raphy and with the kinds and relations of the underlying rocks.

The principles of improvement in domestic plants and animals are found in a diligent study of the geological history of their respective races and are fully illustrated in the development of the present forms of life from the ancient ones. These great changes in form, stature and intelligence make some of the useful stories in the earth's history as they are revealed by the record that is written in the rocks. By the study of this history man is encouraged in self improvement and in the realization of his responsibility to the world about him; he is inspired to higher ideals in his relations with his fellow man and in the field of intellectual achievement; he is stimulated to a more intelligent understanding of the powerful forces in nature and of their influence on the origin and on the destination of the human family.

In view of the present awakening to the needs of people in agricultural vocations and of the many relations of this science to rural welfare, it seems reasonable to expect that the study of agricultural geology in colleges and elsewhere will be extended until it is shared by all who are preparing to do work in rural improvement and that each will continue this study long enough to be able to apply the subject with intelligence.

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THE NOMENCLATURE OF FAMILIES AND SUBFAMILIES IN ZOOLOGY

Recent years have seen gratifying progress in the establishment of permanent rules of zoological nomenclature. Through the Stricklandian Code, the American Ornithologists' Union Code (commonly known as the A. O. U. Code), and, most recently, the International Code, greater uniformity of usage has been achieved than was ever before thought possible.

Family names, however, are still in very much the same state of nomenclatural chaos as were generic and specific names before the adoption of the Stricklandian Code in 1842. Zoological family and subfamily names have come and continued in use by a sort of *auctorum plurimorum* principle; and though current usage is more or less satisfactory so long as every one is agreed, any serious difference immediately causes trouble. Rules by which workers will agree to be bound, therefore, become necessary; and this, it were trite to say, is the reason for any code of nomenclature. Certain authors, however, have recently begun, for reasons other than zoological, to change many family names long in use, and it is, therefore, pertinent now to inquire into the desirability of such changes, and of the formulation of some principles for guidance. Since family and subfamily designations must depend on generic names, they are more in need of definite rules than are the names of still higher groups.

Latreille, in his "Précis des Caractères Générique des Insectes," published in 1796, was the real originator of the family concept in zoology, but he first designated these groups by number, though in a later work adopted plural Latin names with differing terminations. William Kirby, an English naturalist, in a paper on a new order of insects,[1] was the first to advocate the adoption of uniform patronymic endings in "*idæ*." The idea was soon afterwards adopted and elaborated by W. E. Leach, and subsequently by other authors, so that it was brought into general use during the succeeding decade. In 1825, N. E. Vigors, in a paper on the classification of birds, provided an entire set of family names with the ending *idæ*. It is of interest to note, in this connection, that German authors were far behind the English in adopting this improvement in terminology. Subfamily names in "*inæ*" did not come into general use until about the year 1830.

The first definite formulation of the principle of patronymic endings for family and subfamily names was in the Stricklandian

[1] *Trans. Linn. Soc. London*, XI., 1813, p. 88, footnote.

Code,[2] and is introduced in the following language:

B. It is recommended that the assemblages of genera termed *families* should be uniformly named by adding the termination *idæ* to the name of the earliest known, or most typically characterized genus in them; and that their subdivisions, termed *subfamilies*, should be similarly constructed, with the termination *inæ*.

The next epoch-making code of nomenclature, the A. O. U. Code of 1886, Canon V., adds to this only the proviso:

When a generic name becomes a synonym, a current family or subfamily name based on such generic name becomes untenable.

The revised A. O. U. Code of 1908 made no change in this.

The International Code of 1913 has only the following provisions regarding family and subfamily names:

Article 4. The name of a family is formed by adding the ending *idæ*, the name of a subfamily by adding *inæ*, to the root of the name of its type genus.

Article 5. The name of a family or subfamily is to be changed when the name of its type genus is changed.

The Entomological Code,[3] prepared chiefly by Messrs. Nathan Banks and A. N. Caudell, contains so many additional provisions regarding family and subfamily names that it seems worth while to quote entire the portions pertinent to the present discussion:

108. The name of a family shall be formed by changing the last syllable of the genitive case of an included generic name (preferably the oldest) into *idæ*.

109. The name of a subfamily shall be formed by using "*inæ*" in place of the *idæ*. One of the subfamily names shall be based on the same generic onym, or is removed from the family or subfamily, is a part.

113. The name of a family or subfamily is to be changed when the basic generic name is a homonym, or is removed from the family or subfamily, or becomes a synonym.

114. If there are two or more names proposed for the same family or subfamily ending in *idæ* or *inæ*, the earlier name shall be adopted.

15. If there are two family or subfamily names of the same spelling, the more recent shall be replaced, or so modified as not to conflict.

Recent multiplication of family and subfamily names in zoology and their dependence on generic designations make very desirable, in fact, almost necessary, definite rules for their selection and use. In any such rules, families and subfamilies should be treated alike (except, of course, for their difference in termination) just as are genera and subgenera.

The above-quoted codes of nomenclature fail to provide a perfectly satisfactory rule for the stabilization of family and subfamily names, as is fully realized by those who have had to deal with such designations. This is principally because these codes neglect particularly to define the term "type genus," *i. e.*, the genus on which the family name is based, and to specify the method of its selection. There are three methods that have heretofore been depended on for the determination of type genera and the consquent formation of family names; use of (1) the most characteristic genus; (2) the genus whose name is the oldest in the group; and (3) the genus which first formed the basis of a family name.

The first of these methods apparently was the consideration influencing most of the early writers, though there are indications that in many cases the genus for the family name was chosen at random. The objections to this first method are that it is not definite enough; that it depends on too many zoological conditions; and that it is open to continual alteration as the limits of the group change by the admission of other genera which might by some authors be considered more differentiated. In other words, this method of selecting the type genus is too much a matter of personal opinion in its zoological aspect to be of value as a nomenclatural rule.

[2] Report Brit. Association Adv. Sci. for 1842 (1843), pp. 105–121.

[3] "The Entomological Code, a Code of Nomenclature for use in Entomology," May, 1912.

The second method above mentioned, the use of the oldest name within any circumscribed family or subfamily group, is one that a number of modern zoologists use, although almost never with entire consistency, and it needs more careful consideration than the first. It possesses, it must be admitted, the advantage of definiteness and of easy application, but it likewise has several disadvantages which at once become evident when we attempt to apply it to all existing families alike, as we must do in pursuance of the main object of a nomenclatural rule. The most serious of these objections are as follows:

1. A family name would be changed when any genus with an older name than any of its original components is added to the group.

2. Any transference of a generic name to a genus of another family in which such generic name would be older than any already in that family would cause confusion in the transfer of the family name, a result that is always very undesirable.

3. The universal application of this rule would make wholesale changes in familiar family names in almost all branches of zoology, since until recently the use of the oldest genus was apparently only accidental, or because it happened to be the most prominent or characteristic group in the family. This is especially the case with the older authors; and the use of the oldest generic name is not by any means current practise among modern writers, even entomologists, since examination of Dr. Dalla Torre's "Catalogus Hymenoptorum" shows at once that a number of the subfamily and family names that he uses are evidently chosen by another method, for they are not based on the oldest genus included by him in their respective family or subfamily groups. Merely a *few* of the names that would have to be changed were this rule of the oldest generic name enforced are, in Hymenoptera: Ctenopelmatinæ, Dacnusinæ, Euphorinæ, Tetrastichinæ, Tetracampinæ, Tridyminæ; in mammalogy, Desmodontidæ, Oxyænidæ, Oxyclænidæ, Chinchillidæ, Dasyproctidæ, Erethizontidæ, Microtinæ; in ornithology, Ichthyornithidæ, Rallidæ, Gruidæ, Ciconiidæ, Œdicnemidæ, Cathartidæ, Phasianidæ, Picidæ, Capitonidæ, Pycnonotidæ, Ploceidæ and Frigillidæ.

4. Most important of all, it would prevent a definite and permanent concept of the type genus, since this would be constantly shifting by reason of the addition, subtraction, and changes of names.

The third method for the determination of the type genus is the use of the genus from the name of which a family designation was first formed, and the retention of this genus as the family type, whatever its name becomes. The chief objection to this is that it involves search through the literature for the earliest dates of family names, similar to that already made for generic terms. This, however, is not such a great task as might at first appear. In fact, Agassiz, in his "Nomenclator Zoologicus," has made a substantial beginning in this direction for all groups of zoology; while Dalla Torre has performed this service for Hymenoptera; Dr. T. S. Palmer, in his "Index Generum Mammalium," for mammals; and Mr. Robert Ridgway, in his "Birds of North and Middle America," for a part of the birds.

Its advantages do away with the chief drawbacks of the "oldest genus" rule. Most important, it provides a definite and permanent family concept in some generic group. Furthermore, it will prevent all changes in family names from the addition of genera or from alterations of generic names (other than of the type genus) within the family; it will obviate nearly all the transference of family names to unfamiliar associations, with the consequent confusion; and will cause comparatively few changes in the current designations of families.

To adopt any rule will necessarily involve some alterations in current family and subfamily names, but apparently far fewer changes result from what might be termed the "permanent type genus" rule than from that which selects the oldest generic name. The latter has the advantage of easier application and involves less research, but is not nearly so logical nor so scientific as the rule

which provides for a permanent type genus, since this rule corresponds almost exactly to the method of determining the type species of a genus.

A demonstration of the advantage of the "permanent type genus" rule is to be found in the case of the family Bubonidæ, to which the writer has elsewhere already called attention.[4] The generic name *Strix* Linnæus has been, by the mutations of nomenclature, transferred from the barn owls, family Strigidæ, to the horned owls, family Bubonida, and instated there as the proper name for the genus formerly known as *Syrnium*. It thus becomes the oldest generic name in the family Bubonidæ, and by the "oldest genus" rule would require the change of the name Bubonidæ to Strigidæ. By the third method above discussed, the genus *Bubo*, from which the family name Bubonidæ is formed, continues as the type genus, and no change in the name of the family Bubonidæ, into which the generic name *Strix* is introduced, is necessary. The family name Strigidæ would, in this case, disappear entirely, for the generic term *Strix*, removed from the former family Strigidæ, necessitates a change in this name Strigidæ to Tytonidæ, based on *Tyto*, the new name of its type genus formerly known as *Strix*. Thus, *the same generic group in each of these families would continue to remain the type genus, just as a species, whatever its name becomes, remains the type of a genus.* This method of a permanent type genus has been recently endorsed in print, at least inferentially, in the Entomological Code;[5] by Dalla Torre, as an examination of his "Catalogus Hymenoptorum" clearly shows; by Dr. C. W. Richmond in the case of the family Threskiornithidæ;[6] and definitely by Mr. E. P. Van Duzee[7] and Dr. Witmer Stone.[8] Furthermore, the following specialists in various groups, many of whom have personally furnished valuable suggestions, have given their approval to the principles and rules here presented:

Dr. T. S. Palmer; Dr. Witmer Stone; Mr. J. A. G. Rehn; Dr. C. W. Richmond; Dr. W. H. Dall; Dr. P. Bartsch; Dr. O. P. Hay; Mr. G. S. Miller; Mr. N. Hollister; Mr. J. W. Gidley; Mr. A. N. Caudell; Major E. A. Goldman; and Dr. W. H. Osgood.

Since some rule for the determination of the type genus is evidently necessary in order to stabilize family and subfamily names in zoology, the adoption of the third and last method above discussed, *i. e.*, that providing for a permanent concept of the type genus, is now advocated.

For the sake of completeness it seems worth while to formulate the following tentative nomenclatural rules for the determination and treatment of family and subfamily names. These embody all the above provisions in modern codes, with some additions, including that for the type genus just mentioned, and provide for the most important contingencies that may arise.

RULES FOR FAMILY AND SUBFAMILY NAMES

1. The name of a family is to be formed by adding the ending *idæ* to the stem of the tenable name of its type genus.

2. The name of a subfamily is to be formed by adding the ending *inæ* to the stem of the tenable name of its type genus.

3. Subfamily names shall for purposes of nomenclature be accorded the same treatment as family names.

4. The type genus of a family or subfamily must be one of its included genera.

5. The type genus of a family or subfamily is the included generic group from the name of which the family or subfamily name was originally formed, and is to remain the type genus irrespective of changes in its name.

6. A family or subfamily name formed from the name of an included genus is valid whether or not originally accompanied by a diagnosis, or by specific mention of the type genus.

[4] *Proc. U. S. Nat. Mus.*, LII., February 8, 1917, p. 190.

[5] Entomological Code, May, 1912, Rule 114, p. 22.

[6] *Proc. U. S. Nat. Mus.*, LIII., August 16, 1917, p. 636.

[7] *Ann. Entom. Soc. Amer.*, IX., 1916, pp. 89–91.

[8] *Auk*, XXXIV., No. 2, April, 1917, p. 228.

7. The law of priority, subject to that of generic names, shall be fully operative in relation to family and subfamily names.

Remarks.—This, of course, in cases where changes in family names become necessary, should not be held to apply to the use of any names that are not based on the type genus. (See remarks under Rule 12.)

8. In the application of the law of priority, consideration is to be given to all names employed respectively in a family or subfamily sense; and to all supergeneric group names not higher than the grade of family, if based on an included genus; but any such names when brought into use must have their endings changed to *idæ* or *inæ* if they were originally proposed with other terminations.

Remarks.—The necessity for some such rule is obvious, since many early authors, like Swainson, Vigors, and Bonaparte, used plural names with other terminations, such as *ina* and *ini,* which, of course, deserve consideration in determining the priority of family or subfamily names. Some authors, moreover, who extensively employed the terminations *idæ* and *inæ,* changed the penultimate syllable in the family name to "a" whenever necessary to conform to classical usage (*e. g.,* Sylviadæ, Laniadæ); and it is, of course, desirable to retain such names, but with the regular ending. Furthermore, this rule involves the treatment of all supergeneric group terms not higher than the grade of family as potential family or subfamily names.

9. When a family or subfamily is divided, its name is to be retained in both family and subfamily sense for that part containing the type genus of the original group. The remaining portion should take as its family or subfamily designation the earliest name based on any of its included genera. If there is no such name, the family or subfamily may take for its type genus any included genus, preferably the most characteristic or best known.

10. When a subfamily is raised to family rank, its type genus is to be retained as the type genus of such family group.

11. The family or subfamily formed by the combination of two or more families or subfamilies takes for its type genus the generic group in any of its components that was first made the basis of a family or subfamily name.

12. When for any reason the name of the type genus of a family is changed, the dependent family name must be changed to correspond to the new designation of the type genus.

Remarks.—Such change in the name of a type genus occurs whenever the generic term is found to be a homonym or synonym or is transferred to another family group. Since, of course, a family or subfamily designation must be based on the *tenable* name of its type genus, there is obvious necessity for a corresponding change of the family or subfamily name whenever any alteration takes place in the name of the type genus. In such case, to use a family name already proposed but based on another genus would thereby change the type genus of the family and violate Rule 5.

13. Of two family or subfamily names in zoology having exactly the same spelling, the later is to be distinguished from the earlier by the prefix "*Pro*": hypothetical example, Propicidæ.

Remarks.—Such preoccupation occurs when generic terms having the same word-stem are the bases of two or more family names; and to obviate the use of family names identical in spelling necessitates the selection of another designation in place of the family name invalidated. To replace the later name by one based on a newly selected type genus would be the logical method, were it not impossible in the case of monotypic family groups. Similarly, the use of a new family name formed by the addition of *idæ* to the nominative case instead of to the stem of the name of the type genus, would not avail should the nominative case happen to be the same as the stem.

The use of the prefix "*Pro,*" which we have selected on account of its meaning and its brevity, seems to be the most satisfactory rule that can be devised for such cases. For

segregate *Pica* Brisson, as the type and only genus of a separate family, the name of such family could not well be Picidæ, since this is already in use for another group, with *Picus* Linnæus as basis. Consequently the name of the family containing *Pica* would become *Propicidæ*.

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FURTHER RESULTS OF ANALYSIS OF LIGHT DEFLECTIONS OBSERVED DURING SOLAR ECLIPSE OF MAY 29, 1919

1. SINCE the article in SCIENCE of June 11, 1919 (pages 581–585) was written, we have received through the kindness of the Astronomer Royal the printed "Report"[1] giving in detail the reductions and results of the light deflections observed by the two British expeditions during the solar eclipse of May 29, 1919. On the basis of the information in the "Report" we have made an independent reduction of the photographic measures resulting from Crommelin's plates.

The non-radial effects, as resulting from our calculations, are found to be on the average about one third of those derived from the British printed results and as given in the seventh column of Table II. of the previous article in SCIENCE (see page 583); in brief, *our non-radial effects are on the order of the error of observation, so that they may be regarded as non-existent until other observational evidence is obtained.*

2. Table I. contains the revised radial light deflections resulting from all reductions; they are subject to some slight changes when some required additional information has been received. Comparing the observed deflections with those computed on the basis of the Einstein theory of gravitation, it will be seen that generally the observed deflection is greater than the theoretical value.

TABLE I

Radial Light Deflections, May 29, 1919, at Sobral

No.	Star	Dist.[2]	Deflection		O–E
			Obs'd.	Einstein	
3	κ_2 Tauri	1.99	1″.00	0″.88	+0″.12
2	Pi. IV. 82	2.04	1.00	0.85	+0.15
4	κ_1 Tauri	2.35	0.83	0.74	+0.09
5	Pi. IV. 61	3.27	0.57	0.53	+0.04
6	υ Tauri	4.34	0.55	0.40	+0.15
10	72 Tauri	5.19	0.35	0.34	+0.01
11	56 Tauri	5.38	0.31	0.32	−0.01

Star 11, the most distant star, according to the British reductions showed a deflection agreeing better with the value calculated on the basis of the Newtonian Mechanics, but it now shows a deflection agreeing better with the Einstein value. In brief, the results of all reductions would lend additional support to the conclusion reached by the British astronomers, namely, that, as judged by their best photographic plates, the light deflections observed during the solar eclipse of May 29, 1919, accorded better with the calculated values on the basis of the Einstein theory than on the basis of the Newtonian Mechanics.

3. Comparing the observed deflections with the theoretical ones, as given in Table I., it would seem that the former decrease with distance more rapidly than do the latter. Whether this implies that the observed light deflections were the combined effects of the sun's gravitational action and a solar atmospheric action of some kind can possibly not be settled definitely until further observational evidence has been obtained.[3]

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WASHINGTON, D. C.,
July 17, 1920

[1] "A Determination of the Deflection of Light by the Sun's Gravitational Field from Observations made at the Total Eclipse of May 29, 1919," by Sir F. W. Dyson, F.R.S., astronomer royal; Professor A. S. Eddington, F.R.S., and Mr. C. Davidson, *Phil. Trans. R. S.*, London, Ser. A., Vol. 220, pp. 291–333. [The longitude of Sobral, as given on page 296, should read $2^h\ 41^m\ 25^s$ west, instead of $2^h\ 47^m\ 25^s$.]

[2] Expressed in units of the sun's radius.

[3] It may be suggestive that the light ray from star 2, which according to Table I. differed largely from the Einstein value, passed through the solar atmospheric region directly above the remarkable prominence on the southeast limb of the sun.