IGNEOUS ROCK NAMES AND THEIR EVALUATION

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The writer has recently had the privilege of assisting in the revision of a glossary of the nomenclature of petrology. Certain observations were made bearing on the validity, on the mode of establishment, and on the applicability of many rock names in the literature during the course of this work. It is perhaps not generally realized how many varying reasons have been advanced by different authors for proposing a new rock name. An examination of the literature of petrology has shown that the bases of proposal have been greatly diversified. The reasons and arguments set forth, in certain individual but highly typical instances, seem to have been somewhat inadequately integrated with petrologic systems. The more specious names seem to have been advanced without reference to any system or standards whatever. But it may be stated that most authors, at the time of proposal, seem to have been fully aware of their responsibility. Many writers have been extremely diffident about coining a new rock name, but have eventually given way, as the multitude of igneous rock names indicates.

It is regrettable that there are no formal nomenclatorial rules available at present to petrologists, and this is probably a reflection of the stage of development in petrology toward a more rational system. Some salient standards for the naming of rock types have long been needed. But their establishment is obviously the work for a committee, or committees, and will require the concerted efforts of many authorities before completion.

The intention of this paper is, first, to emphasize the great need for precaution in the proposal of additional rock names. It is hardly necessary to call attention to the host of equivocal and loosely defined terms which have appeared by the misuse of prerogative. Second, it is hoped that the observations made here will be of some assistance to the student in evaluating some of the different types of rock names already in the literature.

Locality names appear to be the most abundant, and in many cases the most offensive, of all rock names. This is especially true inasmuch as many of them have obviously been proposed without sufficient consideration of their often limited application. Probably most petrologists agree that the number of usable, fundamental rock names is relatively few. It is well known that the increase, particularly of locality names, and the use of innumerable varietal and sub-varietal names has led to duplication and confusion. It may be said that the promiscuous coining of new names is an offense of the past, or that useless names disappear of their own accord. Actually it appears that some authors have accepted

certain names, and different authors others, and all have used the lot with conspicuously varying meaning. Those names which are quite generally accepted are frequently used with meanings which are deviations from the original sense, or expansions of it, and even greater confusion has resulted from this practice.

Systematic names are here defined as those rock names which have been established with direct reference to some system of petrology. This system is usually fundamentally chemical but almost always includes certain concepts of rock derivation, geologic occurrence and habit. Systematic names as the familiar granite, gabbro, syenite, basanite and trachyte, for example, have been established by general acceptance and recognition of their broad worth and applicability. In most instances these relatively ancient names antedate the development of our modern system or systems of petrology, but have nevertheless been the framework around which the nomenclature has been established. Less widespread rock types and those of restricted or special occurrence have necessarily been referred to, and clustered around, these fundamental names.

In addition to those systematic rock names the origin of which may be said to be related to the earlier days of petrography, there are other systematic names which may be called the petrographic series type. In his monograph on the grorudite-tinguaite series of the Christiania district, Brögger[1] established the existence of a petrographic series of dike rocks composed of closely related members, chemically and mineralogically transitional to one another. The most constant mineralogical characteristic of the members of this series is the occurrence of potash-feldspar, microperthite and potash-soda-feldspar, with abundant aegirine. Soda-amphiboles are also of widespread occurrence and quartz is generally present especially in the rocks of the grorudite, or acid end of the series. Nepheline is a quite constant mineral, although in variable amounts in the rocks within the limits of the series, and subordinate or lacking toward the more acid extremes. Plagioclase is typically absent and biotite usually occurs in only small amounts. The chief chemical characteristic of this series is the predominance of soda and potash, the potash always being less in amount than the soda, and the comparative recession of magnesium and calcium. In the Christiania region this series ranges, in terms of the best developed rock types, from the more acid grorudite through solvsbergite to tinguaite.

From a study of the ratios of the variations of the potash and soda, from the more acid rocks to the more basic extremes, Brögger was able

[1] Brögger, W. C., Die Eruptivgesteine des Kristianiagebietes. I. Die Gesteine der Grorudit-Tinguait-Serie: *Videnskabsselskabets Skrifter, I. Math.-Naturv. Kl.*, **1894**, No. 4, pp. 159–186.

to calculate the approximate composition of a hypothetical basic end-member of the series. The calculated end-member was not, however, found by him among the dike rocks of the Christiania region. But a dike rock from Beemerville, New Jersey, earlier described by Kemp[2] as an "elaeolite-porphyry," was found to have a chemical composition nearly like that of the hypothetical end-member. From the description of this rock, Brögger decided that it also constituted a satisfactory mineralogical equivalent of his calculated end-member. He therefore named this rock sussexite[3] from its occurrence in Sussex County, New Jersey.

This is one outstanding instance in which sufficient chemical data, pertaining to a closely related series of rocks, were available for study. Moreover, chemical gradations between members of this series were satisfactorily smooth and well-defined, so that transitions could be definitely followed. Hence the facts necessary to establish the composition of the projected end-member could be determined. The validity of the calculations was in this instance immediately verified by reference to a description of an actual occurrence of a rock comparable to the desired end-member. Even if no example of an end-member had been known or described at the time of proposal of the new name, a prophetic name might have suitably been given, in consideration of the strong probability of its being discovered. This is an example of what might be called a cultivated rock name.

In 1887, Rosenbusch, having considered the well-established occurrence of the extrusive nepheline-tephrites, was able to postulate the discovery of their plutonic equivalents on grounds which were purely systematic. He therefore felt free to propose the name theralite[4] (Gr. eagerly sought rock) because the weight of probability, systematically arrived at, indicated that these equivalents would eventually be found. Wolff[5] had, indeed, already described certain nepheline-plagioclase rocks from the Crazy Mountains of Montana, which might have been considered the desired rock type. But the description of Wolff, which indicated that the Montana rocks occurred as dikes and in small bodies of uncertain structural relationship, did not satisfy Rosenbusch that this occurrence was actually plutonic in character. In 1903, Bauer[6] described a highly mela-

[2] Kemp, J. F., The elaeolite syenite near Beemerville, Sussex Co., N. J.: *Trans. New York Acad. Sci.*, vol. **11**, p. 66, 1891–92.

[3] Brögger, W. C., *op. cit.*, p. 173.

[4] Rosenbusch, Harry, *Mikroskopische Physiographie der Massigen Gesteine*, 2nd Ed., p. 248, **1887.**

[5] Wolff, J. E., Notes on the petrography of the Crazy Mountains and other localities in Montana Territory: *Northern Transcontinental Survey*, R. Pumpelly, Director, **1885.**

[6] Bauer, Franz, Petrographische Untersuchung des Duppauer Theralithvorkommens: *Tschermaks Min. und Pet. Mitt.*, N.F., vol. **22**, pp. 266–296, 1903.

nocratic rock from the Duppau region in Bohemia, with a hypidiomorphic-granular structure, composed essentially of titanaugite, labradorite, nepheline, and barkevikite, with some biotite, olivine, and a little orthoclase. This rock, being typically massive and plutonic in habit, was accepted by Rosenbusch as the type theralite. Hence the strong basis of accumulated facts and observations, upon which Rosenbusch had established his petrologic system, had accurately indicated the probability of this plutonic occurrence. Such dependence upon, and integration with, the well-established concepts of a highly refined petrologic system is indispensable to the successful classification of a new rock type.

A series of related rocks has sometimes been given the name of the most representative or widely developed member of the series exposed in the type region. Or a regional series, as contrasted with a petrographic series, has been called by the name given that rock representing a distinctive type to which other rocks of smaller bulk development or of less well-defined mineralogy could best be referred. To attach a regional series significance to a rock name involves a geographical connotation and implies the distribution of the associated rocks within a fairly well-defined area. A stratigraphic significance may also be implied, even in the case of igneous rocks, inasmuch as the members of a series of very closely related igneous rocks may have been, and probably oftentimes were, consolidated within the limits of a single epoch of vulcanism.

The Geological Survey of India has made frequent use of series names of this type for simplicity and convenience in mapping large areas. The charnockite series of Holland is an example. The name charnockite was applied by him to a quartz-feldspar-hypersthene-iron-ore rock of igneous origin, found in Peninsular India. Holland[7] applied the name charnockite-series to that group of phanerocrystalline igneous rocks in India which gave evidence of being magmatically related in time and space to the distinctive hypersthene rock, charnockite. The related rocks of this series, by definition, may range through to rocks as basic as norite and pyroxenite, but all show distinctive family resemblance to one another. According to Holland this resemblance is usually expressed by the constant occurrence of ilmenite in place of magnetite and by the absence of titanite throughout the series. These chemical and mineralogical resemblances are thought to be the expression of a true consanguineous relationship between the member rocks. In the case of this charnockite-series, as the term was applied by Holland, those related rocks of the series, which are mineralogically similar to rocks frequently developed elsewhere, are ordinarily designated by the names for those aggregates,

[7] Holland, T. H., The charnockite series, a group of Archean hypersthenic rocks in Peninsular India: *Mem. Geol. Surv. India*, vol. **28**, part 2, p. 128, 1900

as norite or pyroxenite. The rocks of the series may occur as dikes or plutonic masses, for the application of the qualifying term "series" does not effect a restriction of the term to rocks of any special occurrence. Holland himself preferred to restrict the application of the term charnockite-series to those rocks developed only in India, unless identical relationships could be proved for rocks elsewhere. He states:[8]

"But unless a similar formation found in another country, can be proved to be a genetic relation of the typical exposures described in this paper, it is hoped that the name charnockite will never be used outside India. And; Charnockite is a convenient name for a quartz-felspar-hypersthene-iron-ore-rock in the charnockite series, and not a name for any hypersthene-granite occurring in other petrographical provinces."

In a similar manner, Fermor[9] applied the term kodurite-series to a group of closely related manganiferous rocks developed in the Madras Presidency, India. The typical rock of this series is coarsely crystalline, composed of potash-feldspar, manganese garnet and apatite. It may vary in texture from granitoid to pegmatitic. The potash-feldspar content of the original rock had to be calculated originally, as all the feldspar appeared to have been replaced by opal in the type material. The mineralogy of kodurite was so distinctive that varietal names, as quartz-kodurite and pyroxene-kodurite, were used by Fermor for rocks varying from the type because of the occurrence of these minerals. The origin of the rocks of the kodurite series is not definitely established, but in the usage of the Indian Survey this does not invalidate the application of the series terminology. As there used, the term series is applied to both igneous and metamorphic rocks if the genetically distinctive features of the related rocks can be established.

Group names are those used to link together for convenience a number of rock types characterized by a particular mineral or mineral combination. A group name also implies a genetic similarity of structure among the rocks included in any given group. In the use of group names relatively little latitude in the mineralogy of the rocks included in a group is permissible, as compared with the rocks of a regional series such as just described. Those rocks assigned to a particular group need be in no way related, however, other than by the fact of their mineralogical traits. No geographic significance is attached to the rocks placed within a mineralogically defined group, for they are allocated to that group irrespective of their distribution or space relationship. Although artificially arrived at, typical group names may be of convenience in classification. The perknite group of Turner[10] was defined as including those massive,

[8] Holland, T. H., *op. cit.*, p. 131.

[9] Fermor, L. L., *Rec. Geol. Surv. India*, vol. **35**, part 1, p. 22, 1907.

[10] Turner, H. W., Perknite (Lime-Magnesia Rocks): *Jour. Geology*, vol. **9**, p. 507, 1901.

coarsely crystalline and relatively basic rocks characterized by the association of amphiboles and monoclinic pyroxenes. He included under this term rocks bearing rhombic pyroxene, olivine, and feldspar, in small amount, with the usual accessories as biotite and iron-ores. According to Turner, who permitted considerable freedom in the application of this term, only one of the specified essential minerals need be present in the rocks, this expansion allowing the inclusion of nearly monomineralic rocks as well. Such rocks as pyroxenite, hornblendite, websterite, diallagite, and bahiaite, would therefore be included in the perknite group of lime-magnesium rocks.

Certain terms have been given wide application when introduced, some being originally so broad as to possess practically group or series standing. Certain nepheline bearing rocks from Brazil, of widely ranging lithology, were called by Derby[11] jacupirangite. Under this term he included rocks composed of magnetite alone, i.e., ores, rocks composed of magnetite and accessory pyroxene, pyroxene rocks with accessory magnetite, and pyroxene-nepheline rocks. All these types may contain biotite and olivine as accessories. In the Brazilian occurrence the rocks were all part of the same mass and transitional to one another, and might indeed have been called a series. The range of these rocks included under the same name should be noted. In fact the mineralogy of any type rock was not stipulated by Derby, the intention being apparently to use the name with the very broadest significance. As used at present, though, the term jacupirangite may be said to be restricted to a nepheline-titanaugite-ilmenite rock. This restriction has been applied chiefly in recognition of the unusually high and characteristic titanium content of the rock, and the abundance of nepheline. Derby had hinted at this himself, and stated that the most constantly ranging mineral was a titaniferous pyroxene, but he apparently was not aware of the composition of his so-called magnetite, now believed to have been ilmenite. This is an instance in which petrologists have been quick to discern the more critical features of a suite. Hence they have proscribed and limited the term jacupirangite giving it more critical significance.

Many older rock names of formerly variable application have never been re-defined, but have acquired approval and specific meaning through usage and general concurrence. Other rock names have undergone formal re-definition, in some cases repeatedly. Many of the older rock names as originally proposed were applied to rocks inadequately described for more modern purposes. Re-definition of some terms has given them addi-

[11] Derby, O. A., On the magnetite ore districts of Jacupiranga and Ipanema, Sao Paulo, Brazil: *Am. Jour. Sci.*, 3d ser., vol. **41**, p. 314, 1891.

tional significance by establishing the distinguishing features of the rocks with greater clarity in the light of more recent opinion. In cases where a rock name has had very loose and perhaps contradictory application, re-definition has been imperative if the term were to have any value. In such instances the re-definition may, it appears, quite excusably violate the intention of the author of the name. De Lapparent[12] coined the name monzonite in 1864, and it was for a long time used as a collective name for different rocks of the Adamello region. It was also used as a series name, and applied by Rosenbusch to a particular group of augite syenites. No unanimity of application ensued for many years, during which time the name monzonite was used for hornblende-plagioclase rocks, for diorites, augite diorites, and augite syenites, i.e., for rocks which were either plagioclase or orthoclase bearing. Ultimately Brögger re-defined the term in 1895, establishing monzonite as a transition rock between the syenites and the diorites, and as one containing typically both plagioclase and alkali-feldspar. To quote:

"Die Monzonite charakterisiren sich eben dadurch, dass sie weder zu den Orthoklas-Gesteinen noch zu den Plagioklas-Gesteinen, sondern zu einer Übergangsgruppe oder Zwischengruppe zwischen beiden gehören, sie sind eben: Orthoklas-Plagioklas-Gesteine.[13] . . . Es ist mit anderen Worten nach meiner Ansicht nothwendig, zwischen den Orthoklasgesteinen und den Plagioklasgesteine, oder wie es jetzt correcter heissen muss: zwischen den Alkalifeldspath-Gesteinen und den Kalknatronfeldspath-Gesteinen, eine Übergangsordnung von Alkalifeldspath-Kalknatronfeldspath-Gesteinen einzuschieben."[14]

This term, as re-defined by Brögger, appears to embody the essential features of the more recent applications of the term.

Occasionally some rocks, as originally described, were stated to contain minerals later found to have been misidentified. Sometimes a name has been proposed for a rock, the mineralogy of which was substantially correct as given, though the interpretation of its origin has proven incorrect. Re-definition does not, apparently, proceed by any established rule but at the complete discretion of the writer. Names applied originally to rocks of a definite mineralogy have been re-defined so that a structural signification is given the term. Blum[15] proposed the name foyaite in 1861 for a syenite-like rock from Mount Foya, Portugal, distinguished by the presence of abundant nepheline. This typically granitoid rock composed of orthoclase, nepheline, and hornblende (later dis-

[12] de Lapparent, J., Mémoire sur la constitution géologique du Tyrol méridional: *Annales des Mines*, vol. **6**, p. 259, 1864.

[13] Brögger, W. C., Die Eruptivgesteine des Kristianiagebietes. II. Die Eruptionsfolge der Triadischen Eruptivgesteine bei Predazzo in Südtyrol: *Videnskabsselskabets Skrifter, I. Math.-Naturv. Kl.*, **1895**, No. 7, p. 21.

[14] *Idem.*, pp. 22–23.

[15] Blum, R., Foyait, ein neues Gestein aus Süd-Portugal: *Neues Jahrb.*, p. 426, **1861**.

covered to be aegirine in part), might have been called simply nepheline syenite, though a new term was applied. In 1890 Brögger[16] called all those nepheline syenites distinguished by trachytoid structure, foyaites. He took no account whatever of their composition, which thus might range through all the varietal types within the nepheline syenite group. Accordingly, the name foyaite, in the sense of Brögger, no longer signified the type rock. At the same time he applied the term ditroite to those nepheline syenites with typically hypidiomorphic-granular structure; this change also constituted a re-definition, since Zirkel[17] defined ditroite as a sodalite-bearing nepheline syenite. Hence in both instances there is the connotation of a structural characteristic attached to a rock name, which was previously applied to a certain mineralogical aggregate.

Perhaps the original occurrence of a rock has not afforded enough exposures, or sufficiently varied material, to enable the author of a name to make a comprehensive study. Perhaps then, a later writer has been able to establish the relationships of the rock more advantageously. This was done in the case of arkite, a holocrystalline porphyritic leucite (pseudo-leucite)-nepheline-pyroxene-garnet rock from Arkansas, first mentioned by Williams,[18] later analyzed, re-described, and named by Washington.[19] The guiding principal in re-definition seems to be an elaboration of the mineralogy, structure, origin, and relationships of a rock to establish more clearly its systematic place.

In certain cases one may resort to provisional names. The authors of names of this type have recognized that their description, presented at the time of proposal of the name, was inadequate to establish fully the distinguishing characteristics of the rock. Rocks of limited distribution, of confused relations, of dubious affinity or extreme peculiarity, may thus be given names stipulated at the outset to be tentative. Accordingly the reader is admonished not to apply the name indiscriminately and is expected to refrain from its rigorous application until the relationships of the rock can be set forth with greater clearness pending additional study. Harker,[20] for example, described as mugearite an unusual basalt bearing chiefly oligoclase, with some olivine and lesser augite. It may be assumed that he did not wish to commit this name to

[16] Brögger, W. C., Die Mineralien der Syenitpegmatitgänge der Südnorwegischen Augit- und Nephelinsyenite: *Zeit. Krist.*, vol. **16,** p. 39, 1890.

[17] Zirkel, Ferdinand, *Lehrbuch der Petrographie,* p. 595, **1866.**

[18] Williams, J. F., The igneous rocks of Arkansas: *Ann. Rept. Geol. Surv. Arkansas,* **1890,** vol. II, pp. 274–276.

[19] Washington, H. S., The foyaite-ijolite series of Magnet Cove; a chemical study in differentiation: *Jour. Geology,* vol. **9,** p. 617, 1901.

[20] Harker, Alfred, The Tertiary igneous rocks of Skye: *Mem. Geol. Surv. Great Britain,* p. 257, **1904.**

circulation until further research had been completed, and hence applied a name specified to be provisional.

Terms of this type have occasionally proved too tempting to some writers, namely those prone to make rather hasty comparisons. Hence some provisional names may often be very casually applied despite warnings that the restricting genetic features of the rock are not yet sufficiently plain. Certain delicate questions of priority are sometimes involved in the proposal of provisional names. But the use of such tentative names, on the whole, seems to be in accord with more meticulous and deliberate scientific procedure.

Somewhat in the same category as provisional names are those rock names which are stipulated to be of only local application. Tyrrell[21] has called a hyalocrystalline anorthite-enstatite-augite andesite dike rock from the Clyde area, Scotland, cumbraite. He seems to have felt that this locality name would be of convenience in describing certain rocks of this particular district. But he preferred that the name should not be freely used until the more widespread distribution of actual cumbriate could be proved in other petrographic provinces and periods. Hyaline rocks of analogous composition to cumbraite, but associated as facies of larger intrusives, would of course be given names suggestive of their relationship to the parent mass. The proposal of a new term for hyaline rocks is, in the usage of Tyrrell, permissible only when they are of individual mass development.

The foregoing discussion has concerned certain types of igneous rock names proposed or re-defined in accordance with generally satisfactory procedures. Examples are given below of additional types which, it seems to the writer, were proposed on more insecure grounds. Attention will be directed especially to the difficulties arising from the proposal of certain names with the use of what are believed to be rather questionable principles.

The term "porphyry" has had wide application in mining usage, having been applied in general to an intrusive rock as distinguished from an extrusive one. It has thus been easy to attach this qualifying term to names like rhyolite and andesite, and to compound names signifying their intrusive equivalents. As a result there has crept into the literature many free terms which some authors do not apply unless the occurrence of the rock is known to them. Hence certain rocks might be distinguished as rhyolite porphyries, granite porphyries or quartz porphyries, if the intrusive occurrence is known, although laboratory study might not divulge evidence establishing the type of occurrence independent of in-

[21] Tyrrell, G. W., Some Tertiary dykes of the Clyde area: *Geol. Mag.*, 6th. dec., vol. **4**, p. 313, 1917.

formation other than that derived from thin sections. This represents a conflict between a so-called practical application and a generic application in greater accordance with systematic usage. The practice of giving a separate name to equivalent hypabyssal types has entered into many schemes of classification, because on a petrographic basis and with supporting chemical data, it is sometimes possible to discern features peculiar to hypabyssal rocks. Nevertheless, an anomaly arises, for, as in the case of terms like andesite and andesite porphyry, the porphyritic structure may be understood in the first instance, while it has seemed incumbent on some to express the structure in the case of the second term.

To make matters worse, such terms as quartz porphyry and granite porphyry are used with no uniformity even by accomplished petrologists. Johannsen[22] refuses to use the term quartz porphyry for acid dike rocks, because it has so long been used by European geologists for pre-Tertiary effusive equivalents of the granites. He groups rocks like the granophyres under the granite porphyries. On the other hand, Harker[23] has made the granite porphyries a sub-type under his major group of acid hypabyssal rocks, the quartz porphyries. He applies this latter term with a broad significance and considers granite porphyries, granophyres, and acid pitchstones varieties which can best be grouped with the quartz porphyries.

Gradations in a dike feeder to a flow, or a dike apophysis from a plutonic body, are admittedly difficult to follow and delimit. A dike rock, at a level at which it has obtained typical development may possess fairly distinctive internal structures. The ocellar structure common to certain lamprophyres may be taken as an example. However, the structures of dike feeders and their correlated flows must grade imperceptibly into structures typical of flows in the extravasated rock, and into more massive structures in those parts of the dike in closer proximity to the parent plutonic mass. Another variable, in the form of increasing differentiation with increasing distance from the parent mass, may be assumed to influence the composition and mineralogy of the rock. It is here that one must consider the hypabyssal concept as set forth by Brögger.[24] He used this term, in contradistinction to the term "Ganggesteine" of Rosenbusch, as signifying those rocks which are structurally

[22] Johannsen, Albert, *A descriptive petrography of the igneous rocks*, vol. II, Quartz-bearing rocks, p. 286. Chicago, **1932.**

[23] Harker, Alfred, *Petrology for students*, 6th Ed., p. 102, **1923.**

[24] Brögger, W. C., Die Eruptivgestine des Kristianiagebietes. I. Die Gesteine der Grorudit-Tinguait-Serie: *Videnskabsselskabets Skrifter., I. Math.-Naturv. Kl.*, **1894,** No. 4, pp. 123–124.

and mineralogically comparable, irrespective of their development as dikes, as marginal facies of larger intrusives, or as flows. Inasmuch as certain rocks petrographically indistinguishable from one another had been found by him in these varying environments, he considered "hypabyssal" a more accurate and inclusive term.

As the result of the application, in certain petrographic systems, of different names to nearly equivalent rocks of varying occurrence, writers have sometimes proposed new names for rocks structurally and mineralogically comparable, though consolidated under somewhat different conditions. The fact of a differing geologic environment alone appears to have been considered a reason for the new name. At times differences of structure and mineralogy between the rock described and comparable rocks of different occurrence have been most obscure. Pirsson[25] investigated a rock fragment, from a core boring put down on the island of Bermuda, which he believed to be derived from a flow. This was of a moderately porphyritic rock composed of biotite phenocrysts in a nearly isotropic groundmass consisting of analcite, sanadine and nepheline. With this effusive biotite-rich rock there were associated types containing considerable augite. The biotite-bearing lava was lamphrophyric in character and compared most closely with ouachitite, although the latter rock had been up to that time known only in dikes. Pirsson was most diffident about proposing a new name merely on the basis of occurrence but conceded the point thus:

"... and those who demand a separate name for the effusive rocks as contrasted with the intrusive ones, would object to calling it ouachitite, which it is most like in composition and in genesis. The name of bermudite is suggested for consideration, to obviate this difficulty."[26]

It is difficult to reconcile such usage as this, although it has often had the approval of systematists. But it is fitting to point out the absence of authoritative agreement on the validity of the concept of the consolidation of discrete dike types as distinguished from extrusive types. Such a concept is opposed by the occurrence of hypabyssal facies and the gradual structural variations between an intrusive and its related extrusive body. From a petrographic point of view, in the absence of some significant distinguishing structure, mineralogy, or chemical composition, a new name should hardly be proposed for a related rock merely on account of a difference in occurrence.

Peculiarity of occurrence alone has been used as a basis for the proposal of certain rock names. C. W. Knight described a crystal-tuff, occurring in Alberta, composed of fragments of analcite and potash

[25] Pirsson, L. V., Geology of Bermuda island; petrology of the lavas: *Am. Jour. Sci.*, 4th ser., vol. **38**, pp. 331–344, 1914.

[26] *Idem*, p. 340.

feldspar. The mineralogical and chemical composition of this rock was found to approximate that of an analcite-trachyte. For such a tuff Knight proposed the name blairmorite.[27] Thus a derivative of a well established rock type, analcite-trachyte, has been given a separate name in no way suggestive of the composition of the derivative rock, of the rock from which it was derived, or of the geologic occurrence. One small rock fragment of analcite-trachyte was found, but no special name was proposed for it at that time. To the writer it seems ill-advised to create a new name on the rather insecure basis of the pyroclastic occurrence of a rock composed of fragments of an original rock of known systematic place. According to this principle any pyroclastic rock approximating any known rock in bulk composition would be deserving of a new name.

Washington and Larsen used the name arapahite for a fragment of magnetite-basalt. They were in part influenced by considerations of the unusual occurrence of the rock. Outcrops at the type locality appear to have been very poor, but it was thought that the main body of the rock containing their specimen was a breccia. They state:

"While the rock would logically be called a magnetite-basalt, on account of its extrusive character and mode, yet it is so unique as to occurrence and composition, that a special name seems to be justified. For this that of arapahite is suggested."[28]

The writer has no quarrel with establishing this name on a chemical basis, but the validity of using the peculiarity of occurrence as one criterion for proposal seems open to question, especially as the true nature of the form of occurrence was at that time doubtful.

A rock from New Zealand has been called wilsonite and the name ascribed to Henderson.[29] According to a description by Sollas it contained chiefly crystal fragments of acid plagioclase, pyroxene, biotite and quartz, with lithic fragments showing spherulitic growths and others probably of andesite. These were contained in a mottled black and white matrix of glass fragments, some of which had perlitic structure. All of these crystal and lithic elements were cemented by an isotropic glassy base. Opinion differed as to the origin of this rock. Henderson, however, found some fragments of fairly fresh andesite and largely on this basis believed it to be a tuff. Other investigators had considered it a brecciated flow rhyolite. Irrespective of the merits of either case it seems indiscreet

[27] Knight, C. W., Analcite-trachyte tuffs and breccias from southwest Alberta, Canada: *Canadian Rec. Sci.*, vol. **9**, p. 266, 1904 (1905).

[28] Washington, H. S., and Larsen, E. S., Magnetite basalt from North Park, Colorado: *Jour. Washington Acad. Sci.*, vol. **3**, p. 452, 1913.

[29] Henderson, J., The geology of the Aroha subdivision, Hauraki, Auckland: *New Zealand Geol. Surv., Bull.* **16**, New Ser., p. 70, 1913.

to permit the circulation of a new term for a rock admittedly of disputed origin. It has been argued that convenience in discussion of controversial types demands the use of a short term and hence constitutes a basis for using a new name. But if the term is used, the writer feels that it should be made quite clear that it is of the most tentative sort. There are instances in which a new term was proposed although at the time it was impossible to give a correct interpretation of the rock due to lack of knowledge or misidentification of minerals. But at least such terms were made in oblivion of the actual relations, circumstance rendering it impossible to obtain the correct data.

Varietal names have generally been proposed because the rocks under consideration were thought to present a mineralogical or structural departure, in some arbitrary amount, from the type to which the rock given the new name was referred. Evidently some authors have believed that the variant rock warranted a new name solely because of these differences, and often little effort has been made to specify the significance and relationships of the varietal features. Some examples of these varietal names are included here and contrasted with their mineralogically qualified equivalents.

Type	*Variety*	*Varietal Name*
Ghibelite	biotite-ghibelite	ponzite
Monzonite	olivine-monzonite	kentallenite
Hypersthenite	hornblende-hypersthenite	bahiaite
Basalt	magnetite-basalt	arapahite
Bostonite	quartz-bostonite	lindoïte
Nepheline-syenite	albite-rich	canadite
Peridotite	enstatite-peridotite	saxonite
Essexite	olivine-rich essexite	montrealite
Analcite-basalt	biotite-rich	ghizite
Limburgite	leucite-limburgite	batukite
Nepheline-syenite	feldspar-free	monmouthite
Soda-granite	hypersthene-rich	birkremite
Diabase	albitic	holyokeite
Theralite	feldspathic	covite
Picrite	pyroxene-rich	ankaramite
Theralite	leucocratic	rouvillite
Phonolite	microperthitic	apachite

Some varietal names based on structure.

Type	*Variety*	*Varietal Name*
Alaskite	porphyritic	tordrillite
Hornblendite	poikilitic	cortlandite
Nepheline-syenite	trachytoid	foyaite
Nepheline-syenite	hypidiomorphic	ditroite

As a rule it has been construed that the varietal rock constituted a type, which, being transitional to a better established type, was therefore an intermediate rock, and hence that a new term was a refinement of the nomenclature. If this practice were carried to the extreme, an infinite number of rock names might result, each representing a deviation of variable, arbitrary amount (and often of the most subtle significance), in any direction whatever from the type.

Complaint has sometimes been made of the cumbersomeness and lack of euphony of compounded names beset with qualifying mineral names. But in many cases a greater sacrifice of clarity and lack of understanding has resulted from the multiplication of varietal names. Those varietal names of elusive, inadequate definition, which are expressed in terms of a locality are perhaps the most offensive of all. It is, of course, most difficult to state how much deviation from a type constitutes a basis for the proposal of a new name since so many standards could be applied. The entirely subjective considerations of the author of the new name may sometimes appear most inconsequential to other workers. At the very least it seems that varietal names should be meticulously defined, that pains should be taken to specify what the significant variations are, and the amount of variation should be quantitatively expressed if possible.

Washington[30] proposed the name bahiaite for hornblende-hypersthenite. The type hornblende-hypersthenite had previously been described by Merrill[31] from Montana. The bahiaite of Washington was stated by him to be closely comparable in mineralogy and structure to Merrill's type material. Merrill believed the term hornblende-hypersthenite cumbersome, but considered it preferable to a locality name inasmuch as the rock was the only example of that type known to him. Washington stated, on the basis of this one additional occurrence of the rock in Brazil, that the widespread occurrence of hornblende-hypersthenite was thus established. Hence he proposed the locality name bahiaite without any reference to the locality of the type rock described previously by Merrill. This procedure is the opposite of the usual one in which local rock peculiarities and restricted distribution are often emphasized by the application of a locality name. To the writer it seems anomalous to apply a special locality name to a rock on the basis of its widespread occurrence, especially when a properly qualified rock name of known type would suffice. Unquestionably certain locality names are

[30] Washington, H. S., An occurrence of pyroxenite and hornblendite in Bahia, Brazil: *Am. Jour. Sci.*, 4th ser., vol. **38**, p. 86, 1914.

[31] Merrill, G. P., Notes on some eruptive rocks from Gallatin, Jefferson, and Madison Counties, Montana: *Proc. U. S. Nat. Mus.*, vol. **17**, pp. 656–659, 1894.

useful in briefly typifying some very distinctive rock types. But the propriety of applying a particular locality name to an admittedly abundant and widely distributed rock seems highly dubious indeed.

The writer feels that it is now beyond the capability of the individual to reconcile the confused usages just indicated with better usage, but suggests that comparisons be made with those more substantial types of rock names earlier mentioned in this paper. Practical application, precedent, individual preference, and varying concepts of rock derivation are all involved in the proposal of a rock name. The evident lack of standards for the proposal of names might be in part circumvented by applying a quantitative mineralogical scheme, necessarily highly arbitrary but desirable petrographically. Ultimately magmas as well as mineral aggregates must be taken into account, inasmuch as those mineral aggregates produced from a given magma may vary with differing environments. A really successful nomenclature will probably be binomial in character and will thereby bring together the petrographic and magmatic attributes of rocks.