going out each period of the year, industry would have a constant supply and could at the same time appraise desirable individuals who might be employed permanently upon graduating. The government in connection with its ROTC and perhaps similar units for the Navy and aviation could also have students in training, in relays, and be well equipped with a reserve group in time of emergency. The relay system of cooperation with industry is not new. It is in effect in a small number of institutions. The relay system in connection with government service does not exist to the author's knowledge. Certainly if the idea were generally applied, we could continuously afford educational, industrial and Federal fields a supply of individuals for training, and, upon graduation, give the nation a regular supply of skilled leaders. Also, let us not forget that students who can afford to attend college continuously will have their full earning or serving power at the end of two and two thirds or three years in the trimester and quarter systems respectively.

Faculty Salaries and Schedules

At present most teachers are paid only nine or ten months of the year. It is a tradition that the summer period is necessary for study, research or travel. How many teachers utilize the period for any of these purposes? Many of them necessarily work during the summer to increase incomes.

Assuming a twelve-month college year with a regular salary payment for each of the twelve months, the ambitious teacher could still be free during a quarter, trimester or even longer period by making the necessary arrangements and could probably have a much greater variety of study and research at his command than is possible during the summer term. Teachers might even gain practical experience in relays like the students, or they might plan work under great leaders who are not available during summer sessions. By working continuously over an appreciable number of years, an entire year might be available for travel or study. In other words, vacation or study periods could be planned or selected so as best to serve the individual's wants.

What about the traditional summer session? As not all schools are likely to subscribe to a plan like the one which has been proposed, short summer terms to meet state-teacher requirements and the wants of those who have been in the habit of taking summer courses could still be made available.

A Critical Period

A real "all-out" program requires full and immediate cooperation from every man, woman and child. Why not start the "twelve-month college year" now, even if parents and teachers have to make a monetary sacrifice, temporarily? Eventually industry, the state and the nation will make the sacrifice unnecessary.

Alexander Silverman
University of Pittsburgh

MEAN SEA LEVEL AND SAND MOVEMENT; A REPLY[1]

Speculative hypotheses which overlook factual evidence are luxuries which might well be dispensed with during the war, particularly where conclusions might lead to errors of judgment in military construction. A serious case of this nature appeared recently in this journal[2] and was the less excusable because its writer had been informed of the facts. In this article Leypoldt attempted to show that observations by U. S. Grant and by the writers relative to seasonal offshore shifting of sand in winter and onshore shift in summer have been based on erroneous interpretations, and that actually the sand is shifted along the shores of bays due to changing currents piling up at one end of each bay during one season and at the other end during another season. Leypoldt gives the impression that these shifts of the sand are well known and that the out- and in-movement of sand is nothing but an unwarranted assumption.

These arbitrary statements by Leypoldt will be a surprise to every one who has studied the California beaches either from a scientific or engineering point of view. According to Leypoldt, the sand beaches should be as wide on the average in summer as in winter, but the wide zones should be present at different places. This can be said to be absolutely contrary to fact. The writers have made over 50,000 soundings and observations on the width of beaches at La Jolla and elsewhere along the California coast during the past nine years. Short-interval observations have been made for the past four years along the entire length of the beach south of the Scripps Institution of Oceanography at La Jolla and for over a year LaFond has measured the depths along the three open ocean piers in the San Diego area at frequent intervals. Grant and his students have made seasonal measurements of beach profiles at a number of places along the coast near Los Angeles. Also the Los Angeles County engineers have measured profiles off the beaches in Santa Monica Bay at different seasons. The results have been remarkably similar. In nearly all cases the sand level has shown a decrease along the shore during winter and an increase outside. Numerous small beaches in coves of rocky headlands are completely washed out during the first winter storms and do not return until there has been a long

[1] Contributions from the Scripps Institution of Oceanography, New Series, No. 155.

[2] Harry Leypoldt, Science, 94: 2452, 607–609, 1941.

period of small waves. In some cases the beach is removed and rebuilt several times during a season, provided there are long calm periods alternating between storms.

On the other hand, there is much evidence of temporary shifting of sand along the beaches and there are times when cutting at one part of a beach is accompanied by fill along another portion. The records obtained from the beach extending south of Scripps Institution show cases of this nature and the observation of currents at the end of the pier show the reason for the shift of the sand. However, these lateral shifts are on the whole subordinate to the outward and inward movements of the sand as evident from the shoaling and deepening of water recorded several hundred feet from shore.

Leypoldt appears to be disturbed by the idea that oscillating wave motions are accompanied by shifting of sand both toward the land and toward the sea. The study of rip currents[3] gave some data in this regard. Also the study of the effects of different kinds of waves[4] in relation to the shifting revealed that large waves of long period shift sand seaward most effectively, whereas small waves of small amplitude shift sand towards the land.

Leypoldt's hypotheses as to the cause of seasonal fluctuation in sea-level heights are as ungrounded as are those concerning sand movements. He states, "Sea-level heights are functions of rainfall in the locality, together with river discharge and other methods of ground-water return, and water removal for rainfall." Observations from the tide staff at La Jolla show that sea level here is usually highest during the months of least rainfall, when the Southern California rivers are dry, and when the water has its highest salinity. The more plausible explanation of sea-level fluctuation is based upon the fluctuations in water temperatures.[5]

Other statements by Leypoldt, such as "When sea level is high along the Pacific coast of the United States it is low along the South American coast, necessitating an interchange of water between the hemispheres," are made without giving any data whatsoever, so that one wonders if they are not also based on some of Leypoldt's hypothetical hunches. It is to be hoped that in the future Mr. Leypoldt will make some attempt to investigate the facts before he lets these wild ideas loose on the scientific public.

FRANCIS P. SHEPARD
UNIVERSITY OF ILLINOIS

EUGENE C. LAFOND
SCRIPPS INSTITUTION OF OCEANOGRAPHY

[3] F. P. Shepard, K. O. Emery and E. C. LaFond, *Jour. Geol.*, 49: 337–369, 1941.

[4] E. C. LaFond, *Proc. 6th Pacific Science Congress*, II: 795–799, 1939.

[5] E. C. LaFond, *Jour. Marine Research*, 2: 1, 17–29, 1939.

ON TOAD AND FROG ABUNDANCE AFTER HEAVY RAINFALL[1]

GUNTER'S observation on the exceptional abundance of young toads after a season of very heavy rain in southern Texas[2] prompts me to record my observations on the same type of phenomenon in Oklahoma during the same year. A total of 29.02 inches of rain was recorded at Norman, Oklahoma, during the first half of 1941, of which 25.22 inches came between April 1 and June 30. There were 12.02 inches in June alone. Comparable amounts were recorded in many other parts of the state. The extensive flooding formed temporary pools which did not completely evaporate in some regions till mid-summer. From early in April till near the end of June, extensive choruses of Amphibian voices could be heard almost any night and often during the day immediately after a rain. There was a greater opportunity for all forms to breed than had occurred here for many years.

The various species reacted differently, however. The flooding produced many more young than usual of: (1) *Bufo cognatus* Say—literally millions emerged from pools from early May to early June; (2) *Pseudacris streckeri* Wright and Wright; (3) *Pseudacris clarkii* Baird—choruses were so heavy as to be deafening at times, hundreds of thousands of young emerged; (4) *Microhyla olivacea* (Hallowell); (5) *Scaphiopus bombifrons* Cope; (6) *S. hurterii* Strecker; and (7) *Rana sphenocephala* (Cope). I could find no evidence that the successful reproduction of the following had been materially increased: (1) *Bufo a. americanus;* (2) *B. w. woodhousii* Girard; (3) *Acris crepitans* Baird; (4) *Hyla v. versicolor* Le Conte; and (5) *Rana catesbeiana* Shaw. All the above pertains to the region of Norman, Cleveland County.

In southeastern Oklahoma, neither *B. a. americanus, B. w. fowleri, Rana clamitans* Latreille, *R. catesbeiana* nor *R. a. areolata* Baird and Girard reproduced successfully in exceptionally great numbers, but *Pseudacris triseriata* (Wied), *Microhyla olivacea* and *Rana sphenocephala* did so.

It should be recorded also that autoists traveling U. S. Highway 66 between Oklahoma City and central New Mexico reported "thousands of young toads" on the road at night in June. Many similar reports from southwestern Oklahoma lead me to believe that *B. compactilis* was very productive, since this is the toad in that region most likely to frequent roadways in numbers.

The differential reactions of these groups of species is in complete accord with the view that some species are specifically adjusted to a grassland habitat in their breeding activities, whereas others are not. For

[1] Contribution from the Zoological Laboratory of the University of Oklahoma.

[2] *Copeia*, 4: 266, 1941.