in the research optical shops of the Bureau of Standards three years ago."

THE *Journal* of the American Medical Association states that a new department of preventive medicine has been established at Tulane University of Louisiana School of Medicine, New Orleans, as the result of an arrangement with the Commonwealth Fund of New York through which the university will participate in the rural health program recently initiated in Mississippi by the fund. An annual appropriation of $25,000 has been allotted by the fund to the school of medicine to establish the new department and to encourage attention to preventive medicine in other clinical departments. Five free scholarships have been established for undergraduate medical students from Mississippi, providing the student with $1,200 a year for four years, with the requirement that after graduation he shall practice at least three years in Mississippi. In addition, fifteen practicing physicians will be sent each year to Tulane for four months' graduate work. Their tuition and transportation to and from New Orleans will be paid by the fund and they will be allowed a monthly stipend of $250. Dr. William Harvey Perkins is head of the new department. The arrangement with Tulane is similar to that made recently with the Harvard University Medical School for practitioners of Massachusetts.

THE Forest Service of the U. S. Department of Agriculture has announced an addition of 16,558 acres of forest land to the national forest area in the Eastern, Southern and Lake states. The National Forest Reservation Commission has approved an expenditure of $52,624 for the purchase of this land. The land acquired will be added to the national forest purchase units which are already protected and administered by the Forest Service for continuous development of forest resources and to safeguard watershed values.

DISCUSSION

THE UNCERTAINTY PRINCIPLE AND FREE WILL

IN his very excellent presentation of the uncertainty principle, published in a recent number of SCIENCE,[1] Professor Darwin concludes with a comment regarding the significance of this principle in connection with the problem of "free will," which should not be allowed to pass without comment. He may be correct in his view that "the question is a philosophic one outside the thought of physics." Yet the reason that he offers to show that the uncertainty principle does not help to free us from the bonds of determinism is inadequate.

Darwin's argument is that "physical theory confidently predicts that the millions of millions of electrons concerned in matter-in-bulk will behave . . . regularly, and that to find a case of noticeable departure from the average we should have to wait for a period of time quite fantastically longer than the estimated age of the universe." He apparently overlooks the fact that there is a type of large-scale event which is erratic because of the very irregularities with which the uncertainty principle is concerned. I refer to those events which depend at some stage upon the outcome of a small-scale event.

As a purely physical example, one might pass a ray of light through a pair of slits which will so diffract it that there is an equal chance for a photon to enter either of two photoelectric cells. By means of suitable amplifiers it may be arranged that if the first photon enters cell A, a stick of dynamite will be exploded (or any other large-scale event performed); if the first photon enters cell B a switch will be opened which will prevent the dynamite from being exploded. What then will be the effect of passing the ray of light through the slits? The chances are even whether or not the explosion will occur. That is, the result is unpredictable from the physical conditions.

Professor Ralph Lillie has pointed out[2] that the nervous system of a living organism likewise acts as an amplifier, such that the actions of the organism depend upon events on so small a scale that they are appreciably subject to Heisenberg uncertainty. This implies that the actions of a living organism can not be predicted definitely on the basis of its physical conditions.

Of course this does not necessarily mean that the living organism is free to determine its own actions. The uncertainty involved may merely correspond to the organism's lack of skill. Yet it does mean that living organisms are not subject to physical determinism of the kind indicated by Darwin.

ARTHUR H. COMPTON
UNIVERSITY OF CHICAGO

[1] C. G. Darwin, SCIENCE, 73, 653, June 19, 1931.

GEOMORPHIC NOMENCLATURE

IN any progressive branch of science there arrives a time when the nomenclature adopted in the early stages of that science becomes inadequate, either be-

[2] Ralph Lillie, SCIENCE, 66, 139, 1927. Lillie draws much the same conclusion as that found here.