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.

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

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

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 because of inaccurate usage or because of insufficiency in the light of growing conceptions, or for both reasons. This phenomenon is exemplified in the history and present needs of geomorphic nomenclature.

When the conception and the word, peneplain, were simultaneously introduced by the American founder of geomorphic science, Professor William M. Davis,[1] the conception, which this word was manifestly intended to cover, was the land form produced in the penultimate stage of the erosion cycle, the approximate completion of a cycle of erosion over great areas and on large land masses.

Further study of land forms long ago revealed the truth that cycles of erosion are not all of like duration; they may be terminated at any point of progress toward ultimate completion. Where traces of the forms produced in these earlier stages have been preserved, geomorphologists have been content to call them partial peneplains, and more immature forms of still earlier stages have been called terraces or, more recently, straths.

Terrace is too useful a term in its unrestricted meaning to be withdrawn for such a limited and technical use. Strath is defined in the Standard Dictionary as follows: "(Scot.) A wide open valley, usually a river course; distinguished from a glen." This has been its usage by Geikie in "Scenery of Scotland" (p. 156). It is scarcely admissible to use with a new significance a geomorphic term which has a prior and different usage in Great Britain, namely, to designate the broad valley floor unrejuvenated. Several years ago the writer, feeling keenly the need of a term that should not put limitations on so useful a word as terrace (or as bench) and that might be given a restricted technical significance, approached M. R. Campbell and Laurence LaForge of the U. S. Geological Survey for suggestions. The discussion that ensued resulted in the selection of the word *berm*.

Berm is defined in the Standard Dictionary as follows: "*Civ. Eng.* A horizontal ledge part way up a slope; bench. *Fort.* A narrow level space at the outside foot of a parapet, to retain material which might otherwise fall from the slope into the ditch." It is suggested that this term be given a geomorphic usage; it should be used to distinguish those terraces which originate from the interruption of an erosion cycle with rejuvenation of a stream in the mature stage of its development. Dissection, following upon elevation of the land, will leave remnants of the earlier broad valley floor of the rejuvenated stream as a terrace, or berm, and remnants of the uplifted abrasion platform as a seaward-facing terrace, or berm. In different localities every gradation between relatively narrow berms and widely developed peneplains may occur. Considerable latitude should be given therefore in the use of this term, so that it may include berm-like forms as well as typical berms; while those forms more nearly approaching the peneplain might be called partial peneplains.

Such a distinction as the following between berms, partial peneplains and peneplains might be considered: berms, paralleling streams and sea-coast, only cross divides on weak formations; partial peneplains cross divides on rocks of median resistance or on decayed resistant rocks; peneplains are wide-spread on resistant as well as non-resistant rocks.

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[1] "The Physical Geography of Southern New England," *Nat. Geog. Monograph*, 1: 276, 1895.

LORD KELVIN'S "MORTAL SPRING"

WHEN I began the study of the calculus, using Church's "Elements of the Differential and Integral Calculus," I was greatly bewildered by the reasoning leading to the central principle of the subject, the differential coefficient, latterly the derivative. How a quantity, dx, for example, could be something in the first member of the equation and nothing in the second was a great mystery, and the statement that such was the fact came as something of a shock to one who had begun to associate clarity and rigor with all mathematical processes. It looked, to a novice, suspiciously like smuggling approximation methods into a territory where exactitude alone is permissible.

Since Newton was one of the founders of the calculus I turned to him for light, and examined with care his method of passing, using present-day symbols, from $\frac{\Delta y}{\Delta x}$ to $\frac{dy}{dx}$. After considerable labor I was forced to the conclusion that the passage was made by a flash of intuition, and not by so-called logical rigor. His mind had been prepared, of course, for this great insight by deep and long-continued reflection upon the behavior of variable magnitude. This helped me out, for what was good enough for Newton should, surely, be good enough for me. I proceeded at once to apply the new instrument to the solution of interesting and important geometrical and physical problems, with gratifying results. Confidence in the validity of the processes was quickly and firmly established. My satisfaction with this method was strengthened by the discovery that Comte in his later years veered to the view that there is a transcendental element in the calculus which renders all attempted demonstrations alike irrational and futile. The laws of the calculus, like Newton's laws of motion, are to be accepted because in all their applications they are always found to agree with the facts