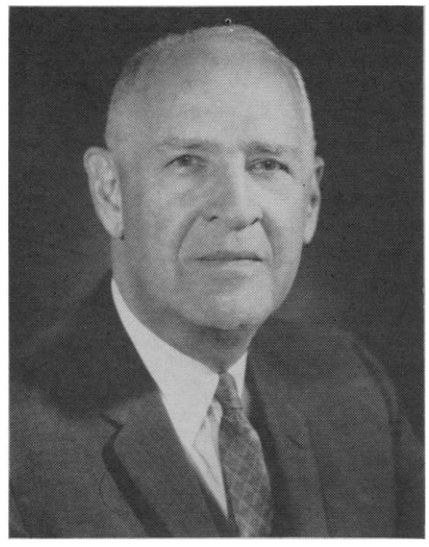
The explanation for this phenomenon lies, in large measure, in the universality of disease and the remarkable advances made in medicine since the war.

Congressmen and senators who live in spacious suburbs and send their children to excellent schools may be badly equipped to recognize the wel-

The author is a Washington-based correspondent. He has written for various publications, including *Harper's* and the *Reporter*, and is the author of a political biography of Charles de Gaulle, to be published this spring by Macmillan.



John E. Fogarty



Lister Hill [Fabian Bachrach]

fare needs of our less fortunate citizens. But they all know about cancer, fear retardation in their children, and have friends whose lives heart attacks have brought to an abrupt end.

Thus, the politics of medical research rests on the fact that illness cuts across the political lines which usually divide men in Washington. It strikes Republican voters as well as Democrats, conservatives as well as liberals, Protestants as well as Catholics and Jews. It affects the rich and the middle-class, who have much influence in Washington, almost as much as it affects the poor, who have next to none. Unlike farm subsidies on the one hand and urban renewal on the other, it has equal impact on city dwellers and country folk. Medical research, unlike conservation or aid to the arts, has almost universal appeal. In practical terms, this appeal means that no powerful lobbies stand, swords drawn, waiting to slash away at the medical research budget.

Congressional Leadership

But medical research would never have reached the current level of federal support if its only advantage were the negative one of having no enemies. A program, even a popular one, must have a champion. Under the American system of government the champion usually is the President, who initiates legislative ideas through his recommendations to Congress. Rarely does the leadership come from Congress itself. But medical research is a special case. Under neither Eisenhower nor Kennedy did the interest of the White House in medical research approach the passion for the program that has been generated on Capitol Hill. Without vigorous champions, one in the House and one in the Senate, each fortuitously placed to exercise his leadership, medical research might be just another federal project, hobbling along on routine appropriations, badgered rather than spurred on by Congress, fighting to hold its own rather than seeking new fields to explore.

The bulk of the credit for the government's massive support of medical research belongs to two men, Representative John E. Fogarty, Democrat of Rhode Island, and Senator Lister Hill, Democrat of Alabama. Each is chairman of the subcommittee of the Appropriations Committee for the Department of Labor and the Department of Health, Education, and Welfare (HEW). Though as a general rule in Washington the longer the title the less the authority, on the Appropriations committees the subcommittee chairmen exercise enormous influence, not only over the budget but, through the budget, over the departments of their jurisdiction. Since the National Institutes of Health, an HEW agency, conducts or supervises the bulk of federally supported medical research, Fogarty and Hill possess vast power over the support of medical research. The peculiarities of the congressional power structure and the seniority system being what they are, it would have been quite normal for these posts to be in the hands of foes of medical research, just as some other, less generously supported programs have the misfortune to be in the hands of foes. But medical research has been lucky. Both Fogarty and Hill are deeply dedicated to its objectives. Far from adopting the economizing habits that are characteristic of the Appropriations committees, they have sought to push their programs up and up. Fogarty and Hill have earned their reputations as friends of public health.

The two men could hardly be more dissimilar. Fogarty, a 51-year-old New Englander, is of Irish-Catholic, working-class background. Hill, 69, is a Southern, Protestant, Anglo-Saxon aristocrat. Fogarty, though given to wearing flamboyant bow ties, is reserved in manner, even timid. Hill is unobtrusive in dress, but outgoing and patriarchal in manner. The two men get along well enough for professional purposes but, having nothing else in common, can hardly be considered close. Together, however, they make up perhaps the most effective leadership team on Capitol Hill.

John E. Fogarty was one of six children raised in the small Rhode Island village of Harmony. When he finished high school he took up bricklaying, his father's trade. But, intelligent and restless, he went into politics. At 21 he became chairman of the local Democratic committee and, a few years later, the president of the bricklayers' local union. In 1940, after having failed once to get the nomination, he ran for Congress and won. But he has never given up his membership in the bricklayers' local, and to this day he builds steps or repairs a chimney for a neighbor during vacations.

Sought Labor Post

True to his labor background, Fogarty first sought a position on the Education and Labor Committee in the House, but he wound up with an assignment to Naval Affairs. It was not until 1947 that he was promoted to a seat on the coveted Appropriations Committee and then, to his displeasure, named to fill a vacancy on the Labor-HEW subcommittee. Two years later, by the accidents of the seniority system, he became the chairman of the subcommittee.

The Appropriations Committee, in those days, was the private domain of its chairman, Representative Clarence Cannon, Democrat of Missouri, a shrewd legislator who was mercilessly tight-fisted with federal expenditures.

Cannon and the senior Republican, equally tight-fisted John Taber of New York, exercised their will through energetic exploitation of committee rules. Soon after joining the committee, Fogarty led a revolt against Cannon and, after a bitter battle, managed by a single vote to reduce the chairman's prerogatives. Cannon at 84 still rules the committee. But the revolt of 1947 ended his domination and left Fogarty free of his veto power.

Though intensely proud of his work on the subcommittee, Fogarty talks about it only reluctantly. His conversation is unpolished and carried on in almost inaudible tones, sometimes resembling a mumble. He seems self-conscious about the attention paid him. He is more at ease in discussing the substance of his work than he is in making abstract declarations about it. But the impression which his words and his actions convey, and which his record sustains, is that he is a man of deeply humanitarian convictions.

"I have always acted on the principle," he said in a moment of eloquence, "that budgetary anemia—induced by cynicism—is an attribute of materialism. It contradicts the notion in our society that the life and well-being of an individual—extended, restored, or eased by the scientific dedication of his neighbors—is a richness beyond all value, a prize without price."

But the House is full of men of conviction. The secret, if such there be, of Fogarty's personal influence is his meticulous attention to detail. Fogarty boasts, without exaggerating, that no committee in Congress works harder than his before bringing out a bill. For this, he credits Republicans as well as his fellow Democrats. But it is on him personally that the burden of leadership falls, and when pressed he admits, "I live this thing all year around." It is well established in the House that the better a chairman knows what is in his bill the greater his chances are of having it passed intact. Fogarty, though by no means a brilliant debater, invariably possesses such a thorough grasp of his material that he can deal in virtuoso fashion with the challenges thrown at him.

Like the day the Turks were beaten at Lepanto or the Moors at Tours, Fogarty regards 4 April 1957 as the historic day on which he turned back the tide against medical research. An obsession for economy had swept through Congress that year, largely as a consequence of the warning by Eisenhower's Secretary of the Treasury, George Humphrey, that an uncut budget would cause a depression that would "curl your hair." When the medical research appropriation proposal reached the House floor, it was submitted to a merciless attack. In the course of the next 2 weeks, Fogarty went down to one defeat after another in voice votes on amendments. As one congressman put it, "If the Ten Commandments had been in that bill, they would have been cut to seven." But when the time came for final passage, when every Congressman had to go on record, Fogarty regrouped his forces and insisted that each of the amendments be reconsidered. A record number of roll calls was held that day, 14 in all, and, except for minor losses, Fogarty left the battlefield victorious. Since the fateful "Day of the Fourteen Roll Calls," Fogarty maintains, his proposals for large appropriations for medical research have never been seriously threatened.

Declined Senate Race

John Fogarty does not seem to be motivated by ambition, in any conventional sense. He has received countless citations, which he cherishes, but he is not a seeker of publicity. Nor is he a seeker of riches. When he was given $5000 in 1959 for the Lasker award, he used it to establish the John E. Fogarty Educational Training Center for the Mentally Retarded. Since then he has set up the Fogarty Foundation, which he helps support with whatever stipends and prizes he receives, including $8333 presented to him this past February by the Joseph P. Kennedy, Jr. Foundation. If political advancement were his goal, he would not have declined the chance to run 3 years ago for the Senate, to which he would almost certainly have been elected. If there is any aggrandizement he covets at all, it is the esteem he has won among men he admires. "It's a hell of a privilege," he explained in an interview, "to listen to the best doctors in the world talk about heart and cancer." A smile of pride crosses his Hibernian face when he reveals that, when he suffered a coronary attack a decade ago, he was treated by Paul Dudley White, who remains his friend and adviser.

Politically, Fogarty is fortunate in being able to give so much time and attention to medical research without risking the support of his constituency. Fogarty is careful, nonetheless, to keep in constant touch with the voters. Without fail, he returns home every weekend, not only to see his wife and teen-age daughter but to see and be seen by the voters. Although his district was Republican before he won office, Fogarty received 72 percent of the vote in the last election. The voters of his district, whether sick or well, clearly approve of what he is doing.

Lister Hill, a senator since 1938, is not quite so fortunate politically. He comes from race-conscious Alabama, not a liberal working-class constituency. His electorate regards medical research as less important than the concerns generally listed under the heading of "states' rights." In that sense Hill finds being a leader in medical research more of a hardship than Fogarty does. He was, in fact, nearly defeated in the last election by an extreme racist opponent. Political survival requires that Hill, too gracious to be a demagogue, boast that he has "stood first and foremost with Alabama and the South in defending Southern ways and traditions." But though he serves the South, it is certain that he is happier serving public health.

More than Fogarty, Hill has an intensely personal concern with the conquest of disease. His father, Luther Leonidas Hill of Montgomery, was one of the prominent surgeons of the South. Hill proudly recalls that his father performed a successful heart operation early in the century to repair a stab wound. The Senator, named for Joseph Lister, was brought up in an atmosphere of medical learning. His father had one of the finest medical libraries in Alabama. The Senator admits unhesitatingly that much of what he does is out of veneration for his father, whom he regards as "an inspiration and a challenge." For whatever he has achieved in behalf of medical research, Hill said, "my father must get the credit."

Hill might have been a physician too, had he not found, while still a young man, that he could not stand the sight of blood. Even now, there's a note of remorse when he explains that he chose to become a lawyer instead. If he had to do it all over again, he said, he would go through the first 2 years of medical school, "if only to learn the terminology." After talk-

ing to Hill, one has the feeling that, having failed to become a physician, he is now paying his debt to medicine on Capitol Hill.

Unlike Fogarty, Hill acquired his position of leadership over medical research by design. In the Senate it is easier for a senior member to select his assignment than it is in the more unwieldy House. Hill, after the war, chose to relinquish considerable seniority over national defense matters to preside over medical affairs. In addition to being chairman of his money-dispensing appropriations subcommittee he is now chairman of the Senate Committee on Education and Labor, which writes legislation concerning the Public Health Service. He thus has double jurisdiction over health matters, an advantage he uses skillfully to advance his favorite cause.

As a Senator, Hill is better placed than Fogarty to take the lead in appropriations because the Senate in recent years has been considerably more generous with federal funds than the House. In large measure, this is because the chairman of the Appropriations Committee, Senator Carl Hayden of Arizona, is not obsessed with economy the way Cannon is. In fact, the Senate has shown itself more liberal than the House in virtually every area. Thus, Hill operates in a milieu more favorable to his objectives than Fogarty does.

But Hill, like Fogarty, also commands the respect of his colleagues for his hard work and attention to detail. The difference between them is that Hill enjoys doing his research on medicine, while for Fogarty it is simply a means to an end. Hill goes home at night and reads medical books and journals. A scholarly, contemplative man, his committee work is his hobby, which he pursues not only for its rewarding results but for its immediate pleasures. It is probably fair to say that Hill does not have Fogarty's deep, undiscriminating humanitarian impulse. But when he takes the floor of the Senate, his colleagues cannot help but be influenced by the fact that the recommendations come forth not only from duty but from love.

Hill invariably recommends a bigger appropriation than Fogarty, because it is easier for him to do so. In 1957 the Administration asked for $126.7 million for the National Institutes of Health, Fogarty's committee voted $135.7 million. Hill raised the figure to $183.2 million, which was the amount on which the House and Senate ultimately agreed. Last year the Administration asked for $780 million. Fogarty brought out a recommendation, which the House approved, of $840.8 million. Hill had the Senate vote $900.8 million. The final figure accepted by both bodies was $880.8 million.

Occasionally Fogarty has complained that the Senate appropriation was too large and that the money could not be efficiently used. Several times, NIH funds have been returned to the Treasury, ostensibly because it was impossible to find worthy projects to spend them on. Though this return suggests that Fogarty may have been right, it is usually suspected that he does not worry at all about excessive appropriations but finds the technique useful for keeping the economizers at bay. Despite his complaints, he and Hill go merrily on with their game, year after year, adding on funds where they think the funds are needed.

Hill, in defense of congressional largesse for medical research, has glowingly predicted the imminent arrival of a "Golden Age of Medicine." He insists that "within a relatively few short years the world will see a tremendous breakthrough of medical knowledge that will enable us to overcome the dread diseases that have plagued and baffled mankind through the ages. There is reason for confidence," he asserts, "that this breakthrough will yield the answer to heart disease, cancer, mental illness, the virus diseases, and the many other crippling degenerative ailments."

His prophecy of "a relatively few short years" may be unduly optimistic, and as pressures grow on the overall federal research budget, medical research is, for the first time in a decade, experiencing a few unaccustomed pinches. But when viewed in perspective, it is clear that the medical research budget occupies one of the most enviable positions in the U.S. Congress, a fact for which the gentlemen from Alabama and Rhode Island are in large part responsible.