time, are shown upon graduated circular dials on the face of the machine. The machine was invented by Dr. R. A. Harris, who seventeen years ago published a brief but comprehensive description and submitted a general plan to the Coast Survey Office. (See report of superintendent for 1894.) The details of the machine-design were worked out by Mr. E. G. Fischer, under whose direction the machine was set up in the instrument division of the survey.

Mechanical aids of this kind are used in connection with the tides, because good predictions require the combination of a considerable number of sine or cosine terms whose arguments vary uniformly with the time. The new machine contains 32 short-period components (*i. e.,* daily, semi-daily, quarter-daily, etc.) and 7 having long periods (*i. e.,* fortnightly, monthly, semi-annual and annual.

In combining these numerous terms two summations are carried on continuously by means of two chains each fixed at one end and free to move at the other. Each chain is laid alternately over and under a series of pulleys whose upward and downward movements cause the free end of the chain to travel back and forth across a fixed initial point. The motion of the free end of one of the chains is proportional to the rise and fall of the tide to be represented or predicted; that of the free end of the other chain (or rather of a marked link a certain distance from this end) is such that when this link passes across a fixed point the height represented by the first chain is at its maximum or minimum value. These statements describe very briefly the general plan upon which the times and heights of the tides are mechanically determined. As already stated the times and heights are shown upon the face of the machine while a curve is drawn which makes a permanent record of all stages of the tide.

The machine is driven by hand and the gears are such that the periods of motions which depend upon them shall represent the known periods of the various sine and cosine terms into which tidal records or observations can be resolved.

In the new machine the error resulting from the representation of the incommensurable astronomical ratios by the gears amounts to less than one degree for a period representing a year in prediction. For the larger terms the error is much less, so that after predicting a year's tides and reading hourly heights for December 30 and 31, the predicted values agreed so well with the values computed directly from astronomical data, as to make the errors negligible.

It may be stated that, although tide-predicting is the most useful purpose to which the machine is put, its broadest application is in the solution of equations of the form $y = H_0 + A \cos(at + \alpha) + B \cos(bt + \beta) + \cdots$, where $A, B, C, \ldots$ denote the amplitudes and $a, b, c, \ldots$ their speeds per unit of time t, of which it draws the graph and indicates the positions and magnitudes of the roots.

SAMUEL TIERNEY, JR.

SPECIAL ARTICLES

XERALEXIS

WHOEVER brings forward a new word must show what the students in journalism would call a "crying need" for it, or take the consequences. The undersigned is not altogether certain as to how crying the need may appear to others, but it seems to him that a single euphonious, appropriate word should be sought to replace the clumsy and rather ill-sounding compound, "drought-resistance." The writer proposes the coining of the word *xeraléxis,* from the Greek ξηρότης, drouth, and ἀλέξησις, a keeping off or resistance.

We have, of course, the words, "xerophytic" and "xerophytism," which do not, however, involve the idea of resistance to drouth in their composition, and do not convey that meaning in usage, although it stands to reason that a "drouth-resistant" plant will have "xerophytic" characteristics of some kind.

There is ample justification for the new word on etymological grounds. The Greeks had many compounds in which the above roots were employed. The root of the adjective *xēros,* "dry" and *xērótēs,* "drouth," is found

in *xērophthalmía,* a dryness of the eyes; *xērobiotikós,* living on dry land; *xērophagía,* the eating of dry food, etc.

The root of the word *aléxein,* "to ward or keep off, to turn away or aside," and *aléxēsis,* "resistance or warding off," is found in such combinations as *alexanemía,* "shelter from the wind," or where Sophocles in the *Œdipus,* uses the adjective *alexímoros,* "warding off fate or death" (μόρος). Hipparchus uses *alexipháρmakos,* in the sense of "warding off poison," or "acting as an antidote."

So the examples might be multiplied. It is strange that the Greeks did not themselves coin a word for "drouth-resistance," for they had and have an abundance of drouth to resist in Hellas, as any one who has ever been there in the summer-time can abundantly testify. It would be interesting to investigate modern Greek terminology on this point.

A euphonious compound of the two above roots can only be made by putting the root for drouth first; although the Greek tendency in the formation of compounds involving *alexein,* in the sense of "warding off," "defending," seems to put the latter first, as in *Aléxandros* (Alexander)—defender of men (anēr, man)—in the examples given above, and many others. To follow this practise and coin such a word as *alexixerótēsis* might be possible for a Greek, but not for us.

Let us accordingly turn the roots around. We then find that we have available for the first member of the compound, two possible nouns, viz., *aléxēsis* (ἀλέξησις)—"a keeping off" or "resistance," and *aléxis* (ἀλέξις) "help"—both from the same root as the verb *alexéo* or *alexō* (ἀλεξέω, ἀλέξω), infinitive *aléxein* (ἀλέξειν)—a verb which has both the primary signification of to "ward off" or "resist" and the derived one of "to help." Here we encounter a difficulty. If we follow a natural analogy and say *xeraléxis,* following "prophylaxis" from the Greek *phulaxis* (φύλαξις), a "watching" or "guarding," then we seem to imply a derivation from the word *aléxis,* "help," rather than from *aléxēsis,* "warding off." But on the other hand, "*xeraléxēsis*" is slightly longer than "drouth-resistance." There remains, of course, the possibility of following another valid Greek analogy, and saying *xeraléxia.*

On the whole, however, *xeraléxis* is preferable on the score of brevity and ease of pronunciation. Perhaps we are justified in calling it a "contract form" of "*xeraléxesis,*" if that will satisfy the philologists.

We then have for "drouth-resistance," *xeralexis* and for "drouth-resistant," *xeralectic.* In the writer's estimation these words might well replace in botanical language generally, not only our English compound, but the awkward French *résistance à la sécheresse,* or the German *Austrocknungs-resistenz.* At all events the new word is logical—as logical as "ecological" in fact.

H. F. Roberts

CRYPTOBRANCHUS ALLEGHANIENSIS, LARUS ATRICILLA AND LARUS MARINUS IN NORTH DAKOTA

In a recent article,[1] Pope has recorded the hellbender (*Cryptobranchus alleghaniensis*) and the laughing gull (*Larus atricilla*) as abundant, and the black-backed gull (*Larus marinus*) as occasional at Devils Lake, North Dakota. These records, if verified, would be of much interest, extending the range of the hellbender to the northwest of that hitherto recognized and bringing the laughing and black-backed gulls from the Atlantic coast far into the interior. In three summers spent in this region, however, I have been unable to verify Pope's records and seriously question their accuracy, both for this reason and because of their inherent improbability.

Franklin's gull (*Larus franklini*) a bird which might readily be mistaken by an inexperienced observer for the laughing gull (*L. atricilla*) is a common breeder in this locality, after the breeding season gathering in large flocks upon the lake. Pope has probably mistaken the ring-billed gull (*Larus delawarensis*) for the black-backed (*L. marinus*). I

[1] Pope, Thomas E. B., "Devils Lake, North Dakota. A Study of Physical and Biological Conditions with a View to the Acclimatization of Fish," Bureau of Fisheries Document, No. 634.