of being varied. An image of the sun in the focus of a lens of about 30 millims. focal length, formed by the light reflected from a plane mirror, is sufficient in most cases. Much inferior to these is the light of a lamp or that of the sky reflected by a plane mirror through a small opening in a screen. It is hardly necessary to remark that perfect distinctness of vision of the signals, which should be equidistant from the centre of the instrument or very nearly so, is essential to accuracy. When the eye of the observer is not adapted to the distance of the signals, the use of a Galileo's telescope of low power will greatly increase the accuracy of the result.

II. *Memoir on the three Types of Humite. By* Professor A. Des Cloizeaux, *F.R.S., Membre de l'Institut**.

Scacchi (Pogg. *Ann.* Ergänzungsb. iii. 1851) and vom Rath (Pogg. *Ann.* Ergänzungsb. v. 1871) have referred the different forms of Humite to three types belonging to the orthorhombic system, all reducible to the same elements. An examination of the optical characters, however, has led me to separate the three types, and to transfer the crystals belonging to types II. and III. to the clinorhombic system, as shown in the following pages.

* Read June 14, 1876.

Type I. System orthorhombic, with a prism-angle of 130° 19′.

$a : b : c :: 907497 : 420059 : 1849650.$

Scacchi's symbols.	Symbols of Des Cl.	Miller's symbols.	Calculated angles.	Observed angles. Scacchi.
A : B	pg^1	001:100	90° 0′	90° 0′
A : e	$pe^{\frac{5}{2}}$	001:205	140 49	140 47
A : e^2	pe^2	001:102	134 27	134 30
A : e^3	$pe^{\frac{3}{2}}$	001:203	126 21	126 17
A : e^4	pe^1	001:101	116 8	116 13
A : e^5	$pe^{\frac{1}{2}}$	001:201	*103 47	103 47
A : i	pa^5	001:015	138 38	138 41
A : i^2	pa^3	001:013	*124 16	124 16
A : i^3	pa^1	001:011	102 48	102 50
A : r	$pb^{\frac{5}{2}}$	001:115	135 52	135 48
A : r^2	pb^2	001:114	129 30	129 32
A : r^3	$pb^{\frac{3}{2}}$	001:113	121 44	121 44
A : r^4	pb^1	001:112	112 24	112 23
A : r^5	$pb^{\frac{1}{2}}$	001:111	101 39	101 41
A : o_2	pm	001:100	90 0	90 0
B : o	g^1g^2	100:310	144 14	144 11
	g^1g^3	100:210	132 48	
B : o_2	g^1m	100:110	114 50	114 48
A : n	$pe_{\frac{1}{3}}$	001:213	116 34	116 30
A : n^2	pe_3	001:211	99 28	99 28
	pg^3	001:210	90 0	90 0 D.
	pN	001:212	108 26	108 20 D.

$N(=b^1 b^{\frac{1}{3}} g^{\frac{1}{2}})$ and g^3 observed by vom Rath and myself.

$e_3(=b^1 b^{\frac{1}{5}} g^1)$ and $e_{\frac{1}{3}}(=b^1 b^{\frac{1}{3}} g^{\frac{1}{3}})$ are the x and μ of figure 227 of my 'Manual of Mineralogy.' I have placed the obtuse angle of the prism in front, in accordance with the general usage for orthorhombic prisms; and I have multiplied the old value of the vertical axis by $\frac{7}{4}$ to simplify the symbols.

The plane of the optic axes is parallel to the base; the acute bisectrix is positive, and is normal to $h^1(010)$. Dispersion hardly appreciable in oil, $\rho < v$ (?). $2H_{a.r} = 78° 18′$ to 79°.

The laminæ parallel to h^1 consist of plates (of greater or less extent) in which the extinction of the light is complete. These are intersected by patches of irregular form in which the extinction is imperfect, and which probably consist of Humite belonging to the third type. These probably interfere with the accurate determination of the chemical composition of crystals of the first type.

Type II. Yellow Humite from Vesuvius, and brown chondrodite from Sweden (Kafveltorp).

Oblique ; prism-angle = 52° 2′ 40″.

$b : a : c : : 419122 : 907930 : 696136$.

Scacchi's symbols.	Symbols of Des Cl.	Miller's symbols.	Calculated angles.	Observed angles. Scacchi.	*Supplementary column.
A : C	$p g^1$	0 0 1 : 0 1 0	90° 0′	90° 0′	90° 0′
	$p e^2$	0 0 1 : 0 1 2	141 51	141 49 Scach. 141 48 Des Cl.	141 50
e^2 pointed out by Scacchi ; refound by vom Rath and myself in chondrodite.					
A : *i*	$p e^1$	0 0 1 : 0 1 1	*122 29	122 29	122 28
A : *e*	$p a^1$	0 0 1 : $\bar{1}$ 0 1	136 0	135 58	135 57
A : *e′*	$p o^{\frac{1}{2}}$	0 0 1 : 2 0 1	135 56	135 58	135 57
	$p a^{\frac{2}{3}}$	0 0 1 : $\bar{3}$ 0 2	119 56		119 52
	$p o^{\frac{1}{6}}$	0 0 1 : 6 0 1	119 50		119 52
$o^{\frac{1}{6}}$ and $a^{\frac{2}{3}}$, vom Rath.					
A : e_2	$p a^{\frac{1}{2}}$	0 0 1 : $\bar{2}$ 0 1	109 5	108 58	109 1
A : e'_2	$p h^1$	0 0 1 : 1 0 0	*108 58	108 58	*109 1
A : *m*	$p a_2$	0 0 1 : $\bar{3}$ 1 2	115 1	115 0	114 58
A : m^2	$p \beta$	0 0 1 : $\bar{3}$ 1 1	95 22	95 20	95 19
A : *n*	$p \eta$	0 0 1 : $\bar{2}$ 1 2	125 5	125 5	125 2
A : n^1	$p o_3$	0 0 1 : 2 1 1	125 2	125 (nearly) DesCl.	125 2
o_3 and η holohedral in Humite (v. Rath) and in chondrodite (Des Cl.).					

* See Supplementary Note, page 13.

Table (*continued*).

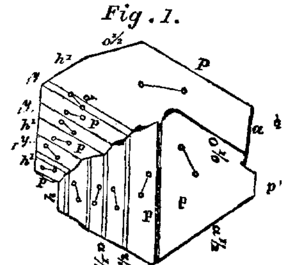
Scacchi's symbols.	Symbols of Des Cl.	Miller's symbols.	Calculated angles.	Observed angles. Scacchi.	*Supplementary column.
$A:n^2$	$p\,a_3$	$001:\bar{2}11$	103° 12′	103° 12	103° 9′
$C:n^2$	$g^1\,a_3$	$010:\bar{2}11$	135 40	135 41	135 41
$C:n^{2\prime}$	$g^1\,h^3$	$010:210$	*135 41	135 41	*135 41
$A:r$	$p\,b^1$	$001:\bar{1}12$	135 20	135 18	135 19
$A:r'$	$p\,d^{\frac{3}{4}}$	$001:223$	135 19	136 (nearly) Des Cl.	135 19
b^1 and d holohedral in Humite (v. Rath) and in chondrodite (Des Cl.).					
	$p\,b^{\frac{3}{4}}$	$001:\bar{2}23$	125 52		125 50
$A:r^2$	$p\,d^{\frac{1}{2}}$	$001:111$	125 50	125 52	*125 50
$b^{\frac{3}{4}}$ and $d^{\frac{1}{2}}$ holohedral in Humite (v. Rath).					
$A:r^3$	$p\,b^{\frac{1}{2}}$	$001:\bar{1}11$	113 28	113 28	
	$p\,d^{\frac{1}{4}}$	$001:221$	113 25	113 10 (nearly) D.	113 26
$b^{\frac{1}{2}}$ and $d^{\frac{1}{4}}$ holohedral in Humite (v. Rath) and in chondrodite (Des Cl.).					113 26
$A:r^4$	$p\,m$	$001:110$	98 12	98 18	98 13

$a_2=\alpha=(b^1 b^{\frac{1}{2}} h^1)$, $\beta=(b^{\frac{1}{2}} b^{\frac{1}{4}} h^1)$, $\eta=(b^1 b^{\frac{1}{3}} h^{\frac{1}{2}})$; $a_3=(b^1 b^{\frac{1}{3}} h^1)=\rho$, of which a part $=h^3$, are shown in fig. 228 of my 'Manual.'

The plane of the optic axes is inclined from behind forward (from a^1 towards $o^{\frac{1}{2}}$), and makes an angle of about 30° with the base. In chondrodite the twins are of a more or less complex character, and consist of two individuals composed of laminæ twinned round an axis normal to the base, which extinguish the light well. The laminæ of the two component crystals are associated along undulating surfaces, which cannot be referred to either of the two planes adopted by Scacchi.

The accompanying figure shows one of the crystals observed by me.

Fig. 1.



The number and extent of the twin laminæ are different in each specimen; but all obey the same law of association.

The acute bisectrix is positive and normal to the plane of symmetry.

$2H_{a.r}=86°\ 27'$.

$2H_{a.b}=86°\ 38'$; $\rho<v$, weak.

* See Supplementary Note, p. 13.

Dispersion *tournante* is fairly distinct, when seen in oil, especially in pale yellow crystals. Seven thin laminæ of a more or less deep reddish brown showed the dispersion in a manner more or less marked; and the separation of the axes in oil varied for red rays from 86° 14′ to 87° 20′.

Type III. Pale yellow and white Humite from Monte Somma. Oblique, with a prism-angle of 50° 24′.

$b : a : c :: 419575 : 907720 : 605135.$

Scacchi's symbols.	Symbols of Des Cl.	Miller's symbols.	Calculated angles.	Observed angles.
			° ′ ″	° ′
A : c	pg^1	0 0 1 : 0 1 0	90 0	90 0
A : i	$pe^{\frac{3}{2}}$	0 0 1 : 0 2 3	136 38	136 35
A : i^2	pe^1	0 0 1 : 0 1 1	*125 13	125 13
A : i^3	$pe^{\frac{1}{2}}$	0 0 1 : 0 2 1	109 26	109 30
	$pa^{\frac{5}{4}}$	0 0 1 : $\bar{4}$ 0 5	149 48	
	po^1	0 0 1 : 1 0 1	149 48	
o^1 and $a^{\frac{5}{4}}$ found holohedral (v. Rath).				
A : e	pa^1	0 0 1 : $\bar{1}$ 0 1	143 12 30	143 15
	$po^{\frac{3}{4}}$	0 0 1 : 4 0 3	143 11 0	
a^1 and $o^{\frac{3}{4}}$ holohedral (v. Rath).				
A : e^2	$pa^{\frac{3}{4}}$	0 0 1 : $\bar{4}$ 0 3	133 40	133 44
A : $e^{2\prime}$	$po^{\frac{1}{2}}$	0 0 1 : 2 0 1	133 40	133 44
A : e^3	$pa^{\frac{1}{2}}$	0 0 1 : $\bar{2}$ 0 1	119 48	119 50
	$po^{\frac{1}{4}}$	0 0 1 : 4 0 1	119 48	
$o^{\frac{1}{4}}$ and $a^{\frac{1}{2}}$ holohedral (v. Rath).				
A : e^4	$pa^{\frac{1}{4}}$	0 0 1 : $\bar{4}$ 0 1	100 49	100 48
A : $e^{4\prime}$	ph^1	0 0 1 : 1 0 0	*100 48	100 48
A : m	$p\alpha$	0 0 1 : $\bar{6}$ 2 3	114 55	114 46
A : m^2	$p\gamma$	0 0 1 : $\bar{6}$ 2 1	92 58	92 50
A : n	$p\epsilon$	0 0 1 : $\bar{2}$ 1 2	132 14	132 7
	$p\epsilon'$	0 0 1 : 4 2 3	132 12	
ϵ' and ϵ holohedral (v. Rath).				
A : n^2	$p\lambda$	0 0 1 : $\bar{4}$ 2 3	122 57	123 0
	po_3	0 0 1 : 2 1 1	122 56	
λ and o_3 holohedral (v. Rath).				
A : n^3	pa_3	0 0 1 : $\bar{2}$ 1 1	111 15	111 18
A : $n^{3\prime}$	$p\pi'$	0 0 1 : 4 2 1	111 14	111 18
	$p\zeta$	0 0 1 : 14,10,3	105 43	
ζ, new form (v. Rath).				

Table (*continued*).

Scacchi's symbols.	Symbols of Des Cl.	Miller's symbols.	Calculated angles.	Observed angles.
$A : n^4$	$p\ \omega$	$001 : \bar{4}21$	97° 23′	97° 25′
$A : n^{4'}$	$p\ h^3$	$001 : 210$	97 23	97 25
$A : r$	$p\ b^1$	$001 : \bar{1}12$	140 14	140 20
$A : r^2$	$p\ d^{\frac{3}{4}}$	$001 : 223$	136 9	136 8
$A : r^3$	$p\ b^{\frac{3}{4}}$	$001 : \bar{2}23$	131 23	131 25
$A : r^4$	$p\ d^{\frac{1}{2}}$	$001 : 111$	125 47	125 50
$C : r^4$	$g^1 d^{\frac{1}{2}}$	$010 : 111$	137 25	137 28
$A : r^5$	$p\ b^{\frac{1}{2}}$	$001 : \bar{1}11$	119 17	119 20
$A : r^6$	$p\ d^{\frac{1}{4}}$	$001 : 221$	111 49	111 53
$A : r^7$	$p\ b^{\frac{1}{4}}$	$001 : \bar{2}21$	103 31	103 37
$A : r^8$	$p\ m$	$001 : 110$	94 35	94 28
$C : r^8$	$g^1 m$	$010 : 110$	*154 48	154 48

α, γ, ϵ, λ, $a_3 = \pi$ posterior, $\pi' = \pi$ anterior, are represented in fig. 229 of my 'Manual;' ζ, ϵ', o_3, and ω are new forms found by vom Rath.

Plane of the optic axes inclined *from behind forward*, making an angle with the base of about 11°. The acute bisectrix is positive and normal to the plane of symmetry. Dispersion of the axes very weak, $\rho < v$. Dispersion *tournante* hardly appreciable in the most homogeneous plates.

$2\,H_{a.r} = 84° 38' \text{ to } 85° 4'$ in white crystals,

86° 40′ to 87° 14′ in a yellow crystal from Monte Somma.

Internal structure more or less complex, formed by the union parallel to the base of twin laminæ (figs. 2 and 3). These

Fig. 2.

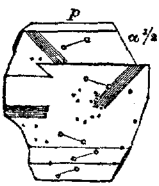
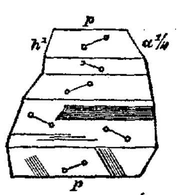
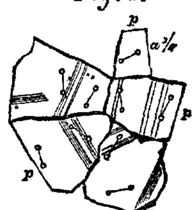


Fig. 3.



White crystals.

Fig. 4.



Yellow crystal

bands extinguish the light distinctly, but are penetrated by narrow bandelets which do not extinguish the light, and which make with the base an angle of about 60°, and appear to be parallel to the faces $e^3 = a^{\frac{1}{2}}$. One yellow crystal (fig. 4), very distinctly twinned, as shown by its very decided reentrant angles, consists of five individuals united in the interior along perfectly irregular surfaces. Each of the members of this twin, except the upper small one, contains both bands parallel to p and bandelets parallel to $a^{\frac{1}{2}}$ of the white crystals.

It seems to me that we might retain the name *humite* for the orthorhombic crystals of type I., that of *chondrodite* for the clinorhombic crystals of type II., and seek a name for the crystals of type III.—*clinohumite*, until a better be found. It ought, however, to be ascertained if all the crystals from Sweden and from America belong to type II., or if the brown crystals from Kafveltorp alone belong to this type, while the grey or brownish ones from Ladugrufvan and Pargas are of type III. (Edward Dana admits the last two types in American crystals). It is, however, evident that there is a close crystallographic and chemical relationship between the second and third types, and that they differ most in their optical properties, although Websky tries to show a chemical difference by means of new formulæ, which I declare myself incapable of following. This point will be understood in time; but what was important was to establish first the undoubted facts, and the non-existence of three types of one and the same species, which had always seemed to me an extraordinary thing, difficult to admit, especially in presence of the holohedrism of the one, and the hemihedrism of the two others.