But perhaps it will be best to begin at the bottom of the series. The lancelet is the lowest fish, if (1) it is a fish, and (2) if the *Tunicates,* and the *Balanoglossi* are not also fishes. If we number the fishes from 1 to 40,000, we shall have to decide beforehand as to the nature of tunicates, lancelets, lampreys, chimæras and sharks as well as that of their various extinct relatives. Apparently the only safe way will be to number the species after another, each in the genus in which it was originally placed. In that case, the genus may go where it will, the species will hold their numbers.

In 1774, Pallas named the lancelet, *Limax lanceolatus.* But it is not a *Limax. Limax* is a land-slug. Must we wait till other shellless snails or *Limax* are numbered, before we can list our first fish. Let us chance it as *Limax* 75 and keep it with the fishes if we can.

In 1834, Costa named this same lancelet *Branchiostoma lubricum. Branchiostoma* 1 is therefore equivalent to *Limax* 75. But the species should not be called *lubricum,* but *lanceolatum.* This Yarrell recognized in 1836, calling it *Amphioxus lanceolatus,* bringing up the old specific name. But his generic name, new and useless, has been the source of much subsequent trouble. In any case the species is not *Amphioxus* 1, because it does not start with *Amphioxus.* It was known sixty years before the time of Yarrell.

Our next fish is *Branchiostoma caribæum* of Sundevall in 1853. This is a doubtful species, most likely the same as *B. lanceolatum,* but it may stand as *Branchiostoma* 2. *Branchiostoma Californiense* Gill 1893 may be *Branchiostoma* 3, and the remaining lancelets are scattered over the world, some recorded as *Amphioxus,* most as *Branchiostoma.*

It is not necessary to follow this further. The same conditions prevail throughout zoology. The fact is that our present Linnæan system of naming species and groups in zoology or botany is still the best which has been devised or suggested. It has the right of way through one hundred and fifty years of usage. All present taxonomy is based upon it. Its embarrassments are due chiefly to the difficulties inherent in the subject, and to the limitations of human nature.

The changes in names of the last thirty years have been, on the whole, in the direction of final stability. The zoologists of the world have devised machinery which will steadily make for permanence, and the necessary period of transition is one from lawlessness to law, from confusion to science. In so far as we have confusion this has arisen through neglect or ignorance of law. It can not be remedied by further neglect. A writer dealing with scientific names must either call an animal or plant whatever he pleases, or else he must conform to regulations inherent in the nature of his work. Arbitrary rules will soon be disregarded. The necessary regulations are those which future workers will approve, and we, who are still working in the infancy of taxonomy, must lay foundations on which the future can build.

In view of the great issues which depend on accuracy of method, such minor issues as that we rather say *Amphioxus* than *Branchiostoma,* or that it suits us better to call the common eel *Anguilla vulgaris* rather than *Anguilla anguilla,* or that our collection is labeled according to the method of Cuvier, sink into insignificance. You can say *Amphioxus* if you like—or *Bdellostoma.* We shall know what you mean, but we shall not try to force these names back into nomenclature, replacing older and legitimate names already becoming better known to the actual worker in taxonomy than these names of temporary convenience ever were or ever will be.

DAVID STARR JORDAN
STANFORD UNIVERSITY

THE USE OF SYMBOLS IN ZOOLOGICAL NOMENCLATURE

AT first thought, Dr. Needham's suggestion[1] that in substance we designate what are practically subgenera, species and so on, by symbols does give more or less of a shock. Never-

[1] SCIENCE, N. S., XXXII., pp. 295–300, September 2, 1910; see also *ib.*, pp. 428–429, September 30, 1910, and XXXIII., pp. 25–29, January 6, 1911.

theless, a little thought certainly shows that some such system as this may be a necessity in the near future and, if for no other reason, should receive earnest attention and discussion. The system proposed by Dr. Needham has obvious advantages: By grouping closely related genera (becoming subgenera) under the old name of the genus when used in its widest sense, two of the fundamental reasons for the existence of nomenclature are reached, namely, stability and ease in identification and in grasping the relations of the various units at a glance. But, to my mind, the system has nothing at all to do with stability unless this fundamental change is instituted. All will grant, I think, that stability is fundamental, as is also ease or at least possibility of identification. I believe, too, that all will concede that neither is possible without what may be called "rigidly" defined genera (=groups), genera which all are willing to rank as such and which all will be able to recognize (perhaps they would be equal to present-day subfamilies at least).

These genera or groups being firmly established by universal acceptance and concise description, then the application of the symbols would doubtless save an immense amount of space. Otherwise, I am certainly at a loss to find any other advantages which they may have. Synonymy nor anything else is simplified by saying that $5=4$ instead of *leucopsallis* = *viridis*. The only thing that matters is whether the statement is true or not. You may call 5 anything that you wish without changing what it represents. And is it not true that most of our troubles cluster about the fact that we have been unable to find out what authors have meant to represent?

The objections to involved nomenclature entered by the zoologist and biologist are entitled to much consideration, but we should not lose sight of the fact that the present systematic unit—the species—was founded by themselves and seemingly we still find an endless number of them. If it is true that they exist it is our duty to keep on recording them. Whether we call them by symbols or names isn't to the point at all. The gist of the matter is, shall the conception of the systematic unit be changed from "natural" species to conceived genera? Will any biologist deny that species exist. Why, therefore, should they wish to escape from them? It is true it is impossible to know all of them nor even their names! But who wants to do this. The fact that they exist is true, or else our conception, or rather perception, of a species is all wrong. Now, if it is true that they exist, I believe that it is necessary that they be represented by names or else symbols. Thus, whether names or symbols are used, either would have to be used an equal number of times, but the symbols would be shorter, that is all. It is not the jungle of names that masters us, is it? Rather, is it not the jungle of things? To simplify, natural laws, not symbols, are needed.

Therefore, it seems to me that the fundamental plan suggested by Dr. Needham, that of falling back upon the old genera and their names, is the only way out of the confusion, present and past. As for the symbols, they are preferable only in so far as they have a tendency to simplify, not our knowledge, which they are certainly unable to do here, but our working methods, time and space.

A. Arsène Girault

Urbana, Ill.,
January 9, 1911

On Factors Contributing to a Low Scientific Productivity in America

A few months ago I offered some criticisms on a paper by Professor Gunn which appeared in Science for October 28, 1910, under the caption, "American Educational Defects." My criticisms were directed chiefly to the method adopted by Professor Gunn, and he has very properly retorted[1] that I should not make too much of the matter of method unless I am prepared to dissent from the practical outcome of his study.

Now so far as this outcome was to the effect that the level of scientific and scholarly productivity in this country is unsatisfactory by comparison with that in certain European

[1] Science, January 20, 1911, N. S., XXXIII., 107.