cates that the substances function in nutrition, but does not indicate in advance of our knowledge *how* they function. The term makes no extravagant claim as to the indispensability of the substance or to any peculiar relationship to life, as unfortunately the terms "vitamin" and "bios" do. In form the new word is similar to the word "metabolite." There is a closely related word already in the dictionary, "nutrility," which pertains to nutrition, but is rarely used.

We may then define a nutrilite as a substance, other than the well-recognized nutrients, which functions in small amounts in the nutrition of organisms. It is to be expected that borderline cases will appear in which it will be difficult to decide whether or not the material in question should be regarded as a nutrilite. This will not seriously impair the usefulness of the term, however, since a similar situation exists in the case of many words such as, for example, "carbohydrate" and "alkaloid."

ROGER J. WILLIAMS

UNIVERSITY OF OREGON

AN ANCIENT WALRUS SKULL

A RATHER interesting find, in the nature of an ancient walrus skull, recently made on Georges Bank off Cape Cod, has been presented to the Boston Society of Natural History. The skull, consisting of the fore part with tusks, which are twelve and fourteen inches long, and most of the flat-crowned crushing teeth of the upper jaw still in place, belongs to an animal now unknown as far south as the New England coast.

It has not been determined how this skull came to be on the bank, nor is it known how long it may have lain on the sea bottom, but it is probable that it came there two hundred and twenty or three hundred years ago. The walrus occurred, during the Ice Age, as far south as Virginia and the Carolinas, where fossil remains have been reported; in the seventeenth century it was found on Sable Island, off the coast of Nova Scotia, while during the last century it was quite common in the Gulf of St. Lawrence and on the shores of Labrador. It is quite possible at that time some of them may have visited the waters of the Gulf of Maine, or even strayed as far south as the Georges Bank, and that the specimen recently found belongs to one of these.

BIRGER R. HEADSTROM

MEDFORD HILLSIDE,
MASSACHUSETTS

THE ROYAL PHOTOGRAPHIC SOCIETY

The Royal Photographic Society of Great Britain is holding its seventy-third annual exhibition in September and October of this year. It is hoped that the American representation in the scientific section will be such as to demonstrate the place held by this country in applied photography. I am collecting and forwarding American work for the scientific section again this year. Exhibits should consist of prints showing the use of photography for scientific purposes and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than June 8, and should be mounted but not framed. There are no fees.

A. J. NEWTON

EASTMAN KODAK CO.,
ROCHESTER, N. Y.

LOW HUMIDITY AND HIGH TACITURNITY

ARIZONA is perhaps best known in the demi-lands of letters as the abode of strong, silent men. So steeped in sentimentality is the lore of their laconism that a pragmatic interpretation has become imperative.

The low humidity of Arizona is almost as proverbial as the silence of her strong men. This is no mere fortuitousness. For low humidity begets parched throats, and it is axiomatic that a desiccated larynx and a vociferous tongue are incompatible.

A practical application suggests itself. Repression of verbosity has been, at times, a problem of national concern, actually jeopardizing the Senate rules. The atmosphere of the district is notoriously humid, and in such an environment loquacity thrives. But to euthenics there is available an effective antidote, a local anesthetic of uncanny selectivity. Even the most garrulous of filibusters could be silenced quickly by the aid of a potent air-dehumidizer.

E. A. VUILLEUMIER

DICKINSON COLLEGE

REPORTS

HORIZONTAL VERSUS VERTICAL FORCES IN CRUSTAL MOVEMENTS OF THE EARTH

PROFESSOR BAILEY WILLIS, of Leland Stanford University, and now president of the Geological Society of America, addressed the Boston Geological Society on January 11, 1928, on "Horizontalist or Verticalist?"

The doctrine of the direction of forces causing diastrophism is a question of faith. Willis stated that he was brought up a horizontalist, and in 1876 G. K. Gilbert had told him to study Appalachian structure, and he was carried far in seeing the effects of horizontal thrusting. On later expeditions into the Alps, the Andes and into Patagonia Willis found his faith in horizontalism supported. Later he went to California, where Gilbert had studied the structure of

the Basin Ranges and had concluded that there the forces had acted upward from below. Willis first accepted the fact that the Sierra Nevada had been tilted but not deformed.

Louderback had described normal faults, arranged as step faults, dipping east, along the eastern front of the Sierra Nevada, and which there bound the range. Willis considered these as superficial slides into the eastern basin, and that the tilting of the mountain had been accomplished by rotation of the mountain block on a rounded base by a horizontal force from the west.

Two recent field seasons in Owens Valley and Mona Lake country along the east base of the Sierra Nevada showed Willis that the normal step faults are but minor slips, and the crest of the range is not the top of the fault scarp, but the top of an arched surface. The arch ends at an elevation of nine thousand feet on the east side, and from there the blocks on the east dip into the valley. The main fault is curved back toward the west beneath the range. The westward back slope of the main range instead of being merely tilted is curved, or domed, and is intersected by faults with throws as great as a thousand feet.

Willis coupled these observations with studies made in tunnels and drifts in the serpentine of the New Almaden mine where the rocks display an extreme squeezing beneath the Sierra Nevada. He thus conceived that the main force was horizontal, and was a tremendous deep-seated thrusting from the west against a stable block on the east. The rocks were squeezed as in a vise. A component of the pressure was necessarily upward, doming the Sierra Nevada upland, and lifting the blocks along faults, which instead of being normal faults are reversed upthrust faults.

This conception took Willis back to his experiments of wax and turpentine made in 1887 and 1888, in which he reproduced the folding of the Appalachian type. The lower surfaces of the material yielded by shear, and shearing planes developed at 45 degrees to the shearing force and caused displacements on a relatively large scale.

If the upswelling is due to a movement in a deeper zone, it must have been due to the conversion of a deep-seated crystalline rock into a gneiss, with vertical schistosity. In order to test this theory, Willis kept the problem in mind on a recent trip around the world. He had become a horizontal verticalist, because he saw how vertical movements of the earth's crust could result from horizontal compression.

During his visit to Japan, he examined the ranges of Hokkaido, the northern island of Japan. The central range, about seven thousand feet in height, is deeply dissected and rugged, revealing complexly folded Paleozoic sediments injected by tongues of granite. The block as a whole has an arched appearance. West of the range, Cretaceous beds are folded and overthrust westward toward Asia. They abut on the west against folds of early and mid-Tertiary strata, which have a more simple structure, but are also overturned toward the continent. Still farther west on the same island the folded Tertiary zone is succeeded by a platform of uplifted, but nearly horizontal Pliocene beds, from which one descends to the coast.

A Paleozoic geosyncline, folded and intruded by granite, must have been peneplaned during the Mesozoic time. Then a new Cretaceous geosyncline formed west of it, and received its fill of sediments, and was in turn folded, by pressures which arched up the Paleozoic mass on the east. The cause of this swelling was the shearing and the development of schistosity in deep-seated crystalline rocks. The active force had come from the Pacific. A third geosyncline formed during the Tertiary time and west of the Cretaceous folds; and having received in turn its load of sediments, was folded before Pliocene time. The fourth, or Pliocene trough, has not yet been folded.

The presence of folds en echelon, especially in the newer Japanese arcs, points to their lying in the shear zone between two rounded disc-like blocks—the one under the Pacific and east of northern Japan, the other under the Asiatic continent. The rotation of both blocks in a clock-wise direction has developed the shearing and folding en echelon between them. The location of granite intrusions in northern Japan was determined by tension.

In the southern island of New Zealand, Willis made a section westward from Dunedin. On the eastern half of the island there is an elevated plateau separated by a deep valley from the Southern Alps to the west. The plateau is broken in an irregular fashion by rift valleys described by Cotton. The plateau is underlain by mica gneisses, as Willis termed them—rocks with horizontal banding but in which the sedimentary structures are preserved. The Southern Alps he found to be a tightly compressed isoclinal fold, which must have been an old fold. On the west side of the range there is a shear-zone recorded by networks of quartz veins, while shatter-zones reveal the modern revival of shearing. The region is probably underlain by a batholith of late Paleozoic age. Willis pictures the movements as being mainly a horizontal thrust from the east, along the curving thrust-plane which dips from the western side of the range and eastward under the range. As

a component of this thrusting there was a vertical uplift of the plateau, due mainly to shearing in the mechanical zone.

The island of Cyprus, in the eastern Mediterranean, Willis found to be of especial interest to him who seeks horizontal forces. Three main structural elements are found in the island; in the north an east-west range of mountains; in the south a higher and broader range, and between them a central plain or lowland. The northern range includes Cretaceous Oligocene sediments, folded and faulted. The central lowland is of tilted and beveled Miocene shales and limestones, overlain unconformably by the horizontal Pliocene. In the Miocene sediments at the foot of the northern range, there is a marvelous exhibition of crushing. The southern massif is the famous Mt. Troodos, the old Olympus of Greek mythology. It is a mass of hornblendic igneous rock, an old plutonic mass, now gneissic.

There has been a thrusting from the north, so that the northern mass has been moved southward. There are no faults in the Miocene central plain except normal faults due to tension. The Miocene dips northward off the northern flank of Mt. Troodos at about 15 degrees, and the rocks have been stretched. The upland of Mt. Troodos is a smoothly rolling mature-land, and on it the ancient Miocene shoreland is approximately indicated by a longitudinal valley, high up on the flank of the mountain, where, banked in by the former cuesta front of the Miocene, a subsequent river has cut a trench into the crystallines of the Troodos massif.

This old shore-line indicates that there was a vertical movement of Mt. Troodos, probably as much as four thousand feet, while twenty miles to the north there is a great overthrust. Here, therefore, is another example of vertical movement in connection with great horizontal compression. The great movement came from the north and was deep-seated (the overthrusting of the northern range is only a shallow expression of it) and as a result of the development of gneissic structure in the Troodos mass in response to the horizontal compression, the southern part of the island was considerably uplifted.

In response to questions on the Cyprus mass, Willis said that he thought that the movements were still going on in Cyprus, of which the recent destructive earthquake of Salamis is testimony. This raised the question of the cause of destructive earthquakes. Willis stated that in his opinion such earthquakes are not the result of slight movements on normal faults, but rather the elastic spring of rocks, from the energy stored up in them through years of compression.

Willis stated that he thought the thrusting upward of a piston of crystalline rock, like that at Mt. Troodos, with a drag along the side of the piston, and consequent removal of material from beneath the contingent areas of the lee side, away from the side of active horizontal pressure, is the cause of subsidence, and the formation of geosynclines.

A lively discussion by Professors Lane, Daly, Terzaghi, Collet, Morris and Dr. Boydell followed Professor Willis's address.

JOSEPH L. GILLSON

BOSTON GEOLOGICAL SOCIETY

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE USE OF THE X-RAY IN BIOLOGICAL INVESTIGATIONS

THOUGH X-ray pictures have been generally adopted by the medical sciences, they have been little used in the descriptive natural sciences where I believe they would greatly facilitate studies. A picture may save months of painstaking technical work. For students it would save the laborious work of microtomy and the subsequent reconstruction of organs from sections.

By using this method many a valuable organism can be kept intact that otherwise would have to be sacrificed for the purpose of study.

As far as I know, X-ray pictures have been used in zoology and botany only by a few workers and by them in only a small way. Probably the first to use them was Dr. David Starr Jordan, who reproduced X-ray photographs of fishes, but confined himself in the main to showing the pictures without giving a detailed description of the objects represented.

One of the main reasons why this method has been so little employed by biologists is the fact that its use necessitates expensive apparatus and that the pictures have to be made by carefully trained experts, who are thoroughly familiar with all the details of the process. In addition to that, the pictures themselves are quite expensive, and as a consequence only institutions with large available funds are able to undertake the work.

Because of the splendid cooperation between the Queen's Hospital and Bernice P. Bishop Museum of Honolulu, I have been able to realize my ambition to study by means of X-rays the majority of the representatives of the ichthyological fauna of a relatively large area and also to make observations and experiments regarding the adaptability of this method to biological studies as a whole.

An undeniable advantage of the Roentgen method, as compared with all others, is that every bone, even the finest, may be seen in its natural position. Even the intermuscular ossifications not connected with the skeleton can be clearly observed; whereas by any other