4 to 5 inches high occurred on the slope above the main terrace, suggesting multiple slipping. This idea is strengthened by the fact that a number of wrinkles resembling small overturned folds occurred on the surface of the large terrace.

Extending southward from the base of the main slip for a distance of 36 feet creep had occurred, forming a terrace whose front was 2 feet high and 6 feet wide. The uphill side of this creep was scarcely discernible except for the steepened slope, since the grass was not seriously disturbed. Gullying on the slope was negligible.

The slip took place on a clay layer about 11 feet above the horizon of the Harlem coal. The material above the clay became saturated with water after a week of almost daily rain. The rain gauge 75 feet above the slip showed the following rainfall record: April 11–12, 1.2; April 15, 0.5; April 16, 0.2; April 17–18, 0.7; April 19–20, 3.3.

When the area was previously studied in 1936 the hillside had just been graded and prepared for grass. No trees had been planted on the slope. At that time 4.5 inches of rain fell in less than 12 hours. The recently observed slip occurred at the same location and on the same clay layer, but after the hillside was well covered with grass and the lower slope planted to trees up to the clay layer and after 4.7 inches of rain had fallen during a week's time. At both times the same clay layer was responsible for the slip after about the same amount of rain had fallen.

The significant difference in conditions under which slumping took place in 1936 and recently lies in the fact that the slope in the first case had no cover of any sort, while in the recent case it was well covered with grass. Another notable difference was in the nature of the rainfall; in 1936 the rainfall was concentrated into a few hours, while in the recent situation about the same amount of rain fell but it was distributed over a period of one week.

Since the quantity of rainfall in both cases was similar we might conclude that slumping may take place in certain areas underlain by clay when a condition of sufficient saturation is reached, whether the slope is covered or not. It is also significant that gullying has been checked by a good cover of grass and trees. Grass and small trees, however, were not sufficient protection against slipping when the condition of saturation was reached. It, therefore, becomes apparent that in this and similar situations the engineer, landscape architect and soil conservationist can not depend on cover alone for protection from slipping.

The fold-like wrinkles which occur on the surface of the terrace formed of slipped material in several cases had become arcuate when they occur just above a tree. The convex side of the arc is on the uphill side away from the tree. This condition indicates that the trees had a tendency to hold the slip. Since some of the trees near the toe of the slip had been moved and one had been overturned it is doubtful that trees would have entirely prevented slipping, though had they extended above the slip area, it is possible that they would have modified the slip and permitted less movement.

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## MATING AND OVIPOSITION IN THE PACIFIC COAST TREE TOAD

IN connection with studies on the biology of amphibia the writer has had opportunity to make certain observations on the mating behavior of the Pacific Coast tree toad (*Hyla regilla*). Since there is apparently no previous account of this in the literature, the following may be of interest.

The beginning of the breeding season of *Hyla regilla* is marked by the congregation of large numbers of vociferous males at transient rain pools and more permanent bodies of water. The female does not enter the water until ready to deposit the eggs; the entry is ordinarily made in late afternoon or early evening, and mating and egg laying completed by the following morning. Since the females enter singly or in small groups, the superior number of males makes probable an immediate mating. By continued observation of hylas collected in the San Francisco Bay region, the details of amplexus and oviposition in this species have been learned.

A preliminary period of clasping is usual before laying begins. In the laboratory this varies from 4 to 24 hours, while in nature it is probably not longer than 4 to 9 or 10 hours. The amplectic posture is of the pectoral type with the male dorsal to the female. The forelegs of the male, placed directly behind those of the female, strongly constrict her in that region. Ordinarily there is no contact between the bodies of the pair behind a point just posterior to the pectoral girdle of the male. The hind legs of the male are folded as if in a sitting position and usually do not touch the female except when directly employed.

Insemination occurs at the moment of egg extrusion. The male brings his cloacal aperture close to that of the female, discharges a quantity of transparent semen, and with a quick, firm extension slides his feet posteriorly over the sides and hips of the female, then deftly retracts to his normal position. Simultaneous with this foot action, the female extrudes a clutch of eggs into the cloud of sperm about her cloaca. Some time before releasing an egg mass the female often scratches at the surface of the substratum on which the eggs are to be deposited. As the eggs are extruded the cloaca is brought into close contact with this surface and attachment is thus effected. The female removes any eggs which may partially adhere to the cloaca during extrusion by a precise flexor-extension reflex of the hind legs. In this the tarsi are applied directly to the adhering eggs and a slow extension effects the removal.

Deposition of an egg mass is usually followed by a quiet moment during which the bodies of the pair become slightly more inflated than normally. The intervals between egg deposition, ranging from 2 to 10 minutes or longer, are spent in bursts of vigorous activity, mainly on the part of the female. What function this may serve, if any, is conjectural, but it apparently takes place under natural as well as artificial conditions. In the laboratory such periods are followed by a rest and then further oviposition. Shortly after laying is complete, the pair becomes separated. The entire time in amplexus has been observed to range from 8 to 40 hours or more.

The total number of eggs deposited was found to range from 500 to 750; however, Storer[1] reports an instance of 1,250 eggs being laid. The number of eggs per clutch is usually about 16, but varies from 5 to 60. Further, a tendency exists toward the close of the laying for the size of the clutch to taper off to 3 or 4 or even single eggs. There is indication that the embrace of the male may be requisite to the proper extrusion of eggs by the female. Three gravid females, isolated without mates, laid only 26, 92 and 80 eggs, respectively, on the evening following capture, and all three died during the ensuing day. The evidence at hand indicates that resorption of eggs does not occur in the gravid, unmated female. It would thus appear that retention of the eggs is fatal to the animal.

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1 T. I. Storer, *Univ. Calif. Publ. Zool.*, 27: 225, 1925.

## THE PROPOSED TERMS "EXERGONIC" AND "ENDERGONIC" FOR THERMODYNAMICS

THE terms "exothermic" for reactions giving off heat and "endothermic" for those absorbing heat were coined in the last century when it was hoped that a concentrated attack on thermochemistry would solve the problems of chemical affinity and enable the chemist to predict the direction of spontaneous chemical reaction. This hope was illusory, but the nomenclature is quite useful and may also be applied to reactions for which the decrease in heat content $-\Delta H$ is positive or negative, respectively.

Those reactions do go spontaneously for which the entropy of the system and surroundings increases. This criterion of the second law of thermodynamics is rather general, and it has been found more convenient to particularize the law with reference to the free energy $F$ and use the criterion that a reaction will go by itself if the free energy decrease $-\Delta F$ is positive at constant pressure and temperature, or in other words, if useful work (rather than heat) could be produced by a reversible mechanism. An interesting chemical analysis of the correlation of these two thermodynamic criteria has been given by T. W. Davis,[1] since the change in entropy $\Delta S$ is negative for many reactions for which $-\Delta F$ is positive and reaction occurs spontaneously. The importance of free energy in chemistry is so great that G. N. Lewis and M. Randall[2] included it in the name of their classical book that crystallized the course of research in chemical thermodynamics.

No terms have received wide acceptance which aptly characterize so-called spontaneous and nonspontaneous reactions. We therefore propose that the term "exergonic" be applied to reactions which can produce work, and "endergonic" be applied to those on which work must be expended to cause the reaction to occur. At constant pressure and temperature exergonic signifies $-\Delta F$ is positive, and endergonic signifies $-\Delta F$ is negative.

These two words are derived from the Greek *ergon*, work, and are etymologically analogous to the corresponding thermochemical terms derived from *thermē*, heat. The word *ergon* was formerly used as a synonym for the unit of work, the erg, and in a more restricted sense applies in physics to a unit of work measured in heat. This application of the cognate word is consistent with modern scientific usage to express free energy values and changes in calories.

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1 *Jour. Chem. Educ.*, 13: 376 (1936).
2 "Thermodynamics and the Free Energy of Chemical Substances," McGraw-Hill Book Company, New York, 1923.

## SAT-CHROMOSOMES

THIS technical term, introduced by Heitz,[1] is widely misunderstood and has been misused repeatedly in cytological literature. "SAT" is an abbreviation[2] of "Sine Acido Thymonucleinico." "SAT-Chromosome" is not a synonym for satellited-chromosome but signifies either a satellited chromosome or a chromosome with a secondary constriction that is associated with the formation of the nucleolus. All satellited chromosomes are SAT-chromosomes, of chromosomes with secondary constrictions, some are SAT-chromosomes,[3]

1 E. Heitz, *Planta*, 12: 775–844. 1931.
2 E. Heitz, *op. cit.*, p. 812.
3 L. Geitler, "Chromosomenbau," Berlin, 1938, p. 24.