THE LINNAEAN CONCEPT OF PEARL MILLET

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The commonly cultivated pearl millet has passed under more aliases, probably, than has any other grass. When the layman asks the botanist why he calls plants by such queer names the botanist tells him that it is for the sake of precision, that a given plant may bear a different common name in each country it inhabits, or in different parts of the same country, but that the Latin name is the same throughout the world. If the layman were acquainted with the Latin synonymy of pearl millet he could cite it to refute the botanist's defense. In the analysis of the Linnaean concept which follows, the common names, pearl millet and yellow foxtail, are used for the sake of precision instead of the Latin names. (The argument for Latin names is in the main, of course, valid, the exceptional case of pearl millet notwithstanding.)

Early in the last century pearl millet had almost as many names as there were floras. *Pennisetum typhoideum*, *Penicillaria spicata*, *Panicum spicatum*, and *Pennisetum alopecuroides* were the most popular. By the middle of the century the other names had mostly dropped out of use, giving place to *Pennisetum typhoideum*. In 1895, early in the period of modern nomenclatorial unrest which still agitates us, Dr. K. Schumann[1] "on the ground of priority" published for pearl millet the name *Pennisetum americanum*, based on "*Panicum americanum* L." In 1914 S. C. Stuntz took up the name *Pennisetum glaucum* (L.) R. Br., based on "*Panicum glaucum* L., based on a specimen from Ceylon." This is the name applied to pearl millet in recent American publications. Robert Brown applied the name *P. glaucum* to yellow foxtail, which was his understanding of Linnaeus's species. Mr. Stuntz published *Chaetochloa lutescens*, based on *Panicum lutescens* Weigel, for the foxtail.

Dr. Otto Stapf in a recent note on "*Setaria glauca* and *S. lutescens*," a copy of which was sent to Dr. A. S. Hitchcock before publication, holds that one should proceed with great caution before shuffling names which involve a grass of economic importance and also a well-known weed. With this opinion I heartily agree. All the names of pearl millet mentioned above are based upon Linnaean names. In order to arrive at a decision (necessitated in revising the North American species of Pennisetum), I have made an analysis of the Linnaean names involved in the problem.

[1] Page references are given in the bibliography.

1753. SPECIES PLANTARUM, PAGES 55, 56.

Panicum glaucum is composed of:

Panicum spica tereti, involucellis bifloris fasciculato-pilosis. *Fl. zeyl.* 44 [Pearl millet].

Gramen alopecuroides maderaspatanum, spica quasi geniculata molli. *Pluk. alm.* 177. *t.* 190. *f.* 6 [*Elytrophorus articulatus*].

β Gramen paniceum s. Panicum sylvestre, simplici spica. *Scheuch. gram.* 46 [*Chaetochloa viridis*].

γ Panicum spica simplici, aristis aggregatis flosculo subjectis. *Gron. virg.* 134 [Yellow foxtail].

Panicum indicum altissimum, spicis simplicibus mollibus in foliorum alis, pediculis longissimis insidentibus. *Tournef. inst.* 515 [Unidentifiable].

Habitat in Indiis.

Setae in spica longitudine flosculorum. Foliorum vaginae oris pilosae. Dum spica recens prodiit Flosculi in series dispositi observantur. [This description applies only to pearl millet.]

Dr. Stapf says it is very probable that the Hermann plants of the Flora Zeylanica were returned to their owner and were not at Linnaeus's hand when preparing the Species Plantarum, that Hermann's plants can not be accepted as types without further evidence. Dr. Stapf holds that such evidence is wanting in the case of *Panicum glaucum*. I should say the description ("Bristles the length of the flowers," and "In the young spike the flowers are seen to be disposed in series") supplies the evidence that Linnaeus had a plant of pearl millet at hand. The name *glaucum* itself applies well to the bluish head of pearl millet, not to the yellow head of the foxtail.

But, Dr. Stapf says, Linnaeus undoubtedly had Gronovius's plant (yellow foxtail) at hand. This specimen is written up as *Panicum glaucum* and numbered 2 by Linnaeus himself (the number of *P. glaucum* in the Species Plantarum). But may not this naming and numbering have been done after the publication of the name? The fact that the two references to Chaetochloa (3 and 4 above) are preceded by β and γ should also be considered. This method of indicating varieties was commonly used by Linnaeus in earlier works as well as in the Species Plantarum. It would seem that Linnaeus regarded the two species of Chaetochloa as varieties of *P. glaucum*, which itself was pearl millet.

If the case ended here (as, strictly following priority, it does) the evidence, because of the description, would, I think, point much more clearly to pearl millet. "Bristles of the spike as long as the flowers" agrees with pearl millet; in yellow foxtail they are much longer. "In the young spike the flowers are seen to be disposed in series" points undoubtedly to the crowded fascicles of pearl millet that appear to run obliquely like the cells of a honeycomb. But in Systema Nature ed. 10. (2: 870. 1759) "seminibus undulato-rugosis. Sp. Pl. n. 2. γ." is added to the diagnosis for *P. glaucum*, which otherwise is taken verbatim from the Flora Zeylanica

reference in the first edition and applies to pearl millet. "Seminibus undulato-rugosis" applies only to the Gronovian plant, yellow foxtail. The reference to no. 2 γ would indicate that Linnaeus wishes to attach the name *glaucum* to the Gronovian plant. The variety β of the first edition is now named *P. viride*. The diagnosis is an exact repetition of that for *glaucum* just above except for the last phrase, which is "seminibus nervosis." The "fasciculato pilosis" does not apply to this species of Chaetochloa any more than it does to the other.

Paralleling this evolution of *P. glaucum* in Linnaeus's mind is that of *P. alopecuroides*, the first species of Panicum in the Species Plantarum (page 55). "Habitat in China" is given as the source of that species. Concerning the plant in the Linnaean Herbarium, Dr. Stapf writes:

> "The diagnosis and the description fit the plant very well. It is the same plant which R. Brown described subsequently as *Pennisetum compressum*. The specimen is numbered 1—the number of *Panicum alopecuroideum* in Species Plantarum, ed. 1.—by Linnaeus, and the country given by him is 'Chin.' The name *alopecuroideum* is not in his handwriting. There is, however, another sheet, written up by him '*alopecuroideum*,' but this is not numbered, nor is there anything to show where he had it from; this is a starved specimen of *Pennisetum spicatum* = *P. americanum* f. (26) *sieberianum* Leeke" [one of the forms of pearl millet].

Besides the diagnosis and unusually good description Linnaeus cites a figure of Plukenet which, according to Trinius and Stapf (and to all appearances), represents *Perotis latifolia*. In the Systema (2: 870) "basi ciliatis" is inserted in the diagnosis following "involucris setaceis." Bristles with ciliate base are found not in the Chinese species but in pearl millet.

A third name involved is *P. americanum*, the third species of Panicum in the Species Plantarum (page 56). This is composed of

Panicum spica simplici aequali, pedunculis bifloris. *Roy. lugdb.* 54. [Unidentifiable by the writer; may be pearl millet.]
Panicum indicum, spica obtusa caerulea. *Bauh. pin.* 7. *theatr.* 522. ["theatr." referred to is the illustrated Theatri botanici, 1658. The figure is copied, by tracing evidently, since it is reversed, from that in Clusius (see below) illustrating *Panicum americanum*.]
Panicum americanum *Clus. hist.* 2. *p.* 215. [The figure referred to is a branching plant with thick heads, about half as broad as long, in the axils of the upper leaves. It can not by any stretch of imagination be taken for pearl millet. The description suggests a large form of common millet, *Chaetochloa italica*].
"*Habitat in* America."

Since there is no description, we may assume that Linnaeus was naming a species he did not know, that is, he was giving a name to certain references in books. Since he appropriates the Clusian name that may be taken as the basis of his name. Clusius's species being unidentifiable, the name may be rejected. A figure on page 216 of Clusius's work entitled "Panicum Americ. sesquipedalis spica" is unmistakably pearl millet. But it is not this figure that Linnaeus cites, nor the Clusian description of it, differentiating it from

his *Panicum americanum*. In 1759 (Syst. Nat. ed. 10. **2**: 870) the phrase name cited in the Species Plantarum from "Roy. lugdb. 54," is given, but the reference to Royen is omitted. In the second edition of Species Plantarum (1762, p. 82) *Panicum americanum* is omitted. The phrase names cited under it in the first edition are now placed under *Holcus spicatus* (p. 1484). The name was not used for a species in any subsequent work of Linnaeus, nor elsewhere until taken up by Schumann in 1895, and transferred to Pennisetum. Schumann says the plant was sent to Linnaeus from America, but there is no evidence that he ever had an actual specimen that he called *Panicum americanum*.

Following "*alopecuroides* 1" with its altered diagnosis in the Systema is "*cynosuroid*. A. P[anicum] spica tereti involucellis unifloris, raiis pilosis," nothing more. The peduncles of the fascicles in the Chinese species are pilose. Having applied "*alopecuroides*" to pearl millet did Linnaeus mean to call the Chinese plant "*cynosuroides*"? If so he changed his mind, for he never uses *P. cynosuroides* again.

In the second volume of the Systema (1759, page 1305) another factor enters into the problem. Panicum is placed under Triandria Digynia. Under Polygamia Monoecia, in the genus Holcus (containing two cultivated sorghums, Johnson grass, and six other species not congeneric with the sorghums), is published *Holcus spicatus* "glumis bifloris muticis, floribus geminis penicillo involucratis, spica ovato-oblonga. *Pluk*. t. 32. f. 4." The diagnosis is original and applies well enough to pearl millet. Plukenet's figure is also very probably pearl millet.

So far we have: (1) *alopecuroides* altered to fit pearl millet (China is never again mentioned in connection with this name; (2) *cynosuroides* (probably a species of Pennisetum), a name not to appear again; (3) *glaucum*, the diagnosis altered and applied to var. γ of the Species Plantarum, but with part of the original diagnosis (applying to pearl millet but not to yellow foxtail) remaining; (4) *Holcus spicatus*, the diagnosis applying fairly well to pearl millet and the figure cited almost certainly meant for that species.

1762. Species Plantarum ed. 2: 82, 83.

Panicum alopecuroideum is here composed of: (1) The altered diagnosis from the Systema [the bristles ciliate at base applying to pearl millet]. (2) The reference to Plukenet's figure of *Perotis latifolia* queried. (3) "Gramen indicum alopecuroides holosericum majus, spica longa pappescente. *Pluk. alm.* 177. *t.* 92. *f.* 5." [The figure is unidentifiable. I took it for *Pennisetum polystachyum* (L.) Schult. of India, but Dr. Stapf writes that a sample of the Plukenet original in the Morison Herbarium at Oxford is *Melica ciliata*. With that species in mind I can see that it looks more like that than it does like *P. polystachyum*.] (4) "*Habitat in* Jamaica." [This habitat is unaccountable.] (5) The description, unaltered, from the first edition [applying to the Chinese plant].

Panicum glaucum is here composed of: (1) The diagnosis given in the Systema (part of it applying to pearl millet and part to yellow foxtail), followed by "*Fl. zey.* 44" (pearl millet only). (2) The Gronovian diagnosis and reference, without "γ" (applying to yellow foxtail). (3) "*Habitat in* Indiis & Italia" (notwithstanding the reference to Gronovius, Flora virginica). (4) The description verbatim from *P. glaucum* in the first edition (the statement that the bristles are the length of the flowers, and the observation of the flowers disposed in series, applying conclusively to pearl millet), with the addition "Semina striis undulatis notata" (applying to the fruit of yellow foxtail and not to that of pearl millet) as in the Systema.

Holcus spicatus (page 1483) is composed of:

Holcus glumis bifloris muticis, floribus geminis penicillo involucratis, spica ovato-oblonga [the diagnosis from the Systema, 1759].

Panicum spica simplici aequali, pedunculis bifloris. *Roy. lugdb.* 54 [Unidentifiable by the writer, may well be pearl millet].

Panicum indicum, spica obtusa caerulea. *Bauh. pin.* 7. *theatr.* 522. [The second citation under *P. americanum* in the first edition of Species Plantarum. The "theatr." referred to is the illustrated Theatri botanici, 1658. The figure is copied by tracing from that in Clusius for *P. americanum*, and does not represent pearl millet. The long description says among other things that the culm near the base is of an elegant blue and shining purple and the pith spongy, characters that suggest sorghum. But the further description of the culm as dividing into branches does not apply to sorghum. (Was it perhaps the illustration that was described?) The spike is said to be sometimes a finger long and sometimes only an inch, and to resemble "Frumenti Turcidi" (maize). It is said to be from the Indies and also from Peru, to be grown in gardens in Belgium, rarely in Germany, from seed sent from Spain. Altogether it reads like a compound of half-remembered plants of sorghum, common millet, and maize. Such a figure and description at any rate can not reasonably be taken as a basis for a name.]

Panicum americanum. *Clus. hist. 2. p.* 215. [See note on *P. americanum* above.]

Gramen alopecuroides indicum maximum. *Raj. hist.* 1908. [Ray's description applies very well to pearl millet.]

Gramen paniceum sylvestre maximum indiae orient. *Pluk. alm.* 164 [error for 174] *t.* 32. *f.* 4. [The figure, which was referred to under *H. spicatus* in the Systema, may well be pearl millet.]

Habitat in India.

Culmus bipedalis, crassitie pennae cygneae, tectus vaginis foliorum hispidis ut ipse culmus. Folia saepius 10, latitudine digiti hispida. Spica crassissima pedicellis brevissimis apice fasciculo setarum, intra quem Flores 2, sessiles. Calyx bivalvis, membranaceus, biflorus. Petalo exteriore hermaphroditi mucronato; masculi obtuso. Stylus floribus longior, lanatus, laeviter apicae bifidus. Antherae oblongae. [A hispid culm two feet tall, and as thick as a swan's quill, covered with hispid sheaths and with hispid blades, is certainly not pearl millet, but the rest of the description might apply to it, or, somewhat better, to common millet. Did Linnaeus possibly have a sterile plant of

Panicum miliaceum and a head of pearl millet or of common millet when he wrote the description?]

Summing up the problem as it stands after the publication of the second edition of the Species Plantarum, we have:

1. *P. alopecuroides*: the diagnosis applying to pearl millet, the description to the Chinese species, the citations from Plukenet and the habitat applying to neither.

P. cynosuroides and *P. americanum* are omitted.

2. *P. glaucum*: both diagnosis and description are composites of the characters of pearl millet and yellow foxtail; the citation from Gronovius refers to the foxtail.

3. *Holcus spicatus*: the diagnosis with a minor exception applies to pearl millet; the description applies partly to *Panicum miliaceum* (?) and partly to pearl millet (?) Three of the citations refer to pearl millet and two to an unidentifiable figure.

1767. Systema Naturae ed. 12: 86–87, 669.

Panicum alopecuroides is exactly that of the tenth edition of the Systema [altered from Species Plantarum to fit pearl millet].

Panicum glaucum: the diagnosis is that of the tenth edition [applying to pearl millet], the reference to "Sp. Pl." omitted, and "Pedunculus valde sulcatus" applying to yellow foxtail added.

Holcus spicatus: the diagnosis is that of the tenth edition, applying fairly well to pearl millet. The reference to Plukenet is omitted.

1771. Mantissa Plantarum 2: 322.

"Panicum alopecuroid. Excludatur et reformatum restituatur sequentibus." The diagnosis now reads: "spica tereti, involucellis setaceis fasciculatis bifloris, pedunculis villosis" [applying well to pearl millet]. The second Plukenet reference (that to the unidentifiable *pl.* 92. *f.* 5) is cited, "*Habitat in* India *orientali*." The description given in the first and second editions of the Species Plantarum is dropped and a new one inserted: "Statura Panici italici. Culmi et totum villosum. Folia latitudine digiti transversi, utrinque pilosa, etiam vaginis. Spica magnitudine digiti ex Involucellis multiseto-fasciculatis, villosis, scabris, bifloris, pedicellatis, longitudine flosculorum. Florum valvula accessoria longitudine reliquarum." [The statement that the sheaths and both sides of the blades are pilose does not apply to pearl millet, nor does that of the accessory valve as long as the rest, whether either of the glumes or the sterile lemma is meant. If Linnaeus had a ripe spikelet of pearl millet with the globose grain forcing apart the lemma and palea, he might have meant that the lemma, palea, and grain are of equal length, which would be correct.]

Panicum glaucum and *Holcus spicatus* are not given in the Mantissa, being in their author's mind, doubtless, in no need of correction.

From the foregoing it seems quite probable that, as in the case of subsequent authors, Linnaeus sometimes had very vague or confused "concepts" and that, like many another busy author, he "revised" his books with a pair of scissors and a paste cup. May it not be possible, even, that some of the students whose botanical papers form Linnaeus's numerous Dissertationes academicae, wielded the scissors and paste brush for him? At any rate the revisions do not show careful reconsideration. Should subsequent changes of diagnoses, that in each case serve to blend further the diverse elements, outweigh the original almost clear application of the name *Panicum glaucum* to pearl millet?

So much for Linnaeus's concept; now to take a rapid survey of the species as treated by subsequent botanists. Pearl millet was not generally confused with other species, but there were diverse views as to its proper generic position, all realizing that it did not belong to either Panicum or Holcus. In Murray's revision of Linnaeus's Systema Vegetabilium, 1774, he placed *Panicum alopecuroides* (itself uncertain as shown above, but applied to pearl millet by Murray) in Alopecurus (*A. indica*). Cavanilles in 1802 placed it in Cenchrus. In 1805 L. Richard (in Persoon's Synopsis Plantarum) established the genus Pennisetum for this and allied species, renaming pearl millet *P. typhoideum*, possibly, because of the confusion in the Linnaean names, wishing to reject them all. In 1809 Willdenow, apparently unacquainted with the recently published Pennisetum, proposed Penicillaria for pearl millet. Running through the more important subsequent botanical works containing the species we find:

Pennisetum typhoideum used by Persoon, 1805; Sprengel, 1825; Trinius, 1826, 1834; Steudel, 1854; Hooker, 1896; Stapf, 1898; Watt, 1892, 1908; Trimen, 1900; Battandier and Trabut, 1902; Cooke, 1908.

Penicillaria spicata used by Willdenow, 1809; Roemer and Schultes, 1817; Link, 1821; Kunth, 1823; Nash, 1903.

Pennisetum americanum used by Schumann, 1895; Leeke, 1907; Hitchcock, 1908.

Pennisetum spicatum used by Körnicke, 1885; Beal, 1887.

Pennisetum glaucum used by Stuntz, 1914; Hitchcock, 1920. (Brown used this name for yellow foxtail.)

Panicum spicatum used by Roxburgh, 1820.

Cenchrus spicatus used by Poiret in Lamarck's Encyclopedia, 1816.

It will be seen that *Pennisetum typhoideum* has been the favorite in recent years but has not had a majority.

In 1916 Drs. Schinz and Thellung discussed the case. They state that *Panicum glaucum* L., 1753, is a composite (Sammelart) of three different species. [If the citations given as belonging to the species itself as well as β and γ are included, it contains six.] The authors further state that in 1759 (in the Systema) Linnaeus himself restricted the name to his earlier

var. γ. But in the Systema we have "P. spica tereti, involucellis bifloris fasciculata-pilosis (applying to pearl millet and not to yellow foxtail), seminibus undulato-rugosis. Sp. pl. n. 2. γ" (applying to yellow foxtail and not to pearl millet). Instead of "restricting" the name to either species Linnaeus adjusts it to both. In the foxtail the spikelets are solitary in each fascicle and the fascicles are not pilose. In pearl millet the spikelets are usually two to the fascicle and the fascicles are pilose. In the second edition of the Species Plantarum, which affords greater space, Linnaeus again cites "Fl. zey. 44" (pearl millet only) and gives the original description of pearl millet, adding to it that of the fruit of yellow foxtail.

Now "in the interests of stable nomenclature" what can be done to bring order out of this confusion?

My own judgment would be that:

1. *Panicum alopecuroides* be restricted to that of the Species Plantarum, 1753, the citations discarded, leaving the Chinese specimen as the type (= *Pennisetum alopecuroides* (L.) Spreng., but not as Sprengel applied the name).
2. *Panicum glaucum* be restricted to its first diagnosis and description, applying clearly to pearl millet, and that the citations, including the varieties β and γ, be discarded. The name *glaucum* itself applies to the bluish tinge of the spike of pearl millet (= *Pennisetum glaucum* (L.) R. Br., but not as Brown applied the name).
3. *Panicum americanum* be rejected, since it was based on two unidentifiable figures, one evidently drawn from a tracing of the other.
4. *Panicum cynosuroides* be rejected. This seems to have been used but once, by Scopoli in 1778, and applied to *Chaetochloa viridis*.
5. *Holcus spicatus* be restricted to its first diagnosis in 1759, becoming a synonym of *Pennisetum glaucum*.

The object in publishing this lengthy analysis is primarily to make available for the use of others what has cost much time and study. But a second reason is that it furnishes a good example of the "Linnaean concept of species," to which botanists who are not systematists sometimes bid us return. This is not to find fault with Linnaeus, it is only to show that he was human and fallible like the rest of us. His concept of species was not "broader" than ours, as is commonly supposed by those who have not used his books. He described very closely allied forms, such as *Bromus purgans* and *B. ciliatus*, or even "split" a single species, as when he described *Andropogon divaricatum* and *A. alopecuroides* for the commonest Erianthus of our eastern states (*E. divaricatus* (L.) Hitchc.). When Linnaeus had a plant in hand his descriptions are often vivid impressionist pictures. That of *Panicum dichotomum* "like a little tree, simple below and branching above," recalls the autumnal phase of the plant instantly *to one who knows it.* But in the majority of his species there is no description but the brief diagnosis following the name, which is often inadequate for identification.

From the case here presented the botanist who is not a systematist may also see some of the reasons why we have codes of nomenclature and why with all our codes we have not as yet attained stability.

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