ON THE TERMS "ANABELIOID" AND "FROBENIOID"

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The purpose of this brief note is to state my position with regard to certain *morphological issues* that have been raised by various people concerning the terms *"anabelioid"* and *"Frobenioid"* that appear in some of my papers.

(1.) The first main point that I would like to make is the following:

(P1) Unlike mathematics, the process of determination of *"correct final answers"* with regard to issues of morphology in a language is **far** *from being an* **"exact science"**.

In particular, although it makes sense to discuss *"typical examples"* and *"general trends"* in the context of such issues of morphology, in the case of many such issues, especially those of a relatively subtle nature, it does not make sense — i.e., in the way that it makes sense in mathematics — to say that a certain form of a word is *"right"* or *"wrong"* in any sort of objective sense. Unlike the case with mathematics, the collection of rules that underlie various issues of morphology are *far from being guaranteed to be free of internal logical contradictions*. That is to say, there exist cases where applying various well-accepted rules in different ways gives rise to *different, or logically inconsistent, final answers* to a given question — a situation that can never occur in mathematics! This imprecise nature of issues of morphology leads naturally in discussions of such issues of morphology to consideration of **statistics** *of occurrence* of various patterns of morphology. That is to say, languages contain so many "rare exceptions" and "rare inconsistencies" that the existence of a relatively rare **"counterexample"** to a given proposition in discussions of issues of morphology does not carry the same weight as the existence of a counterexample in a mathematical discussion.

(2.) With regard to the suffix *"-oid"* in English, we first review the following basic point:

(P2) The suffix *"-oid"*, which is of Greek origin and means "similar to", may be appended to *stems* of *nouns* and *adjectives*.

Examples of words obtained by appending the suffix "-oid" to a noun exist in such great abundance that we will not take the time to list examples of this phenomenon in the present note. Some people have asserted that this suffix cannot be appended to adjectives. First of all, it seems to me that this assertion is *amply refuted* by the existence of the following well-known examples:

- polaroid = (third declension Latin adjective) polar-is + oid,
- australoid = (third declension Latin adjective) austral-is + oid,
- monoid = (first/second declension Greek adjective) mon-os + oid.
- affinoid = (third declension Latin adjective) affin-is + oid.

These examples are sufficiently mainstream that it seems entirely unreasonable to dismiss them as "rare cases". Searches of MathSciNet revealed the following less well-known examples used in mathematical papers:

- perfectoid = perfect + oid,
- directoid = directed + oid,
- reguloid = regular + oid,
- isoloid = isolated + oid,
- relevantoid = relevant + oid.

Second of all, as a more general matter, the distinction in both Latin and Greek between nouns and adjectives is often far from clear-cut. That is to say, in both Latin and Greek, adjectives frequently appear without any explicit noun to modify (typically, in the case of Greek, preceded by a definite article), in which case they refer to "a thing(s)/person(s) which/who is/are ..." and hence function grammatically as nouns. As a result, in many contexts, it becomes quite problematic to determine where to draw the line between adjectives used in this way and words that should be regarded as genuine nouns in their own right. This phenomenon may also be seen in English to a lesser extent in the case of the *adjectival* suffix "-ian" (cf. "Gaussian", "pfaffian", which typically function as *nouns*), as well in the case of the suffix "-oid" itself which is frequently used to form both *nouns* and *adjectives*.

(3.) Thus, in summary, it follows from (P2) that

(P3) it is well within mainstream accepted norms to append the suffix "-oid" to the **stem** of the *adjective "anabelian"* or to the **stem** of the *noun "Frobenius"*.

The *nontrivial issue* that arises is the question of just what these *stems* are. Moreover, we note that this issue of *determining stems* is, in fact, entirely *independent* of the specific suffix (i.e., such as "-oid") under consideration. In particular,

(P4) *statistical* issues concerning mainstream morphological patterns with regard to the issue of determination of stems may be investigated by considering suffixes other than "-oid" such as, for instance, the more common suffix "-ty".

The point of view of (P4) will be exploited in the following discussion.

(4.) In the case of the noun "Frobenius", the issue that arises is the following:

(I1) *Should the noun "Frobenius" be regarded, from the point of view of issues of morphology, as*
(a) a second declension masculine Latin noun, or
(b) a non-Greco-Latin word that just happens to end in "s"?

That is to say, the term "Frobenioid" amounts to taking the position of (a), while the term "Frobeniusoid" (which has been proposed by some people) amounts to

taking the position of (b). One way to measure the extent to which (a) and (b) are supported by various mathematical authors is as follows. In the context of Frobenius automorphisms in number theory, (a) corresponds to a plural form *"Frobenii"* (which also just happens to be the singular genitive form), while (b) corresponds to a plural form "Frobeniuses". Then one interesting piece of *statistical data* is the following. A Google search for "Frobenii"/"Frobeniuses" revealed a *sharp gap* in the number of hits:

"Frobenii"/"Frobeniuses": 30700/503

(i.e., an *overwhelming* degree of support for (a)). Such data strongly supports the conclusion that (a) is well within mainstream accepted patterns of usage.

(5.) The issue of determining the stem of the adjective "anabelian" is more subtle. This subtlety revolves around the following issue:

(I2) *Is the stem of this adjective "anabelian-", "anabeli-", or "anabel-" (i.e., "-ian-", "-i-", or "-")?*

One reason for the subtlety of (I2) is that there does not exist a corresponding noun "anabelius/-um/-a" (for instance, meaning "anabelian variety") with stem "-i-". On the other hand, although the noun "Abel" (i.e., the name of the mathematician) exists, since the intended meaning of the term "anabelian + oid" is *"similar to an anabelian variety"* — i.e., **not** *"not (i.e., 'an-') similar to the mathematician Abel"!* — the point of view that this noun "Abel" is the appropriate stem is **inconsistent** *with the semantic aspects of the situation.*

(6.) From the point of obtaining *statistical data* concerning mainstream morphological patterns (cf. (P4)), it is natural to consider (I2) in the context of the following more general issue:

(I3) *Is the stem of an adjective of the form "xxx-ian" (i.e., ending in the Latinate suffix "-ian") "xxx-ian-", "xxx-i-", or "xxx-" (i.e., "-ian-", "-i-", or "-")?*

As discussed in (P4), this issue (I3) may be investigated to a certain extent by considering morphology patterns in the case of the suffix "-ty" (although, as discussed in (P1), such an approach is by no means completely rigorous in any sort of strict mathematical sense!). For instance, in the case of the adjective *"Christian"*, the quite common "Christianity" suggests that *"-ian-" is one accepted mainstream accepted answer to (I3).* On the other hand, the noun "Christity" (though certainly much less common than "Christianity": a Google search gave rise to 114000000/1360 hits for "Christianity"/"Christity") also exists, hence suggests that at the very least "-i-" may also be an acceptable answer to (I3). The case of the adjective "Christian" is, however, potentially misleading (not only because of the unusual cultural standing enjoyed by this adjective, but also) since there *does* in fact exist a noun with stem "xxx-" (i.e., "Christ"). Similar examples include *"barbarian"* (where we recall the Greek noun "barbaros" with stem "barbar-"), *"Egyptian"* (where we recall the Greco-Latin noun "Aegypt-os/-us" (i.e., "Egypt") with stem "Aegypt-"), *"Hungarian"* (where we recall the Greek noun "houngroi" (i.e., "Hungarians") with stem "houngr-"). By contrast, since *there does* **not** *exist a* **noun** *(i.e., such as a noun "anabel"!) with stem "anabel-"*, it seems that, from the point of view of obtaining *statistical data* concerning mainstream morphological patterns

of relevance to (I2), it is more appropriate to consider the following *refined version* of (I3):

(I4) *Consider an adjective of the form "xxx-ian" (i.e., ending in the Latinate suffix "-ian") for which there does* **not** *exist a* **noun** *with stem "xxx-" or stem "xxx-i-". Then is the stem of such an adjective "xxx-ian-", "xxx-i-", or "xxx-" (i.e., "-ian-", "-i-", or "-")?*

(7.) Although it is not easy to find ways to obtain *bulk statistical data* that addresses (I4) directly, one approach is to consider adjectives obtained by appending the adjectival suffix "-arian". Indeed, in the case of this suffix, typically there does *not* exist a corresponding *noun* with stem "-ar-" or "-ari-". Google searches for the suffixes "-ianity"/"-ity"/"-ty" yielded the following ("number of hits") data:

· "humanitar-": 100/1080/8,
· "egalitar-": 26/471/0,
· "utilitar-": 76/458/1,
· "authoritar-": 28/320/0,
· "trinitar-": 10/306/0,
· "totalitar-": 170/55/2,
· "libertar-": 47/40/43,
· "vegetar-": 418/4/0.

(In this context, it is perhaps of interest to recall examples such as "faculty", "difficulty", "liberty" of the suffix "-ty" (which corresponds to the Latin suffix "-tas") appended *without* an "-i-" to an adjectival stem that ends in a liquid consonant (i.e., "l" or "r"). The English language also contains such words as "cruelty", "property", "frailty", "specialty", "safety", "subtlety", and "entirety", although such examples are a bit misleading since their spelling originates from French words and hence does not necessarily reflect the morphological patterns that appear in the original Latin words.) Again, as discussed in (P1), *this data does not suggest any simple, clear-cut, absolute solutions to (I4).* On the other hand, this data does strongly suggest the following

(P5) **"bulk statistical answer"** *to (I4):*
      (a) The answer "-i-" — i.e., which corresponds to **"anabelioid"** *— to (I4) is a* **very strongly supported** *acceptable answer to (I4).*
      (b) The answer "-ian-" — i.e., which corresponds to **"anabelianoid"** *— to (I4) is also a* **substantially supported** *acceptable answer to (I4).*
      (c) The answer "-" — i.e., which corresponds to **"anabeloid"** *— to (I4) is only* **relatively rarely supported** *as an acceptable answer to (I4).*

In particular,

> *this data appears to be amply sufficient to* **refute** *the assertion that was been made by some people to the effect that "anabelioid" is incorrect in some sort of objective sense, while "anabeloid" is correct in some sort of objective sense.*

My own preferences, in light of the bulk statistical answer (P5), may be summarized as follows:

$$\text{"anabelioid"} > \text{"anabelianoid"} >>> \text{"anabeloid"}.$$

In particular, I am *unable to explicitly endorse* the use of the term "anabeloid" and, moreover, for the reasons explained above, I do not see how this form of the term can be justified relative to widely accepted morphology patterns. On the other hand, again, in accordance with the discussion of (P1), I do not intend to actively "prosecute" or prohibit the use of the term "anabeloid" (or the term "anabelianoid").