



IX. Account of a simple method of representing the different crystalline forms by very short signs, expressing the laws of decrement to which their structure is subjected

C. Hauy

To cite this article: C. Hauy (1799) IX. Account of a simple method of representing the different crystalline forms by very short signs, expressing the laws of decrement to which their structure is subjected , Philosophical Magazine Series 1, 2:8, 398-413, DOI: [10.1080/14786449908676939](https://doi.org/10.1080/14786449908676939)

To link to this article: <http://dx.doi.org/10.1080/14786449908676939>



Published online: 25 Jan 2010.



Submit your article to this journal [↗](#)



Article views: 4



View related articles [↗](#)

opinion, so as to approach nearest to the proposed end; and he gives a short sketch of his method, which contains also some new observations *.

IX. *Account of a simple Method of representing the different Crystalline Forms by very short Signs, expressing the Laws of Decrement to which their Structure is subjected.* By C. HAUY. *From Journal des Mines, An. IV. No. 23.*

THE different crystals belonging to each mineral substance are connected with one identical primitive form, which, in its turn, serves to connect them in common. An accurate knowledge of these mutual relations depends upon that of the laws to which their structure is subjected, and of which the effect is to determine the number and assortment of the planes arranged around the primitive form, in order to produce the secondary forms. By a necessary consequence the naturalist, who is familiar with the progress of these laws, needs often only to keep in his eye the primitive form, and an account of the decrements which its angles or edges undergo, to represent to himself the polyedron thence resulting, and to see, in some measure, in idea, the metamorphosis of the nucleus from which this polyedron originates.

These considerations induced me to conceive the idea of converting into very concise language, analogous to that of algebraic analysis, a definition of the different laws by which secondary crystals are determined; and thus to compose a kind of formulæ representative of these crystals. To accomplish this, it will be sufficient to distinguish by letters the angles and edges of the primitive form, and to accompany these letters with figures pointing out the decrement which

* Dr. Chladni is the author also of a Dissertation on the Mass of Iron found by Professor Pallas in Siberia, and of some papers on fire-balls. See Phil. Mag. vol. ii. p. 1, 225, and 337.

such an angle or edge undergoes, and of which the result is this or that secondary form. I have endeavoured to subject the arrangement of the letters to a regular progress in relation with the order of the alphabet; so that this arrangement might appear as if occurring naturally of itself.

1. Let us suppose that fig. 1. represents an oblique angled parallelopipedon, the faces of which have angles different in measure, and which are the primitive form of a particular kind of mineral such as feldspar*. Having adopted the vowels to denote, in general, the solid angles, place the four first *AEIO* at the four angles of the upper basis, following the order of the alphabet, and at the same time the common mode of writing, which is to begin at the top and to proceed from right to left. (See *fig. 2.* where the arrangement of the letters in lines is rendered sensible to the eye.)

2. Having adopted the consonants to denote the edges, in general, place, according to the same rule, the first six *BCDFGH* on the middle of the sides of the upper base, (*fig. 1.*) and on the two longitudinal edges of the lateral face, which first presents itself from left to right.

3. Lastly, place on the middle of the upper base and the two lateral faces, situated in front, the three letters *PMT*, which are the first of the syllables that form the word primitive.

4. Each of the four solid angles or of the six edges, denoted by letters, is susceptible, in the present case, on account of the irregular form of the parallelopipedon, of undergoing peculiar laws of decrement; but as these laws act with the greatest possible symmetry, at least in common, every thing that takes place on one of the angles or edges, pointed out, is repeated on the angle or edge diametrically opposite among those which remained unoccupied; so that the latter is supposed to perform the same function as the

* The parallelopipedon is supposed to be represented in such a manner that the angle *BAC*, farthest from the observer, is one of the angles of the base.

former. For example, Ap (*fig. 3.*), being the same form as *fig. 1.* the decrements which the angle A undergoes, occasion similar ones on the angle p (*fig. 3.*). The case is the same with the edge Ar , in regard to the edge Op ; of Iu in regard to Es , &c. After this, nothing is necessary but to denote the number of solid angles or edges which undergo decrements really distinct, because the latter actually contain those which take place on the analogous angles or edges.

5. It will, however, be sometimes necessary to point out these last angles or edges; and in that case we may employ the small letters which bear the same names as the large letters employed in *figure 1*; that is to say, that p (*fig. 3.*) be denoted by a ; sp by c ; pu by b , &c. But it will not be requisite to mark these small letters on the figure. It will be sufficient to introduce them in the sign of the crystal; because they may be easily referred, in idea, each to its proper place.

6. To denote the effects of decrements by one, two, three or more ranges, in breadth, the figures 1, 2, 3, 4, &c. may be employed, as shall be explained hereafter; and to denote the effects of decrements by two, three, &c. ranges in height, the fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c. may be used.

7. The three letters $PM T$ will serve to denote either the form of the nucleus, without any modification, when they compose alone the sign of the crystal, or the faces which would be parallel to those of the nucleus in case the decrements did not extend to their limits; and these letters will then be combined in the sign of the crystal with those which have relation to the angles or the edges on which the decrements act.

8. The principal or most simple decrement, in regard to any solid angle whatever, such as O , may take place either on the base P or on the plane T , which is to the right of the observer, or on the plane M situated to the left. But it must be remarked that the observer is supposed to move round

round the crystal till he is opposite the angle on which the decrements he is considering take place ; or, what amounts to the same thing, that he is supposed to turn the crystal until the angle in question is found opposite to him ; and it is in regard to this position that such a decrement is said to take place towards his right or towards his left. For example, if the angle A be under consideration, we must conceive that the observer, who at first was opposite to the point O, has placed himself opposite to A ; then, by still supposing figure 3 to represent the same solid as figure 1, the decrements to the right will be those which take place on the plane A E s r, parallel to the diagonal drawn from E to r ; and the decrements to the left will take place on the plane A I u r, parallel to the diagonal which goes from I to r. We shall see hereafter the advantage of viewing in this manner, in regard to the uniformity of method.

9. To denote the first of the three decrements of which I have spoken, or that which takes place on the base P, the indicating figure must be placed above the letter. To denote the second, or that which takes place towards the right, the figure must have the usual place of an exponent on the right, and towards the top of the letter ; and the third, or that which takes place towards the left, must be denoted by placing the figure towards the left, and, in the like manner, towards the top of the letter.

Thus $\overset{2}{O}$ will express the effect of a decrement by two ranges in breadth, parallel to the diagonal of the plane P, which passes through the angle E (*fig. 1*) ; O^3 the effect of a decrement by three ranges, parallel to the diagonal of the face T, which passes through the angle I ; and 4O the effect of a decrement by four ranges parallel to the diagonal of the face M, which passes through the angle E.

10. In regard to the decrements on the edges, those which take place towards the contour B C F D of the base may be expressed by a figure placed above or below the letter,

ter, according as their effect operates upwards or downwards, departing from the edge to which they are referred; and those that regard the longitudinal edges G, H, may be denoted by an exponent placed either in the usual manner or on the left of the letter, according as they take place either to the right or the left.

Thus $\overset{2}{D}$ will express a decrement by two ranges proceeding from D towards C; $\overset{3}{C}$ a decrement by three ranges proceeding from C to D; $\overset{2}{D}$, a decrement by two ranges descending on the face M; $\overset{3}{H}$ a decrement by three ranges proceeding from H towards G, &c. To determine the direction of the decrements to the right or left of any ridge, we must proceed as in regard to the decrements which affect the angles (3). For example, the decrements to the left of the edge G will be those which take place in proceeding from E s to A r (*fig. 3*).

12. In the case in which we should be obliged to denote, by means of a small letter, such as *d*, a decrement on the edge, opposite to that which bears the large letter D, we ought to consider the crystal as turned upside down: Thus $\overset{2}{d}$ would express a decrement by two ranges ascending on the inferior base *p*; as $\overset{2}{D}$ expresses one which ascends on the upper base P. For the same reason $\overset{3}{c}$ would express a decrement by three ranges proceeding from *sp* (*fig. 3.*) towards EO.

13. If the same angle or the same edge undergoes several successive decrements, on the same side, or several decrements, in regard to different sides, we may be satisfied with writing one letter accompanied with different figures indicating the decrements.

Thus $\overset{2}{\overset{3}{D}}$ (*fig. 1.*) will denote two decrements on the edge D; one by two ranges ascending above the base P, and the other by three ranges descending on the plane M. $\overset{2}{H}^2$ will denote two decrements by two ranges on both sides of the edge H, &c.

14. If there are mixed decrements, they may be denoted, according to the same principles, by employing the fractions $\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, &c. the numerators of which refer to decrement in breadth, and the denominators to decrement in height.

15. It now remains to discover a method of representing the intermediary decrements. An example will convey an idea of that which I have adopted. Let AEOI (fig. 4.) be the same face as fig. 1, and let us suppose a decrement by a range of double molecule, according to lines parallel to xy , so that O y may measure lines equal to two sides of a molecula, and O x lines merely equal to one side. This decrement, therefore, may be denoted thus ($\overset{1}{O} D^1 F^2$): first the parenthesis shews that the decrement is intermediary; $\overset{1}{O}$ shews that it takes place by one range on the angle denoted by the same letter, and that it refers to the base; $D^1 F^2$ indicate, that for one edge of molecula subtracted along the side D, there are two edges subtracted along the side F.

16. It is useful to have a language to express these different signs in such a manner that they may be easily written when dictated. The signs O^2 , 3O might be enounced by saying, O two at the right, O three at the left. To enounce $\overset{2}{O}$, O we might say, O under two, O above four: and lastly, the sign ($\overset{1}{O} D^1 F^2$) might be thus enounced: In a parenthesis O under one, D one, F two.

17. Let us now give an example of the combination of these different signs in the expression of a compound crystalline form. But it will first be necessary to determine the order according to which the letters that concur to form one expression ought to be arranged. Should we admit the alphabetic order, the result would be a sort of confusion in the view presented by the formula. It appears therefore more natural to adopt that order which would direct the observer in the description of the same crystal; that is to say, to begin by the prism or the mean part; to indicate its different faces

as they present themselves to the eye, and then to proceed to the faces of the summit, or of the pyramid. This will be illustrated by the different examples we shall mention in the course of this article.

Let zv (*fig. 5.*) be the variety of feld-spar, named *fimilaire*, the primitive form of which is represented *fig. 1.* In this variety the plane $nqxr$ (*fig. 5.*) results from a decrement by two ranges on the edge G (*fig. 1.*), proceeding towards H ; the plane $rkspvx$ (*fig. 5.*) is parallel to the plane M (*fig. 1.*), which is concealed only in part by the effect of the decrement. The plane $sump$ is parallel to the plane T ; the pentagon $kzyus$ arises from a decrement by two ranges on the angle I , parallel to the diagonal which proceeds from A to O ; and, in the last place, as this decrement does not reach its limits, the summit bears a second pentagon $zlnrk$ parallel to the base P . All this description may be thus expressed by five letters, $G^2MT\dot{I}P$.

18. Let us next proceed to parallelopipedons of a more regular form; and let us first consider the case in which they differ from the rhomboid. We shall suppose that the parallelopipedon is the same as that of *fig. 1*, the form of which has varied, so as to become more symmetrical. In consequence of this variation, certain solid or salient angles, which were different in the first parallelopipedon, have become equal: whatever takes place in the one is repeated in the other; and consequently they must be marked with the same letter. Thus, in algebra, certain solutions are simplified in the particular cases in which a quantity at first supposed to be different from another becomes equal to it.

19. Let us conceive, for example, that the primitive form is a right prism, the base of which is the oblique-angled parallelograms (*fig. 6.*), and we shall have $O = A$, $I = E$, &c. We must then substitute on both sides the second letter for the first, as seen in the figure. By continuing to run over the different modifications of the parallelopipedon, we shall see them pass through different degrees of simplicity, ana-

logous

logous to those of the forms themselves, and we shall have successively :

20. For the oblique prism having rhombuses for its bases the expression represented figure 7 ;

21. For the right prism with rectangular bases that seen figure 8 ;

22. For the right prism having rhombuses for its bases that of figure 9 ;

23. For the right prism with square bases that of figure 10,

24. And, in the last place, for the cube that of figure 11. Here the base only is denoted by letters, because what takes place in regard to this base may be applied to any one of the other faces.

25. For all these different primitive forms a method of figures, analogous to that which I have adopted for the oblique-angled parallelepipedon of figure 1, may be followed ; but the letters of the same name, figured in the same manner, need not be repeated.

One example will serve to give an idea of this method. Let *ar* (fig. 12.) be the most common variety of the cymophane, the nucleus of which is a rectangular parallelepipedon, such as that seen fig. 8. The sign of the secondary crystal will be, $MT^2G G^2 \overset{1}{B} A^{\frac{3}{2}} \overset{3}{2} A$, in which M corresponds to *gobl nr*, T to *bets*, 2G to *fgnm*, G to *betl*, $\overset{1}{B}$ to *dacf*, or *bact*, $A^{\frac{3}{2}}$ to *cfgo*, and $\overset{3}{2}A$ to *cebo*.

To illustrate better the steps which have conducted to this expression, let us point out, for a moment, all the angles and all the edges by as many particular letters, as if the parallelepipedon were oblique-angled. (See fig. 13.)

The sign then will become $MT^2G H \overset{1}{B} \overset{1}{F} \overset{3}{2} \overset{1}{E} \overset{3}{2} \overset{1}{O}$; but by comparing figure 13 with figure 8, we see that $H = G$, $F = B$, $O = A$; by substituting then in the place of the first letters their values, we shall have $MT^2G G \overset{1}{B} \overset{1}{B} A^{\frac{3}{2}} \overset{3}{2} A$, which amounts to the expression above shewn, by suppressing the useless repetition of $\overset{1}{B}$.

26. It results from the preceding, that we must avoid con-

founding, for example, ${}^2G\ G^2$ with $G^1\ ^1G$. The first sign denotes decrements which take place on the faces $t\ T$ (*fig. 8.*), proceeding from the edges G towards those which correspond with them behind the parallelopipedon; and the second denotes decrements which take place on the face M proceeding to meet each other. If the two decrements took place simultaneously, their representative sign would be ${}^2G^2$.

In the preceding signs, each letter, such as 2G or G^2 , cannot be applied but to one edge situated as that letter itself to the right or left; but ${}^2G^2$ may be applied indifferently to both edges: for this reason it is needless to repeat that letter.

27. Let us give a new example, taken from the *topaze distique*, called commonly the Saxon topaz (*fig. 15.*). If we suppose figure 9 to represent the primitive form, which is a right prism, with rhombuses for its bases, we shall have as the sign of the variety in question ${}^3G^3\ M\ B^2\ E^1\ P$, which is explained in the following manner: 1. The planes similar to $otz\ q\ r$ (*fig. 14.*) arise from a decrement by three ranges on each side of the edges G (*fig. 9.*); 2d, the planes $ty\ A\ z$, $xy\ A\ p$, are parallel to the planes M , and thus the preceding decrement has not attained to its limits; 3d, the facets $bky\ tv$, $nky\ sb$, and $gbk\ i$, $buk\ i$, arise from two successive decrements on the edges B , one by two ranges, and the other by three; 4th, the facets $acg\ bvx\ m$, and those which correspond to them, on the other side, arise from two successive decrements on the angles E , one by one range, and the other by two ranges; 5th, in the last place, the terminating face $c\ d\ f\ lig$ corresponds to the base P of the primitive form.

28. It may be readily concluded from the same principles, that the dodecaedron with rhombuses for its planes, originating from the cube (*fig. 8.*), is expressed by the single letter B ; that the octaedron originating from the same nucleus, has for sign A , &c.

29. The rhomboid, supposing it placed under the most natural aspect, that is to say, in such a manner that the two solid angles composed of three planes with equal angles be
upon

upon one and the same vertical axis, has properly no base, but only two summits, which are the extremities of the axis. These angles and edges may be denoted as seen figure 15. The letter *e* makes known that the angle which bears it is similar to that marked with the same large letter; so that if all the lateral angles had their indications expressed, the three nearest the upper summit would bear the letter E, and the three next to the lower summit, and which are visibly opposite to the first, would have for their indicative letter *e*.

As the rhomboid has its six faces equal and similar, it is only necessary to consider the decrements in regard to one of the faces, such as that which bears the letter P, because all the rest are only repetitions of the latter. This being laid down, 1st, the decrements which depart from the upper angle A, or from the upper edge B, will have their indicating figure placed below the letter A or B; 2d, those which depart from the lateral angles E will be denoted by the same letter written twice, one on the right, and the other on the left; 3d, in regard to those which depart from the lower angle *e*, or from the lower edge D, the figure destined to express them will be placed above the letter *e* or D.

Let us suppose, for example, that figure 16 represents analogical carbonat of lime, in which the vertical faces *ecpg*, *ogrz*, &c. result from a decrement by two ranges on the angles *e* (fig. 15.); the oblique faces *mdce*, *bego*, &c. from a decrement by two ranges on the edges D, and the terminating faces *imeb*, *iftb*, from a decrement by a range on the edges B, we shall have the following sign $\overset{2}{e} \overset{2}{D} B$.

30. The other primitive forms, after what I^r have said in regard to the parallelepipedon, will be attended with no difficulty. I shall run them over in succession. Figure 17 represents the expression of the octaedron with scalene triangles; figure 18 that of the octaedron with isosceles triangles, and figure 19 that of the regular octaedron. To place the figures, which accompany the letters, we shall conform to what has been said in regard to the rhomboid. Thus (fig. 18.)

we must put the figure below for the decrements which proceed from A to B; above for those that depart from D; and at the side for those which depart from E.

If we wished to denote the result of a decrement by one range on all the angles of the regular octaedron (*fig. 19.*), we should write $A^1 A^1$; and to indicate the result of a decrement by a range on all the edges we should write $B^1 B^1$. The first of these decrements produces a cube, and the second a dodecaedron with rhombuses for its planes.

31. In some kinds of crystals, as those of the nitrat of potash, the octaedron, the surface of which is composed of eight isosceles triangles, similar four to four, must be situated as represented figure 20, in order that the secondary crystals may be in the most natural position; that is to say, that the edges at the junction of the two pyramids composing the octaedron may be, one in a vertical direction as F, and the rest in a horizontal direction as B. By comparing *fig. 20* with *fig. 21*, where the letters have been placed as if all the angles and all the edges had peculiar functions, we shall readily conceive the distribution adopted figure 20, and brought back to the symmetry of the real primitive figure; for, in the present case, we have $E = A$, $D = C$, $G = F$. The indicating figure must be placed below the letter for decrements departing from B; and on one side or below it for those departing from A, according as their effect shall be directed towards B or F.

32. The tetraedron being always regular, when it becomes the primitive form, its expression will be represented figure 22. To indicate, for example, a decrement by three ranges on all the edges we must put B^3 and B^3 ; and to denote one by two ranges, on all the angles, we must put $A^2 A^2$, as in the case of the regular octaedron.

33. A short view of figure 23 will be sufficient to give an idea of the method of denoting the regular hexaedral prism in ordinary cases; and with regard to the manner of placing the

the figures I shall not enlarge on it, as it may be easily deduced from what we have adopted in regard to quadrangular prisms. But, it sometimes happens that three of the solid angles, taken alternately, are replaced by facets, while the intermediary angles remain untouched. In that case the expression of the prism will be that seen fig. 24.

34. The rhomboidal dodecaedron, in certain species, as that of red silver ore, has six of its faces which perform the functions of the planes of a prism; while the six other faces enter into the analogy of rhomboids (29); so that the faces of each order may undergo particular decrements, independently of those which regard the faces of the other order. Figure 25 represents the expression of this dodecaedron. Each face of the summit, in the same case, may be considered as the base of an oblique quadrilateral prism (20), and the adjacent planes as belonging to the same prism. Thus the manner of placing the letters which indicate the decrements, and the figures that accompany these letters, will be analogous to that which takes place in quadrilateral prisms.

35. In other species, such as that of the garnet and sulphure of zinc, each solid angle, composed of three planes, may be assimilated to the summit of an obtuse rhomboid; and thus by employing figures only for one face we shall have the expression represented by figure 26.

36. We shall not employ the sign of the dodecaedron with isosceles triangular planes, because it is more natural to substitute the rhomboid from which it arises, as we have more simple laws of decrement.

37. It remains to give the means of representing a particular case which takes place in certain crystals, where the parts opposite to those that obey certain laws of decrement remain untouched, or are modified by different laws. This case belongs, in a particular manner, to turmalins; and it is easy then to indicate the difference by means of a zero. For example, in the very obtuse turmalin, the nucleus of which we shall suppose represented figure 15, the prism which is enneagonal has six of its planes produced by sub-

tractions

tractions of one range on the six edges D, D, &c. ; and the other three by subtractions of two ranges on three only of the angles E or e . Moreover, the inferior summit has simply three faces parallel to those of the nucleus ; while on the superior summit the three edges B are each replaced by a facet, in consequence of a decrement by one range which does not attain to its limits. The representative sign of this form will be : $\overset{1}{D} \overset{2}{e} \overset{2.0}{E} \overset{1.0}{P} B, \overset{1.0}{b}$. The quantities $\overset{2.0}{E}$, $\overset{1.0}{b}$ shew, the first that the angles opposite to e undergo no decrement, and the other that the edges opposite to B remain also untouched. If these edges were subjected to a different law, taking place by two ranges, the sign would become $\overset{1}{D} \overset{2}{e} \overset{2.0}{E} \overset{1.0}{P} B \overset{2}{b}$. According to this we are supposed to admit that the decrements, represented by a large letter, do not implicitly contain like decrements analogous to the small letter of the same name ; or reciprocally, that if the second letter should not enter into the expression of the sign with a different figure, we should not place there the same figure accompanied with a zero. In the first case, each of the two letters expresses a decrement which is peculiar to the edges or angles it denotes ; in the second, that which is affected by a zero shews that the angle or edge it denotes undergoes no decrement.

38. Let us still quote the variety of the sulphure of zinc, which exhibits the dodecaedron having rhombuses for its planes, the four solid angles of which, composed of three planes, are replaced by triangular facets situated like the faces of a tetraedron, while the opposite angles remain untouched*. By always adopting figure 16 to represent the primitive form, we should thus express the variety in question : $\overset{1.0}{A} \overset{1}{a} \overset{1.0}{A} \overset{1}{a}$.

39. I have enlarged upon the explanation of the principles of this method, that I might, if possible, omit nothing

* This variety is still modified by other facets, of which, for the greater simplicity, no notice is taken.

which

which may serve to give a clear idea of it, and enable an observer to represent immediately a secondary crystal of a given form. But if any one should confine himself merely to a knowledge of the signs employed in this method, and should only wish to read them, without being desirous to know the art of writing them, a few simple rules only will be necessary to be known, which I shall here briefly mention; they will form a review of the preceding details.

1. Every vowel employed in the sign of a crystal denotes the solid angle, marked with the same vowel on the figure representing the nucleus; and every consonant indicates the edge which bears that consonant, or the face, the middle of which it occupies on the figure of the nucleus.

2. Each vowel and each consonant is accompanied with one or more figures; the values of which, as well as the positions, indicate the laws of decrement which the angles or corresponding edges undergo. We must except the three consonants P, M, T, each of which, when it forms part of the sign of a crystal, indicates that the crystal has faces parallel to that which bears this letter.

3. Each letter, comprehended in the sign of a crystal, is understood, with the cipher or ciphers that accompany it, on all the angles or edges, which perform the same functions as that which, in the figure, is immediately marked with the letter in question.

4. Every whole number, placed above a letter, indicates a decrement in breadth, which ascends in departing from the angle or edge marked with that letter.

5. Every whole number, placed below a letter, indicates a decrement which descends in departing either from the summit or the edge which bears that letter*.

* Allusion is made here to the general progress of decrements, to which the particular cases that seem to make an exception are referred. For example, if the decrement took place by one range on the angle at the summit of a rhomboid, the face produced would be horizontal; but this decrement enters into those which are descending, and of which it is, as it were, the boundary.

6. Every

6. Every whole number, placed towards the top and on the right or left of a letter, denotes a decrement which takes place to the right or left of the angle, or of the edge marked with the same letter.

7. Every letter, such as ${}^3\text{H}^2$ or $\overset{2,3}{\text{G}}$, which bears several figures, placed different ways or in the same manner, indicates that the corresponding edge or angle undergoes, at the same time, different kinds of decrements announced by the numbers.

8. The fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, &c. which have unity for numerator, denote decrements in height by two, three, four ranges, &c.

9. The fractions $\frac{2}{3}$, $\frac{3}{4}$, $\frac{3}{2}$, &c. each term of which is greater than unity, denote mixed decrements by two ranges in breadth and three in height, or by three ranges in breadth and four in height, or by three in breadth and two in height.

10. The parenthesis, such as $(\overset{3}{\text{O}} \text{D}^1 \text{F}^2)$, denotes an intermediary decrement. The letter $\overset{3}{\text{O}}$ indicates: first that the decrement takes place by three ranges on the angle O, and that its effect is ascending. $\text{D}^1 \text{F}^2$ make known that for one edge of *moleculæ* subtracted along the side marked D, there are two edges subtracted along the side marked F.

11. Every small letter, comprehended in the sign of a crystal, indicates the angle or edge diametrically opposite to that which bears the large letter of the same name on the figure; or the small letter in question is omitted as superfluous.

12. We must except the letter *e*, which is always found on the figure of the rhomboid, and which indicates the angle opposite to that which bears the letter E.

13. When a sign contains two letters of the same name, one large and the other small, with different figures, the two angles or two edges opposite to which these letters correspond, are supposed to undergo each separately the law of decrement indicated by the figure that accompanies it.

14. Every

14. Every letter, whether large or small, marked with a figure followed by a zero, makes known that the decrement indicated by this figure has no effect on the angle or edge to which that letter belongs.

X. *Curious Fact respecting the Natural History of the Otter.*

By C. POISSONNIER, *Justice of Peace of the Canton of Bonnat, Department of la Creuze. From Le Moniteur Universel, Nivose 21, An. VII.*

I HAD considered as a fable what Father Vaniere says, in the fifteenth book of his poem called *Prædium Rusticum*, in regard to an otter which he had tamed to such a degree that it would plunge before his eyes into a canal of vast extent, and bring to him with great fidelity the prey it had caught. From the accounts I had read in the works of different naturalists, I believed that this animal was of a nature so ferocious that it was no way susceptible of being tamed; but I am now convinced of the contrary. Having procured a young otter in the month of Germinal last, it has fully repaid all the care and attention I bestowed on it; for it goes regularly every morning to take a turn on the banks of the small river Creuze, which runs at the distance of about a hundred paces from my habitation, and seldom returns without bringing me a fish still alive. To whatever distance it goes, it always returns with the utmost punctuality to the small kennel which I have constructed for it.

It has been said also that this animal is amphibious, but I have found the contrary to be the case. My otter never plunges into the water but to catch its prey, and it returns as speedily as possible to the banks, where it shakes itself like a small water-spaniel. If it is obliged to remain under water for any length of time, it raises its head in order to breathe; from which I conclude that the otter swims better than other animals; but is not amphibious, since it cannot live under water above half an hour.