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An Overview of the Type Mineralogy of Africa*

by

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KEYWORDS. — Mineralogy; History of Science; Mineral Nomenclature; Africa.
SUMMARY. — Out of the ca. five thousand five hundred valid mineral species currently known, about four hundred were initially described for localities in Africa. The first new mineral descriptions for this continent date from the late 18th century, but significant numbers have only been reached from the early 20th century onward. Up to now, the largest number of new species have been described in Namibia, the DR Congo and South Africa, with a considerable lead over all other countries. In this overview of the type mineralogy of Africa, regional variations and the history of new mineral descriptions are covered, combined with a discussion of some general aspects of mineral species' validity and mineral nomenclature, based on examples from Africa.

TREFWOORDEN. — Mineralogie; Geschiedenis van de wetenschap; Naamgeving van mineralen; Afrika.
SAMENVATTING. — *Een overzicht van de type mineralogie van Afrika*. — Van de ca. vijfduizend vijfhonderd geldige mineraalsoorten die momenteel gekend zijn, werden er ongeveer vierhonderd voor het eerst beschreven voor vindplaatsen in Afrika. De eerste beschrijvingen van nieuwe mineralen voor dit continent dateren van het einde van de 18de eeuw, maar significante aantallen werden pas bereikt vanaf het begin van de 20ste eeuw. Tot op heden werden de grootste aantallen nieuwe soorten beschreven voor Namibië, de DR Congo en Zuid-Afrika, met een aanzienlijke voorsprong op alle andere landen. In dit overzicht van de type mineralogie van Afrika worden regionale variaties en de geschiedenis van de beschrijving van nieuwe mineralen behandeld, samen met een bespreking van enkele algemene aspecten van de geldigheid van mineraalsoorten en van de naamgeving van mineralen, aan de hand van voorbeelden uit Afrika.

MOTS-CLÉS. — Minéralogie; Histoire de la science; Nomenclature minéralogique; Afrique.
RÉSUMÉ. — *Aperçu de la minéralogie type de l'Afrique*. — Parmi les quelque cinq mille cinq cents espèces minérales valides actuellement connues, environ quatre cents furent initialement décrites pour des sites en Afrique. Les premières descriptions de nouvelles espèces sur ce continent datent de la fin du XVIII^e siècle, mais des quantités significatives n'ont été atteintes qu'à partir du début du XX^e siècle. Jusqu'à présent, le plus grand nombre d'espèces nouvelles décrites a été en Namibie, en RDC et en Afrique du Sud, avec une avance considérable sur tous les autres pays. Dans cet aperçu de la minéralogie type de l'Afrique, sont abordées les variations régionales et l'historique des descriptions de nouvelles espèces minérales, en parallèle avec quelques aspects généraux de la validité d'espèces minérales et de la nomenclature minéralogique, à partir d'exemples africains.

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Introduction

The type mineralogy of a region refers to all mineral species whose original description is based on the study of specimens from that area. It is part of the natural heritage of a region, and it has important ties with the history of mineralogical research and the evolution of mineral nomenclature through time. A discussion of type mineralogy should consider both valid and non-valid mineral species, whereby ‘mineral species’ refer to crystalline substances that formed by natural geological processes and that are characterized by a unique crystal structure and a well-defined chemical composition. Valid species are in practice those which have been approved at some stage by the Commission on New Minerals, Nomenclature and Classification (CNMNC) of the International Mineralogical Association (IMA), founded in 1959.

A discussion of the type mineralogy of most continents is a vast subject. For Africa, a complete overview of all valid and non-valid species by country, with a fully-referenced presentation of the history of the description of each species, has recently become available (Mees, 2018). The present text is limited to a general historical overview and to some comments about selected aspects of mineral nomenclature, illustrated by African examples.

Overview

At this moment (January 2020), a total of 5,532 valid mineral species, with type locality on any continent, are known, based on the most recent edition of the list published periodically by the IMA-CNMNC (November 2019). Among those species, 409 were first described, entirely or in part, for specimens from African localities. This number is relatively small in comparison with those for other continents, such as Europe and North America, where the study of mineral occurrences had a much earlier start.

The distribution within Africa shows strong variations between countries (tab. 1)*. New mineral species have been described for twenty-nine African countries, on a total of fifty-four. Three nations have together provided nearly three quarters of all African species, *i.e.* Namibia, the DR Congo and South Africa. For a few other countries the total also exceeds ten, but for most other listed countries only one or two new species have been described. The total of all valid species enumerated in table 1 is 411, which is greater than the real total of 409, due to two species with shared type localities in two African countries (gallite, described for both Namibia and DR Congo, and palladosilicide, described for both South Africa and Tanzania). The total of 409 species can be increased by also considering type localities on islands that are part of the African continent but that currently belong to non-African nations. This concerns three minerals, described for Gran Canaria (mogánite), Socotra (riebeckite), and Ascension (dalyite). In addition, the total could be more significantly enlarged by attributing minerals described for meteorites to the country where the meteoritic type material was found, as arguably done in some form by the IMA-CNMNC. For meteorites collected in Africa, fourteen valid new species have been described up to now, including eight for meteorites found in Morocco.

* For tables see annex, pp. 89-94.

As non-valid species, a total of 152 minerals can be proposed for Africa, varying in degree of formality of their original description and in type of discreditation. Among the three nations for which most valid new species have been described, South Africa has the lowest ratio of valid to non-valid species (tab. 1), due to descriptions of named compounds belonging to categories such as types of asbestos and impure diamond. The record is also poor for countries like Madagascar (including nine minerals described by Alfred Lacroix between 1910 and 1923) and Tanzania (including six gemstone types representing mineral varieties). For other countries, the record is much better, both for countries where a single deposit was intensively investigated during a short period of time (*e.g.* Gabon) and for countries yielding new mineral species for various localities over longer periods (*e.g.* Morocco).

New Mineral Descriptions for Africa through Time

Naming of minerals has a long tradition, going back to classical antiquity. Ancient written sources include works by Theophrastus (*Περὶ Λίθων*, ca. 300 BCE), Dioscorides (*De Materia Medica*, ca. 50-70 CE), and Pliny the Elder (*Naturalis Historia*, ca. 77 CE), which are all widely accessible through annotated translations. For minerals described in these texts, and in more recent important works such as *De Re Metallica* by Georgius Agricola (ca. 1556), only a few of them have some connection with Africa. One example is natron, for which Egypt is listed in early texts as one of the known localities. This may well refer to salt lakes of the Wadi Natrun depression, west of the Nile River delta, but natron in the sense of Pliny and others was clearly a general term for sodium carbonate deposits, without corresponding to the mineral as it was subsequently defined (natron, $Na_2(CO_3).10H_2O$). Another example is topaz ($Al_2SiO_4F_2$), whose name is derived from Topazion (Zabargad), an island along the coast of Egypt, but it almost certainly originally referred to forsterite ($Mg_2(SiO_4)$), for which the island is a known locality. The most convincing example is in fact emerald, for which Wadi Sikait in the Eastern Desert of Egypt is assumed to have been the original source, but this only concerns a beryl ($Be_3Al_2Si_6O_{18}$) variety, not a valid species.

The oldest modern description of a new mineral species for a locality in Africa has been widely considered to be that of prehnite, recognized for an unspecified locality in the former Cape Province (tab. 2). It was first described by Klaproth (1788), who referred for the name to the classification system of Abraham Werner, who is best known through a report with a later publication date than the article by Klaproth (Werner & Hoffmann, 1789). Together with witherite and torbernite, prehnite was the first mineral whose name was derived from that of a person (Hendrik Prehn or von Prehn, an army officer who provided the type material). At the time of publication, this attracted strong criticism from some mineralogists, who argued that names referring to persons are intrinsically meaningless, containing no information about the nature of the mineral.

The status of prehnite as first African mineral is in fact unjustified, because its description was preceded by that of trona by Bagge (1773), for a locality whose rather vague identification does allow an attribution to present-day Libya ('Suckena Province, two days journey from Fezzan') (tab. 2).

Prehnite and trona were the only new mineral species described for Africa in the course of the 18th century. During the 19th century, only six new mineral species were added (tab. 2), which is a very small number in comparison with what was reported for other parts of the world in the same period. They include two ammonium minerals discovered for guano deposits along the coast of southern Africa, which were surveyed at that time as a source of fertilizer (stercorite, teschemacherite), one salt efflorescence mineral described for an (ephemeral) occurrence in South Africa (apjohnite), two antimony minerals from historical mining sites in northern Algeria (nadorite, senarmontite), and a metamorphic mineral with type locality on the island of Socotra (riebeckite). The latter is probably the most widely known mineral with African roots, at least among geologists.

The rate of recognition of new species became greater from the start of the 20th century onward, with a steady increase up to the 1980s (fig. 1). During the first two decades, half of all new African species were described by Alfred Lacroix of the *Muséum national d'Histoire naturelle* in Paris, for specimens collected in erstwhile French colonies (tab. 2). Other examples are the first two new minerals from Tsumeb in Namibia, a deposit for which a great number of new species has subsequently been identified. They also include a first uranium mineral (rutherfordine), described for a locality in Tanzania rather than for the DR Congo, as well as two zinc minerals from the Zambian part of the Copperbelt region of Central Africa (parahopeite, tarbuttite), predating the description of the first new species for the Katangese part (cornetite). For both categories of minerals, *i.e.* secondary minerals containing uranium or locally abundant base metals, Katanga has later been a much more important type locality area than any neighbouring region.

The increase in number of valid new species described through time for Africa between the 1900s and the 1980s was followed by two less productive decades, followed by a new increase. These overall trends are compatible with patterns that are recognized when all new species, for all continents, are considered (Barton, 2019), described mainly in terms of peak periods (1960s, 1980s, 2010s). Important factors are technological improvements, including development of new analytical methods, but also the transition from analogue to digital registration of measurements, the creation of databases with reference data, and an evolution towards wider access to those data sets. The impact of new analytical methods is illustrated by some new mineral descriptions for African localities: in the 1930s, braggite (PtS) was presented as the first species to have been recognized by X-ray diffraction analysis and named in honour of the developers of the method (Bannister & Hey, 1932), and in the 1960s, a pioneering microprobe study led to the description of geversite ($PtSb_2$; Stumpfl, 1961), together with the first characterization of some unnamed compounds that were later defined as valid new species (*e.g.* genkinite, stumpflite).

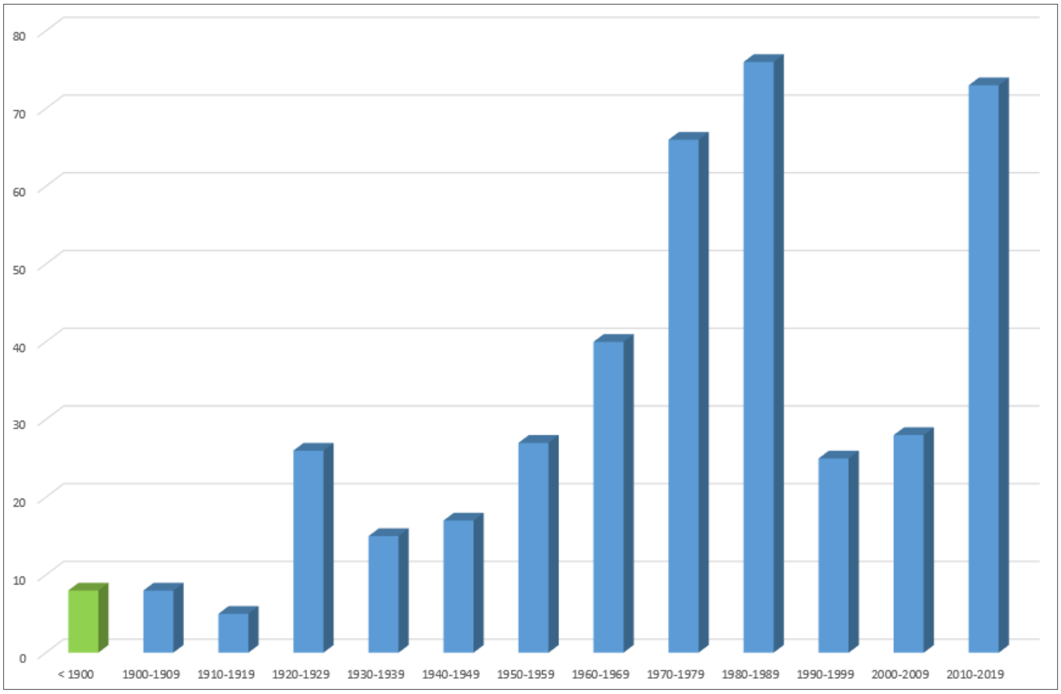

Fig. 1. — Number of valid mineral species described for Africa through time, by decennium.

Mineral Species Validity

The previous section mainly deals with valid mineral species. As mentioned in the beginning, specimen validity is currently decided by an international commission (IMA-CNMNC). Before the establishment of this screening system in 1959, one important form of evaluation of new mineral descriptions and subsequent studies consisted of the opinion presented in authoritative handbooks. The most influential was Dana's *System of Mineralogy*, especially the first six editions, published between 1837 and 1892. At that time, it was relatively common for authors of handbooks to suggest names for assumedly valid minerals that had been described by others as unnamed species, which was later unsuccessful (Povarennykh, 1972) or widely criticized (Gagarin & Cuomo, 1949). Some of the earliest minerals described as new species for African localities were in fact named by others (tab. 2): senarmontite and teschemacherite by J. D. Dana, apjohnite by E. F. Glocker, and cornetite by H. Buttgenbach. Another form of evaluation consisted of reviews of new mineral descriptions in mineralogical journals. The most systematic and influential reviews were those in *American Mineralogist*, founded in 1916. The assessments presented in these compilations were generally well justified, but they did record to some extent the opinion of individual mineralogists, including long-serving editors such as Michael Fleischer, which always leads to the risk of a certain degree of bias, for example in accepting proposals for discreditation by others, as in the case of *e.g.* epiianthinite and partridgeite. Occasionally, the style in which new mineral names were rejected was rather harsh, as in the case of borgniezite, for which Fleischer stated that "there is no excuse for burdening the literature with such names".

Since the creation of the IMA-CNMNC, this commission has evaluated all new mineral proposals. The first round of voting still dealt exclusively with minerals whose description had already been published, with delhayelite, pandaite (later discredited), wyartite and yoderite as approved African species, and with epiianthinite, dixeyite and kivuite as discredited species. In this first report (Anonymous, 1962), the commission insisted again that new mineral proposals should in the future be submitted before publication, a practice that is now widely respected. Among minerals described for African localities, congolite (Wendling *et al.*, 1972) is an example of a more recently described mineral that was only approved after publication, and arnhemite and pyrophosphite (Martini, 1994) are examples of non-valid species whose descriptions were published despite their rejection by the IMA-CNMNC, in both cases with publication in non-mineralogical journals.

In addition to evaluating individual new mineral proposals, the IMA-CNMNC has also published general nomenclature reports presenting decisions for large numbers of species (Nickel & Mandarino, 1987; Burke, 2006), as well as reports dealing with specific mineral groups (Henry *et al.*, 2011; Hawthorne *et al.,* 2012), both containing many decisions affecting the status of minerals described for African localities. One example of an African mineral whose status has changed through time is hydropyrochlore ($(H_2O,\square)_2Nb_2(O,OH)_6(H_2O)$), which was originally described as an unnamed pyrochlore variety by Van Wambeke (1965), who explicitly referred to a need for IMA-CNMNC consensus on pyrochlore group nomenclature before a name could be proposed. This was later done by describing it as kalipyrochlore in an IMA-approved nomenclature report by Hogarth (1977), followed by a full description under that name by Van Wambeke (1978), but the mineral is currently qualified as hydropyrochlore in the revised pyrochlore classification system presented by Atencio *et al.* (2010). The complexity of changes in mineral nomenclature is also illustrated by tweddillite ($CaSr(Mn^{3+}{}_2Al)[Si_2O_7][SiO_4]O(OH)$), described as a new mineral by Armbruster *et al.* (2002). A short time later, the name was replaced by manganipiemontite-(Sr), at the introduction of a root-name-based nomenclature system for the epidote group, presented in an IMA report with the same first author as the tweddillite description (Armbruster *et al.*, 2006). The name was later reinstated, arguing that it had been too widely used to be suppressed (Revheim & King, 2016). Both examples concern mineral groups characterized by a continuous wide range in composition between various end-members, for which nomenclature rules expressing element-dominance at specific crystal lattice sites are generally imposed, in order to obtain a limited number of rational names, including names for species that have not yet been discovered or formally described. A related example are minerals containing rare-earth elements (REE) as essential constituents, for which the rules proposed by Levinson (1966) have been adopted by the IMA-CNMNC, with a suffix recording the dominant REE and with preservation of the name of the first described species if it exists, even if part of the root name is redundant (yttrocolumbite-(Y)) or contradictory (yttrotungstite-(Ce)).

Mineral Names

Despite arguments against mineral names referring to persons in the largely prehnite-centred debate that took place at the end of the 18th century, naming minerals in honour of individuals has since become common practice. Out of the 409 species described for type localities in Africa, a majority have been named after persons (231 species; tab. 3). The other main categories are mineral names referring to provenance (seventy-eight species) and to chemical or physical characteristics (thirty species). In addition, many mineral names are derived from those of existing species (sixty-two species), typically with a prefix or suffix specifying the nature of the difference between the new and earlier defined species. The few names that can not be assigned to these categories include some referring to organizations (*e.g.* nimite, sasaite) or to deposit type (*e.g.* stercorite), as well as one name derived from that of a journal (minrecordite) (tab. 4).

Most persons in whose honour minerals have been named are mineralogists or geologists. The latter include many who worked for mining companies, which are also represented by various other types of professions, including prospectors, administrators, and mine owners. Physicists and chemists include several pioneers in the study of radioactivity, in whose honour uranium-bearing minerals have been named (*e.g.* becquerelite, curite, rutherfordine). A recent trend is naming minerals after mineral collectors and dealers, for regions currently producing collectable specimens. The total of 231 valid mineral species named after persons does not correspond to the number of individuals involved, because a few of them have been named after more than one person (braggite, ludlockite, taniajacoite), compensated by two mineral names referring (in part) to the same person (keyite, ludlockite). A few more examples of double use of person names exist when both valid and non-valid species are considered (hermannroseite/roseite, sidpietersite/pietersite). Among the 231 valid species, only ten have been named after women (clairite, effenbergerite, erikapohlite, eylettersite, giniite, joosteite, kudryavtsevaite, mathiasite, sklodowskite, tredouxite), which include three minerals named in tribute to the wife of the author of the mineral's description. Another observation is that only a single African mineral species has been named in honour of a non-Caucasian African national (nyerereite).

As illustrated by some of the examples mentioned, most names referring to persons are based on family names or on a combination of given names and family names. Others have been derived in a more complex way, such as afwillite (A. F. Williams), orlymanite (Orlando Lyman), and warikahnite (Walter Richard Kahn), which is another practice that was criticized at some stage (Eakle, 1928). Also mélonjosephite, named in honour of Joseph Mélon, could well have been named more intuitively by respecting the normal order of name and surname.

Names referring to provenance mainly concern mining sites or other specific localities, but several names refer to regions (*e.g.* shabaite-(Nd)) or to the country of origin as a whole (congolite, kenyaite, marokite, senegalite, tunisite, zaïrite, zimbabweite). The current ferronigerite-2*N*1*S*, originally described as nigerite, could be seen as another example, but not namibite, named after the Namib Desert. The type locality of namibite is in fact at some distance from that region. Other examples of somewhat misleading names are atokite and rustenburgite, named after mines that are not specified as type locality in the original description.

Names based on mineral properties include those referring to composition, which can be limited to a single major element (*e.g.* gallite, germanite) or provide more complete information (*e.g.* althupite, bismoclite). Physical properties recorded by mineral names include colour (*e.g.* ianthinite), crystal morphology (*e.g.* triangulite), and aggregate type (*e.g.* oursinite).

Numbers for all categories of mineral names are increased if derived names are not considered separately. They include names referring to a difference in dominant metallic element (*e.g.* zincobriartite), dominant anion group (*e.g.* arsenohopeite), dominant rare-earth element (*e.g.*

allanite-(Y)), water content (*e.g.* metavanmeersscheite), or crystal structure (*e.g.* trikalsilite). Other derived names were coined as part of root-name-based systems (*e.g.* hydrokenopyrochlore, potassic-fluoro-pargasite, ferronigerite-2*N*1*S*). Still others express a genetic relationship, such as formation through dehydration (*e.g.* metaschoepite), or a relationship based on shared mineral properties (maghemite).

Differences between Countries

Between African countries, there are great differences in the number of new mineral species that have been described (see tab. 1). One aspect is simply the size of a country, whereby Gambia intrinsically has smaller potential than Zambia, but it is clearly not the only factor. For example, the three most productive countries (Namibia, DR Congo, South Africa) are all quite large, but several other sizeable countries have not yielded any new mineral species (*e.g.* Angola, Mali, Sudan). A more important factor is regional geological setting and the occurrence of mineral deposits with unique characteristics. An overview of the localities for which most new mineral species have been recognized shows that exceptional deposits are responsible for a large proportion of those species (tab. 5). For Namibia, about two thirds of all new species were described for Tsumeb, with the Kombat mine as a distant but important second place. For the DR Congo, more than a third of all new species has the historically important uranium deposit of Shinkolobwe as type locality. For South Africa, the Kalahari Manganese Field, comprising the Wessels and N'Chwaning mines, is responsible for a third of all valid species, and a significant number has been described for various Bushveld Complex localities. Other major African sites or areas are the Bou-Azzer district and Tachgagalt in Morocco, as well as Mounana in Gabon, the latter producing all nine minerals described as new species for that country.

Besides the presence of unique deposits, the history of their discovery, mining, and mineralogical study has also been a major factor. Great economic or strategic interest in specific commodities during certain periods has, for example, prompted mineralogical research for Bushveld Complex deposits, and it has at least made specimens from deposits such as Shinkolobwe widely available at some stage. Several series of new minerals have been identified through the efforts of individual mineralogists or groups of researchers. Some of the previously mentioned important deposits, such as Mounana and Tachgagalt (tab. 5), are examples of this. It is also clearly expressed by peaks in the histogram presenting the evolution of new mineral discoveries through time for the DR Congo (fig. 2), with maxima reflecting the work of Alfred Schoep (1920s), Johannes Vaes (1940s), Thure Sahama (1950s) and Michel Deliens in collaboration with Paul Piret (1980s).

Finally, a kind of self-reinforcement seems to exist, whereby specimens from localities with an established reputation in terms of new mineral potential are most likely to be studied with great attention by collectors and mineralogists.

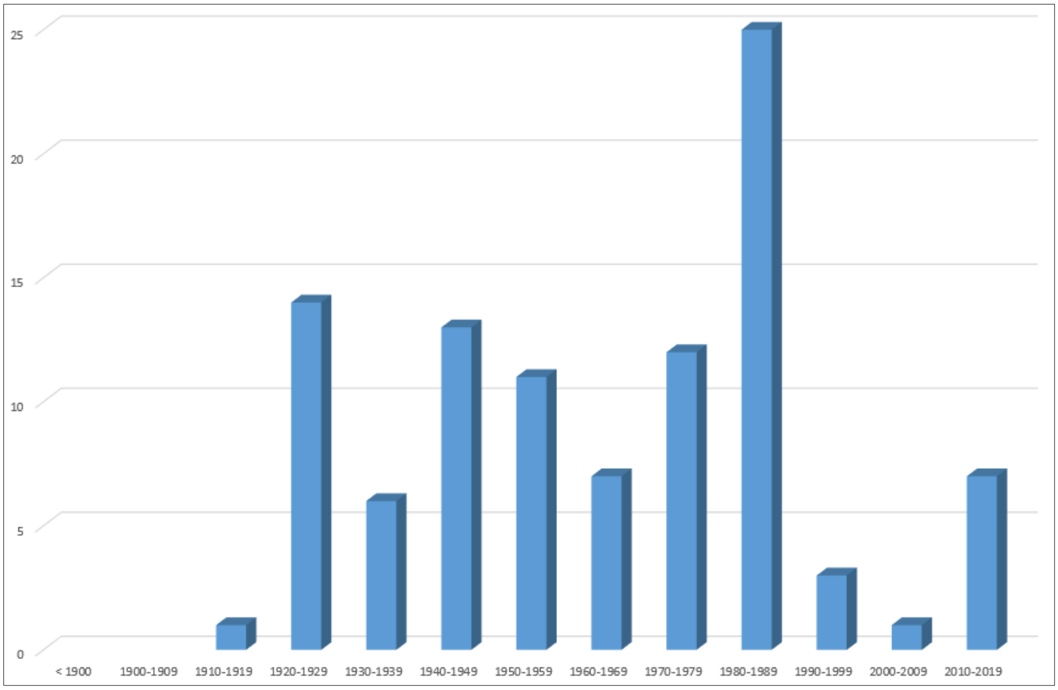

Fig. 2. — Number of valid mineral species described for the DR Congo, by decennium.

Concluding Remarks

In closing, a discussion of the type mineralogy of Africa on a forum provided by the Royal Academy for Overseas Sciences is an opportunity to highlight the connections existing between this Academy and new mineral descriptions for Africa. Most importantly, several new species have been described for specimens from Africa by members of the Academy. The most productive member has been Michel Deliens, who was involved in the description of twenty-eight valid new species, which at this moment is still the greatest number to have been reached for Africa by any researcher. Other Academy members who contributed in this way to the type mineralogy of Africa are Henri Buttgenbach and Jacques Thoreau. These two mineralogists are also among the fourteen Academy members in whose honour African mineral species have been named, including two non-valid species (tab. 6). In publications of the Academy, the original description of three new species has appeared, namely those of sharpite (Mélon, 1938), varlamoffite (Gastellier, 1950), and lueshite (Safiannikoff, 1959). For varlamoffite, an earlier mention by Buttgenbach (1947, pp. 182-183) exists, but the Academy publication by Gastellier (1950) is a reproduction of an unpublished note by the same author dating from 1946. Finally, a lasting contribution to the type mineralogy of Africa in a publication by the Academy has been the first use of the concept and name of 'columbo-tantalite' by Lancsweert (1954), a term that has subsequently, in abbreviated form (coltan), become widely known, also outside the fields of mineralogy and geology, as the informal name of one of the main mineral resources of the Great Lakes region of Central Africa.

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ANNEX

Table 1

Number of valid and non-valid mineral species with type locality in an African country, according to number of valid species

Country	Valid	Non-valid	Country	Valid	Non-valid
Namibia	107	21	Lesotho	2	0
DR Congo	100	27	Mozambique	2	5
South Africa	79	37	Nigeria	2	0
Morocco	21	3	Tunisia	2	2
Madagascar	17	11	Burundi	1	0
Tanzania	14	11	Chad	1	1
Gabon	9	0	Egypt	1	5
Kenya	8	3	Ethiopia	1	2
Zambia	8	1	Ghana	1	0
Algeria	6	6	Libya	1	1
Uganda	6	2	Niger	1	1
Rwanda	5	0	Senegal	1	1
Guinea	4	3	Angola	0	1
Botswana	3	0	Cabo Verde	0	1
R. Congo	3	0	Sierra Leone	0	1
Zimbabwe	3	4	Sudan	0	1
Cameroon	2	0	Swaziland	0	1

Table 2

First minerals described as new species for localities in Africa, arranged chronologically, up to 1919

Name	Formula	Publication	Locality	Country
18th century				
Trona	$Na_3(HCO_3)(CO_3).2H_2O$	Bagge (1773)	Suckena Province	Libya
Prehnite	$Ca_2Al(Si_3Al)O_{10}(OH)_2$	Klaproth (1788)	Cape Province	South Africa
19th century				
Teschemacherite	$(NH_4)H(CO_3)$	Teschemacher (1845)	Coastal site	South Africa
Apjohnite	$Mn^{2+}Al_2(SO_4)_4.22H_2O$	Glocker (1847)	Algoa Bay	South Africa
Stercorite	$(NH_4)Na(PO_3OH).4H_2O$	Herapath (1850)	Ichaboe Island	Namibia
Senarmontite	Sb_2O_3	de Senarmont (1851)	Sensa	Algeria
Nadorite	$PbSb^{3+}O_2Cl$	Flajolot (1870)	Djebel Nador	Algeria
Riebeckite	$\square Na_2(Fe^{2+}{}_3Fe^{3+}{}_2)Si_8O_{22}(OH)_2$	Sauer (1888)	Socotra	Yemen
20th century, first decade				
Grandidierite	$MgAl_3O_2(BO_3)(SiO_4)$	Lacroix (1902)	Andrahomana	Madagascar
Otavite	$Cd(CO_3)$	Schneider (1906)	Tsumeb	Namibia
Rutherfordine	$(UO_2)(CO_3)$	Marckwald (1906)	Lukwengule	Tanzania
Bityite	$CaLiAl_2(Si_2BeAl)O_{10}(OH)_2$	Lacroix (1908)	Mont Bity	Madagascar
Plancheite	$Cu_8(Si_4O_{11})_2(OH)_4.H_2O$	Lacroix (1908)	Mindouli	R Congo
Villiaumite	NaF	Lacroix (1908)	Rouma Island	Guinea
Parahopeite	$Zn_3(PO_4)_2.4H_2O$	Spencer (1908)	Kabwe	Zambia
Tarbuttite	$Zn_2(PO_4)(OH)$	Spencer (1908)	Kabwe	Zambia
20th century, second decade				
Cornetite	$Cu_3(PO_4)(OH)_3$	Cesàro (1912)	Etoile Mine	DR Congo
Manandonite	$Li_2Al_4(Si_2AlB)O_{10}(OH)_8$	Lacroix (1912)	Antandrokomby	Madagascar
Tsumebite	$Pb_2Cu(PO_4)(SO_4)(OH)$	Busz (1912)	Tsumeb	Namibia
Fornacite	$CuPb_2(CrO_4)(AsO_4)(OH)$	Lacroix (1915)	Renéville	R Congo

Table 3

Categories of names for minerals with type locality in Africa

Category	Total	Namibia	DR Congo	South Africa
Persons	**231**	**65**	**61**	**45**
Mineralogists	82	28	17	14
Geologists	71	4	30	16
Collectors, dealers	29	19	1	7
Mining company staff	22	11	5	3

Physicists, chemists	9	0	5	2
Government and army staff	6	0	0	1
Others	12	3	3	2
Locality	**78**	**18**	**15**	**14**
Locality	62	13	13	13
Region	9	5	1	1
Country	7	0	1	0
Properties	**30**	**4**	**12**	**8**
Composition	24	4	7	7
Morphology, colour	6	0	5	1
Derived names	**62**	**16**	**12**	**10**
Other categories	**8**	**4**	**0**	**2**

Table 4

Information about the etymology of minerals mentioned in the text

Name*	Formula	Locality**	Etymology
Afwillite	$Ca_3[SiO_4][SiO_2(OH)_2].2H_2O$	Dutoitspan Mine, SA	Alpheus F. Williams
Allanite-(Y)	$CaY(Al_2Fe^{2+})[Si_2O_7][SiO_4]O(OH)$	Zaaiplaats Mine, SA	Y-dominant allanite
Althupite	$AlTh(UO_2)_7(PO_4)_4O_2(OH)_5.15H_2O$	Kobokobo, DRC	Al-Th-U-P mineral
Arsenohopeite	$Zn_3(AsO_4)_2.4H_2O$	Tsumeb, NM	Arsenate analogue of hopeite
Atokite	Pd_3Sn	Bushveld Igneous Complex, SA	Atok Mine
Becquerelite	$Ca(UO_2)_6O_4(OH)_6.8H_2O$	Shinkolobwe, DRC	A.Henri Becquerel
Bismoclite	BiOCl	Jackals Water, SA	Bi-O-Cl mineral
Braggite	PtS	Bushveld Igneous Complex, SA	W. H. Bragg & W. L. Bragg
Clairite	$(NH_4)_2Fe^{3+}{}_3(SO_4)_4(OH)_3.3H_2O$	Lone Creek Fall cave, SA	Claire Zingg-Martini
Curite	$Pb_{3+x}[(UO_2)_4O_{4+x}(OH)_{3-x}]_2.2H_2O$	Shinkolobwe, DRC	Pierre Curie
Effenbergerite	$BaCuSi_4O_{10}$	Wessels Mine, SA	Herta S. Effenberger
Erikapohlite	$Cu^{2+}{}_3(Zn,Cu,Mg)_4Ca_2(AsO_4)_6.2H_2O$	Tsumeb, NM	Erika Pohl-Ströher
Eylettersite	$Th_{0.75}Al_3(PO_4)_2(OH)_6$	Kobokobo, DRC	Lea Eyletters
Ferronigerite-2N1S	$(Al,Fe,Zn)_2(Al,Sn)_6O_{11}(OH)$	Egbe, NG	Nigerite polysome
Gallite	$CuGaS_2$	Kipushi (DRC), Tsumeb (NM)	Gallium-bearing minera
Germanite	$Cu_{13}Fe_2Ge_2S_{16}$	Tsumeb, NM	Germanium-bearing mineral

Giniite	$Fe^{2+}Fe^{3+}_4(PO_4)_4(OH)_2.2H_2O$	Usakos, NM	Gini Keller
Hermannroseite	$CaCu(PO_4)(OH)$	Tsumeb, NM	Hermann Rose
Hydrokenopyrochlore	$\square^2Nb^2O^4(OH)^2(H^2O)$	Antandrokomby, MD	Pyrochlore with dominant H2O and vacancy
Ianthinite	$U^{4+}_2(UO_2)_4O_6(OH)_4.9H_2O$	Shinkolobwe , DRC	Violet colour (*ianthinos* in Greek)
Joosteite	$Mn^{2+}Mn^{3+}O(PO_4)$	Helikon II Mine, NM	Charlotte Jooste
Kudryavtsevaite	$Na_3MgFe^{3+}Ti_4O_{12}$	Orapa, BT	Galina Kudryavtseva
Keyite	$Cu^{2+}_3Zn_4Cd_2(AsO_4)_6.2H_2O$	Tsumeb, NM	Charles Locke Key
Ludlockite	$PbFe^{3+}_4As^{3+}_{10}O_{22}$	Tsumeb, NM	F. Ludlow Smith & C. Locke Key
Maghemite	$(Fe^{3+}_{0.67}\square_{0.33})Fe^{3+}_2O_4$	Bushveld Igneous Complex, SA	Combined magnetite and hematite properties
Mathiasite	$(K,Ba,Sr)(Zr,Fe)(Mg,Fe)_2(Ti,Cr,Fe)_{18}O_{38}$	Jagersfontein, Bultfontein, SA	Morna Mathias
Mélonjosephite	$CaFe^{2+}Fe^{3+}(PO_4)_2(OH)$	Angarf-Sud, MR	Joseph Mélon
Metaschoepite	$(UO_2)_8O_2(OH)_{12}.10H_2O$	Shinkolobwe, DRC	Schoepite dehydration product
Metavanmeersscheite	$U(UO_2)_3(PO_4)_2(OH)_6.2H_2O$	Kobokobo, DRC	Dehydrated vanmeersscheite
Minrecordite	$CaZn(CO_3)_2$	Tsumeb, NM	*Mineralogical Record*
Namibite	$Cu(BiO)_2(VO_4)(OH)$	Khorixas, NM	Namib Desert
Nimite	$(Ni,Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$	Bon Accord, SA	National Institute for Metallurgy (NIM)
Nyerereite	$Na_2Ca(CO_3)_2$	Oldoinyo Lengai, TZ	Julius K. Nyerere
Orlymanite	$Ca_4Mn^{2+}_3Si_8O_{20}(OH)_6.2H_2O$	Wessels Mine, SA	Orlando H. Lyman
Oursinite	$Co(UO_2)_2(SiO_3OH)_2.6H_2O$	Shinkolobwe, DRC	Radial aggregates (sea urchin)
Potassic-fluoro-pargasite	$KCa_2(Mg_4Al)Si_6Al_2O_{22}F_2$	Tranomaro area, MD	Pargasite with dominant K and F
Pietersite*	$\square Na_2(Fe^{2+}_3Fe^{3+}_2)Si_8O_{22}(OH)_2$	Outjo, NM	Sidney Pieters
Roseite*	Os-Ir sulfide	Yubdo, ETH	Hermann Rose
Rustenburgite	Pt_3Sn	Bushveld Igneous Complex, SA	Rustenburg Mine
Rutherfordine	$(UO_2)(CO_3)$	Lukwengule, TZ	Ernest Rutherford
Sasaite	$Al_6(PO_4)_5(OH)_3.36H_2O$	West Driefontein cave, SA	South African Speleological Association
Shabaite-(Nd)	$CaNd_2(UO_2)(CO_3)_4(OH)_2.6H_2O$	Kamoto, DRC	Shaba
Sidpietersite	$Pb^{2+}_4(S_2O_3)O_2(OH)$	Tsumeb, NM	Sidney Pieters
Sklodowskite	$Mg(UO_2)_2(SiO_3OH)_2.6H_2O$	Shinkolobwe, DRC	Maria Sklodowska (Marie Curie)
Stercorite	$(NH_4)Na(PO_3OH).4H_2O$	Ichaboe Island, NM	Guano deposit (*stercoro*, Latin for manuring)

Taniajacoite	$SrCaMn^{3+}{}_2Si_4O_{11}(OH)_4.2H_2O$	N'Chwaning III Mine, SA	Tania & Jaco Janse van Nieuwenhuizen
Tredouxite	$NiSb_2O_6$	Bon Accord, SA	Marian Tredoux
Trikalsilite	$K_3NaAl_3(SiO_4)_3$	Nyiragongo area, DRC	Structural relationship with kalsilite
Triangulite	$Al_3(UO_2)_4(PO_4)_4(OH)_5.5H_2O$	Kobokobo, DRC	Trinagular shape
Warikahnite	$Zn_3(AsO_4)_2.2H_2O$	Tsumeb, NM	Walter Richard Kahn
Zincobriartite	$Cu_2(Zn,Fe)(Ge,Ga)S_4$	Kipushi, DRC	Zinc-dominant briartite

[*] Non-valid minerals.
[**] BT = Botswana, DRC = DR Congo, ETH = Ethiopia, MD = Madagascar, MR = Morocco, NM = Namibia, SA = South Africa, TZ = Tanzania.

Table 5

Individual and grouped localities for which the greatest number of new species have been described

Category	#	Context
Namibia (Σ 107)		
Tsumeb	72	Sulfide ore body, with subsurface oxidation zones
Kombat	16	Sulfide ore body, in dolomite host rock
Aris	6	Phonolite
DR Congo (Σ 100)		
Shinkolobwe	39	Vein-type uranium deposit
Kobokobo	13	Uranium-bearing, phosphate-rich pegmatite
Musonoi	6	U-Se-rich ore body within stratiform Cu-Co deposits
Nyiragongo volcano	6	Melilite-nephelinite lava
South Africa (Σ 79)		
Kalahari Manganese Field	25	Hydrothermally altered sedimentary Mn deposits
Bushveld Complex	15	Platinum-group element deposits
Bon Accord	7	Mantle-derived Ni ore deposit
Morocco (Σ 21)		
Bou-Azzer mining district	8	Oxidation zone of hydrothermal Co-arsenide ore deposit
Tachgagalt	7	Vein-type manganese ore deposit
Gabon (Σ 9)		
Mounana	9	Sandstone-hosted uranium deposit

Table 6

Academy members in whose honour mineral species have been named

Name	Profession and affiliation	Mineral
Raymond Anthoine (1888-1971)	Mining engineer, various companies	Anthoinite
Henri Buttgenbach (1874-1964)	Mineralogist, Université de Liège	Buttgenbachite
Félicien Cattier (1869-1946)	Administrator, Union minière du Haut-Katanga	Cattierite
Jules Cornet (1865-1929)	Geologist, École des Mines de Mons	Cornetite
Fernand Delhaye (1880-1946)	Geologist, various companies	Delhayelite
Hubert Droogmans (1858-1938)	Administrator, Comité spécial du Katanga	Droogmansite*
Paul Fourmarier (1877-1970)	Geologist, Université de Liège	Fourmarierite
Armand François (1922-2012)	Geologist, Union minière du Haut-Katanga, GCM	Françoisite-(Nd)
Jacques Lepersonne (1909-1997)	Geologist, Musée royal de l'Afrique centrale	Lepersonnite-(Gd)
Aimé Marthoz (1894-1962)	Administrator, Union minière du Haut-Katanga	Marthozite
Achille Salée (1886-1932)	Geologist, Université catholique de Louvain	Saléeite
Jacques Thoreau (1886-1973)	Ore geologist, Université catholique de Louvain	Thoreaulite
Robert du Trieu de Terdonck (1889-1970)	Mining engineer, Union minière du Haut-Katanga	Trieuite*
Edward Wayland (1888-1966)	Geologist, Geological Survey of Uganda	Waylandite

* Non-valid species.