NO. 6

Crystal structure of ramsayite. N. V. Belov and A. M. Belyaev. *Doklady Akad. Nauk S.S.S.R.* 69, 185-8 (1949).—Elementary cell dimensions, detd. from Weissenberg diagrams: $a_0 = 14.26$; $b_0 = 8.57$; $c_0 = 5.09$ A.; space group $V_h^{16} = Pnma$, with 4 mols. $Na_2Ti_2Si_2O_9$ in the unit cell; d. 3.38 to 3.43. There are 22 independent parameters, in the coordinates of the ions (given in % of the axial lengths): Ti(8): $x = 10.8$; $y = -15.1$; $z = 13.5$; Si(8): $x = 2.3$; $y = 15.3$; $z = 10$; Na(8): $x = 15.2$; $y = 4.6$; $z = 65$; $O_I(8)$: $x = 9$; $y = 17.7$; $z = 19$; $O_{II}(8)$: $x = 7.2$; $y = 0.8$; $z = 20$; $O_{III}(8)$: $x = 6.7$; $y = 23$; $z = 41$; $O_{IV}(8)$: $x = 23.2$; $y = -17.5$; $z = 45$; $O_V(4)$: $x = 25$; $y = 0$; $z = 2$. Distances Si – O = 1.58; 1.59; 1.62; 1.73 A.; Ti – O: 1.84 – 2.05 A.; Na – O = 2.22 – 2.51 A. The structure is characterized by $[SiO_4]_\infty$ chains, similar to those in the pyroxenes, and in agreement with the acicular-prismatic habit of the synthetic mineral. Cleavage planes are (210) and (100), through the layers of the O^{2-} parcels. The smaller ionic radius of Ti^{4+} and Na^+, in comparison to Mg^{2+} and Ca^{2+} explains the hardness of ramsayite, higher than that of diopside. The character of the birefringence is neg., because of the stronger effects of the $[TiO_6]$ chains parallel to c than that of $[SiO_3]_\infty$ chains in pyroxenes. The structure is in the c_0 dimensions identical with that of brookite, and a_0 is accurately = 9/10 of diopside. While in pyroxenes the O^{2-} layers are 4-fold, the ramsayite shows 6-fold layers of the same kind. Also in the directions b_0 and c_0 are 3 and 2 layers, but the packing is not cubic as in pyroxene; it has a plane of symmetry parallel to the layer. The coordination of Na^+ to O^{2-} is about octahedral (but with 1 additional O^{2-} in next neighborhood). Similar to that of Ca^{2+} in diopside which is octahedral, too (but with 2 addnl. O^{2-} neighboring). These octahedral chains are arranged with the $[TiO_6]$ chains in the same structural motive as Ca octahedral chains are in pyroxenes combined with $[MgO_6]$ chains. Although the at. ratio Si:O is in ramsayite apparently 1:4.5, in the structure it is strictly 1:4, because 1/2 of the O^{2-} are not bound to Si^{4+}. The Patterson analysis confirmed the structure proposed; the packing in the O^{2-}-layers is very characteristic in the sequence (ABCACB), while in diopside it is (ABCABC).

W. Eitel

BELOV, N. V.

USSR/Chemistry - Crystals
Ions

1 Mar 50

"Crystallochemistry of Mineralizers," N. V. Belov, Corr Mem, Acad Sci USSR

"Dok Ak Nauk SSSR" Vol LXXI, No 1, pp 61-64

For the chemist one of most useful results of mineralogy is extensive interchangeability of F^- and $(OH)^-$ anions. These interchanges are "isomorphic," i.e., they reflect slightly and only gradually the properties of the mineral and are possible in very wide limits. Generally discusses mineralization in topaz, quartz, spar, etc.

165T18

BELOV, N. V.

USSR/Minerals - Crystallography 11 Jul 50

"Determining the Parameters of Beryl by the Method of Partial Projections," N. V. Belov, Corr Mem, Acad Sci USSR, R. G. Matveyeva

"Dok Ak Nauk SSSR" Vol LXXIII, No 2, pp 299-302

Discusses partial projections, new method for structural analysis of crystals. Previously, diagrams of atomic arrangement were synthesized in form of projections of the cell on coordinate axes, from which coordinates (parameters) were read directly. In partial projections,

[redacted] 175T66

USSR/Minerals - Crystallography (Contd) 11 Jul 50

only part of the cell, e.g., ½, 1/3, is projected. Results obtained for beryl agree for the most part with those obtained by Bragg and West in 1926. Submitted 20 May 50.

[redacted] 175T66

BELOV, N. V. 178T95

USSR/Physics - Crystallography 1 Nov 50

"Enantiomorphic Criteria," N. V. Belov, Corr Mem, Acad Sci USSR

"Dok Ak Nauk SSSR" Vol LXXV, No 1, pp 33-35

Defines enantiomorphic ("mirror form") crystals as that pair of crystals, of any chem compn, belonging to same type of symmetry, which are characterized by the fact that if one crystal has property which can be described by the word "right" (dexter) then the same property in the other crystal must surely be described by the word "left" (laevus). Describes enantiomorphism by [illegible] to 6.

178T95

1951

Geological Chemistry

8

Doklady Akad. Nauk S.S.S.R. 75, 807–10(1950). The characteristic differences in the previously given position coordinates published by the authors (*C.A.* 45, 7174d), by Hamburger and Buerger (*C.A.* 43, 8087c), and by Donnay and Buerger (*C.A.* 44, 10430h) are tabulated. The nearly complete agreement of the electron density projections (Patterson-Harker synthesis method) and the very satisfactory similarity in the intensity of the (*hk*0) interferences is detd. by the agreement in the horizontal coordinates in the 3 published structure variants. The chief difference, however, is the absence of Mg(Fe) positions as given by Buerger, *et al.*, in the structure given by the authors. They correspond to the positions of Al in the proposal of Patterson and Harker. (Al + B) is in their structure nearly hidden by the Si ions, arranged with these on the vertical axes, in a double-layered hexagonal ring, with $[SiO_4]$ in the upper and $[(Al, BO_3)]$ in the lower layer. The distance Na – O_I = 2.23 A.; Na – O_{II} = 2.28 (not 3.11 A. as given in Donnay's and Buerger's proposal); Na – O_{IV} = 3.00 A.; Na – O_V = 2.93 A. Of importance also is the difference of the coordination for the Al^{+++} cations: $[AlO_6]$ in the structure given by the authors, $[AlO_4]$ in Buerger's. In the latter, the improbable distances 2.25 and 2.68 A. for Al – O are calcd. and are much higher than the theoretical value 1.88 A. Of the octahedron edges, two are much too short and three much too long. The isomorphous replacement of Mg^{++} by Al^{+++} in tourmaline is emphasized by Buerger, but in the structures of the authors three are not 3, but 6 Mg^{++} coordinates with O^{--} in octahedra, in which Mg^{++} replaces Al^{+++} but not vice versa. The intensity discussion for Fe-tourmaline in comparison with Mg-tourmaline must give for Fe + O a stronger peak than for Si + Al + O, but such a difference was not observed. The discussion chiefly concerns the problem of "satellite" peak intensities in the implication of electronic density distribution. Buerger's deductions would be fully valid for the space group C_4^2 = *R*3 but not for C_{3v}^5 = *R*3*m*. The previous intensity data of the authors are supplemented by a diagram of the observed and calcd. intensities for (*hk*0) reflexes which are in excellent agreement.

W. Eitel

BELOV, N.V.

PHASE I TREASURE ISLAND BIBLIOGRAPHICAL REPORT AID 456 - I

BOOK

Author: BELOV, N. V. Call No.: AF540841

Full Title: STRUCTURAL CRYSTALLOGRAPHY

Transliterated Title: Strukturnaya kristallografiya

Publishing Data

Originating Agency: Academy of Sciences, USSR. Institute of Crystallography

Publishing House: Academy of Sciences, USSR

Date: 1951 No. pp.: 88 No. of copies: 3,000

Editorial Staff: None

Text Data

Coverage: This small booklet discusses the principles of geometrical crystallography and deducts the main mathematical formulae for indices. It does not go beyond the scope of geometrical crystallography.

TABLE OF CONTENTS

Purpose: Not given

Facilities: None

No. of Russian and Slavic References: None

Available: A.I.D., Library of Congress

1/1

BELOV, N. V.

USSR/Minerals - Mineralizers Nov/Dec 51

"Some Applications of the Theory of Mineralizers," N. V. Belov

"Iz Ak Nauk SSSR, Ser Geol" No 6, pp 44-48

Belov discusses the action mechanism of mineralizers from standpoint of crystallochem compn using examples of hydrolysis of glass and abraded feldspar.

205T84

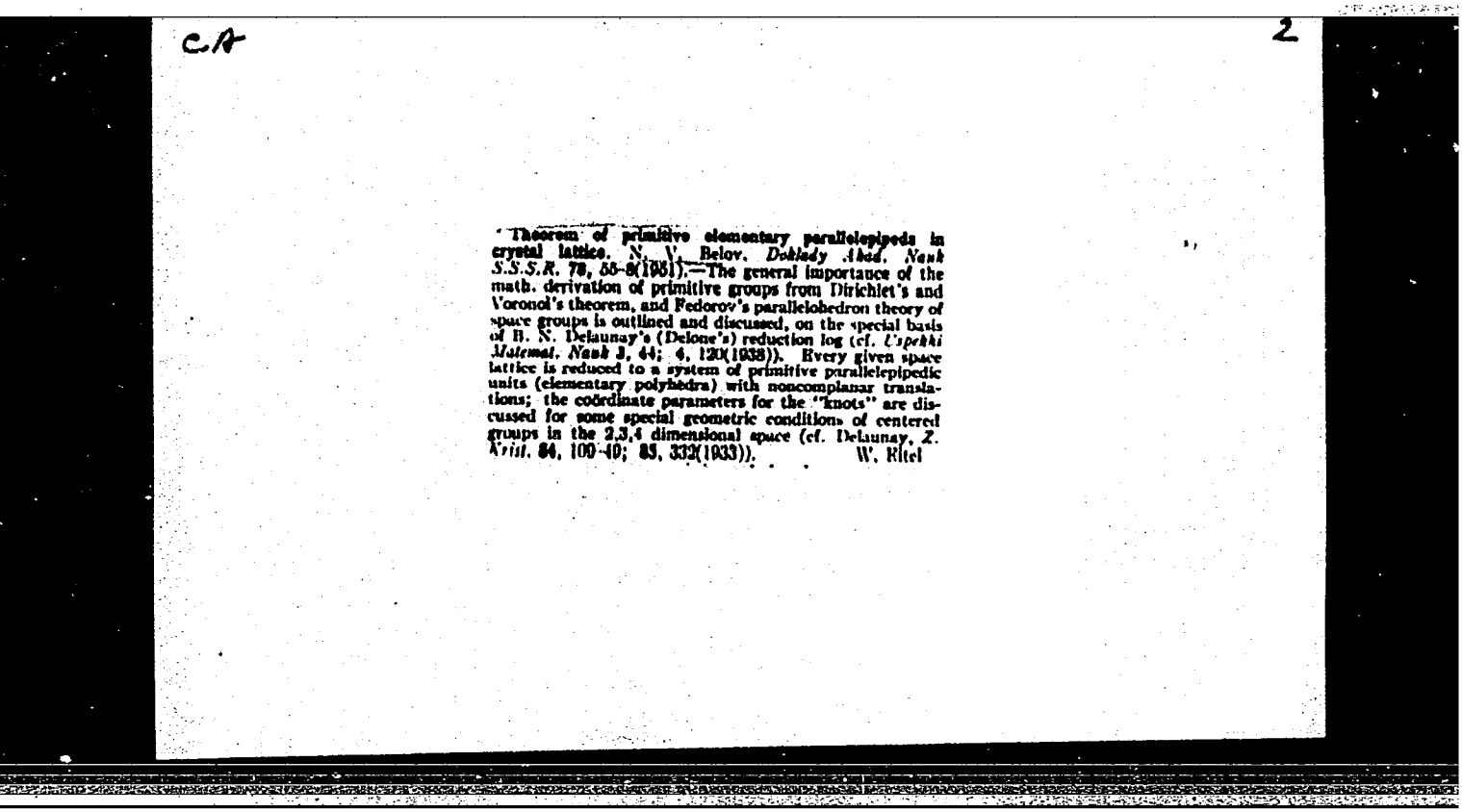
BELOV, N.V.

Part 2: Report on structural mineralogy. Min.sbor. no.5:13-36 '51. (MLRA 9:12)

1. Institut kristallografii Akademii nauk SSSR, Moskva. (Mineralogy)

BELOV, N.V.

The nature of the austenite phase. Trudy Inst.Krist., Akad. Nauk S.S.S.R. 6, 141-6 '51.
(CA 47 no.15:7281 '53) (MLRA 4:10)



CA

2

Theorem of primitive elementary parallelepipeds in crystal lattice. N. V. Belov. *Doklady Akad. Nauk S.S.S.R.* 78, 55-8(1951).—The general importance of the math. derivation of primitive groups from Dirichlet's and Voronoi's theorem, and Fedorov's parallelohedron theory of space groups is outlined and discussed, on the special basis of B. N. Delaunay's (Delone's) reduction log (cf. *Uspekhi Matemat. Nauk* 3, 44; 4, 120(1938)). Every given space lattice is reduced to a system of primitive parallelepipedic units (elementary polyhedra) with noncomplanar translations; the coördinate parameters for the "knots" are discussed for some special geometric condition» of centered groups in the 2,3,4 dimensional space (cf. Delaunay, *Z. Krist.* 84, 109-49; 85, 332(1933)). W. Ritel

S.A.
Sect. A

M & X-Ray
Crystallography

548.735.2

5442. A general method of solving crystal structures of symmetry D_{2h}^{16} (Pnma). N. V. BELOV AND V. I. MOKEEVA. *Doklady Akad Nauk, SSSR*, 81, 187–90 (No. 2, 1951).

Many important minerals and synthetic inorganic and organic compounds crystallize with the space group *Pnma* (*Pbnm* in the mineralogical orientation). Conditions are particularly favourable for solution as the heavier atoms generally lie in special positions on the mirror planes. Three Patterson-Harker sections (at $z = \frac{1}{2}$, etc.) give the positions of the heavier atoms, then a Fourier projection on to a mirror plane and a Fourier section halfway between the mirror planes are recommended for finding the remaining atoms. The application of the method to a new structure (ilvite) and to the verification of the structure of olivine will be published later.

A. L. MACKAY

SA
Sect. A

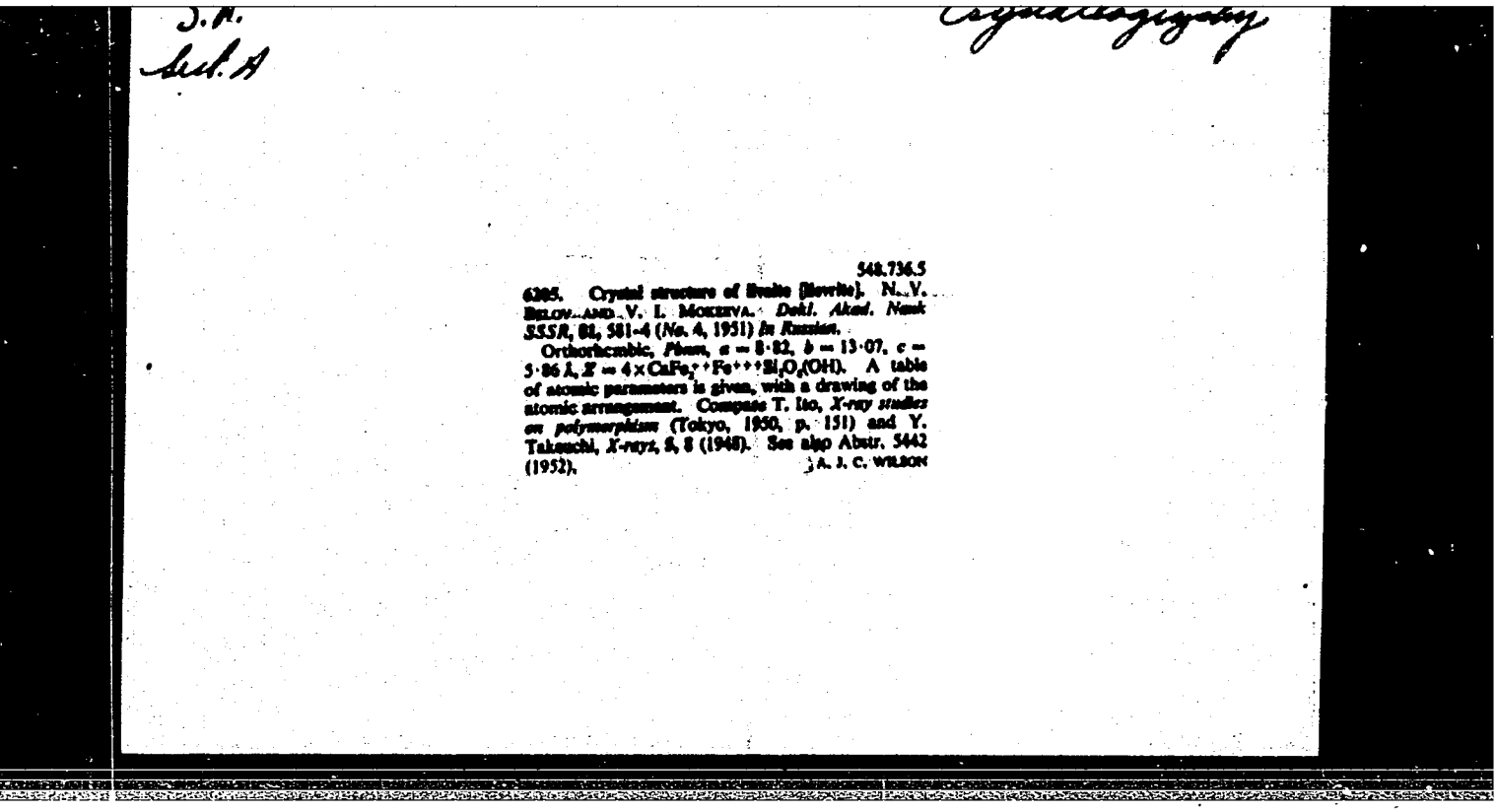
Crystallography

548.735.4

6181. Determination of the parameter in the structure of olivine (forsterite) by the method of three-dimensional harmonic synthesis. N. V. BELOV, E. N. BELOVA, N. N. ANDRIANOVA AND R. F. SHARNOVA. *Dokl. Akad. Nauk SSSR*, 81, 399–402 (*No.* 3, 1951) *In Russian.*

Parameters differing by 0·0·02 from those of Bragg and Brown [*Z. Krist.*, 63, 538 (1926)] are found, giving Si–O and Mg–O distances which differ by up to 0·2 Å. See also Abstr. 5443 (1952).

A. J. C. WILSON



548.736.5

6285. Crystal structure of Ilvaite [Ilmvite]. N. V. BELOV AND V. I. MOKEEVA. *Dokl. Akad. Nauk SSSR*, 81, 581–4 (*No.* 4, 1951) *In Russian.*

Orthorhombic, *Pbnm*, $a = 8{\cdot}82$, $b = 13{\cdot}07$, $c = 5{\cdot}86$ Å, $Z = 4 \times CaFe_2^{++}Fe^{+++}Si_2O_7(OH)$. A table of atomic parameters is given, with a drawing of the atomic arrangement. Compare T. Ito, *X-ray studies on polymorphism* (Tokyo, 1950, p. 151) and Y. Takeuchi, *X-rays*, 5, 8 (1948). See also Abstr. 5442 (1952).

A. J. C. WILSON

S.A.
Section A

548.736.6

6898. Crystal structure of ilvaite [hevrite]. N. V. BELOV AND V. I. MOKEEVA. *Dokl. Akad. Nauk SSSR*, 81, 825–7 (*No. 5*, 1951) *In Russian*.

Two independent determinations of the structure of ilvaite [$CaFe_3^{++}Fe_2^{+++}Si_2O_8(OH)$] are found to disagree completely [Y. Takeuchi, *X-rays* (Osaka), 5, 8 (1948), and N. V. Belov and V. T. Mokeeva, *Abstr.* 6205 (1952)]. The former is severely criticized on account of the interatomic distances entailed.

A. I. MCKAY

BELOV, N.V.

USSR/Chemistry - Silicates Apr 52

"Investigation of the Structure of Crystals," N. V. Belov, Corr Mem, Acad Sci USSR, Laureate of Stalin Prize

"Priroda" No 4, pp 17-20

Describes results of X-ray structural analysis carried out by himself and members of his group on silicate minerals. Outlines newly discovered relationships. States that in his work "Crystal Chemistry of Mineralizers" a theoretical explanation is given to the practically important effect of especially introduced fluorine and hydroxyl

215T18

groups in facilitating crystn of silicate melts by shortening chains, I. V. Grebenshchikov established that the increase of surface strength of glass on wet polishing is also due to this effect.

215T18

BELOV, N. V.

"Peculiarities in Solidification of Natural and Synthetic Aluminosilicate Melts in the Light of Crystallochemistry,"

SO: Vestnik Akademii Nauk SSSR, No. 4, 1952, pp. 109-113

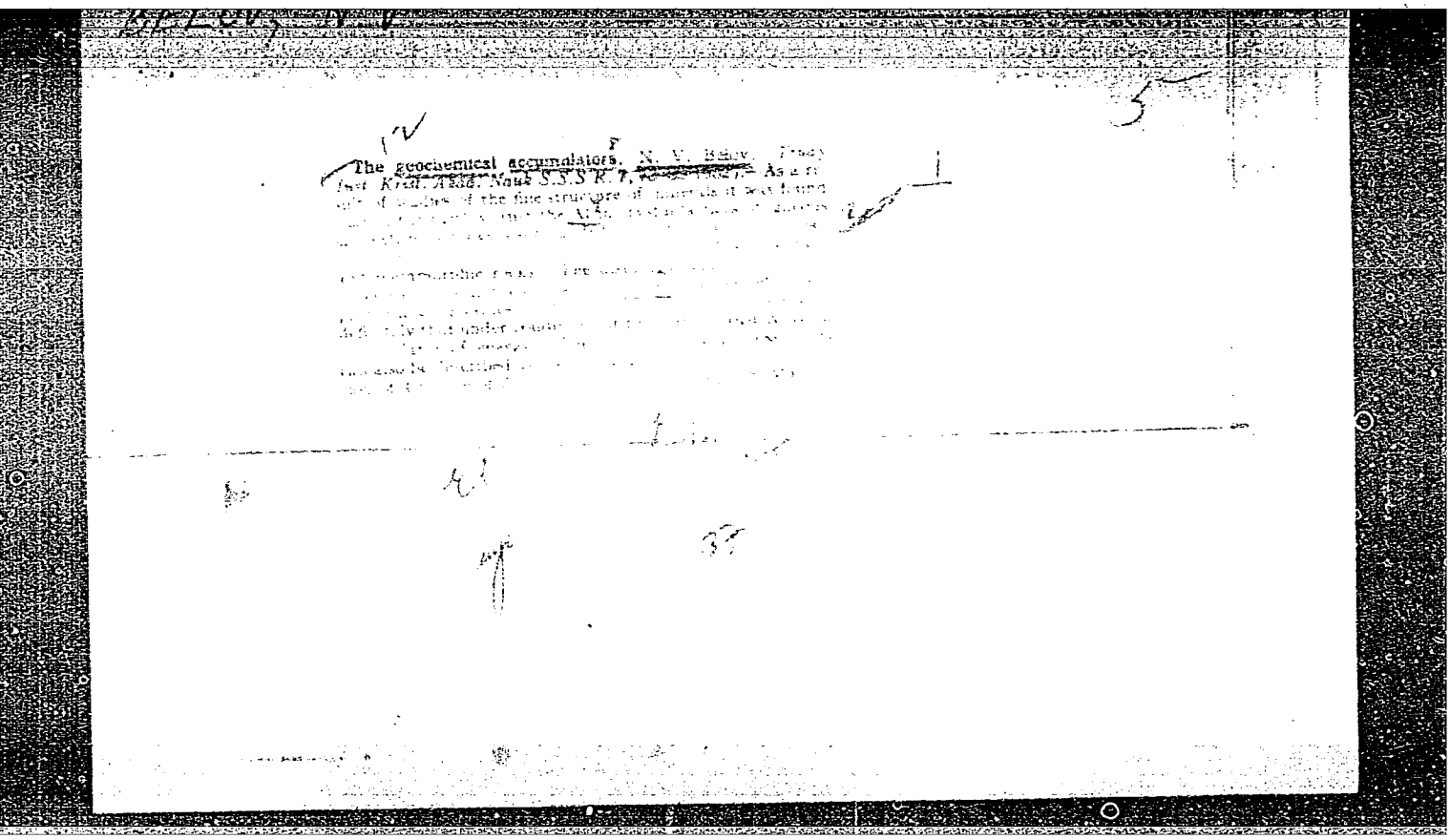
1. BELOV, N. V.

2. USSR (600)

4. Crystallography

7. Crystallographic procedures in solving geometric problems. Trudy Inst.krist., no. 7, 1952.

9. Monthly List of Russian Accessions, Library of Congress, April 1953, Uncl.



The geochemical accumulators.

1. BELOV, N. V.

2. USSR (600)

4. Crystallography, Mathematical

7. Simplification of the formula of a structure factor. Trudy Inst.krist., no. 7, 1952.

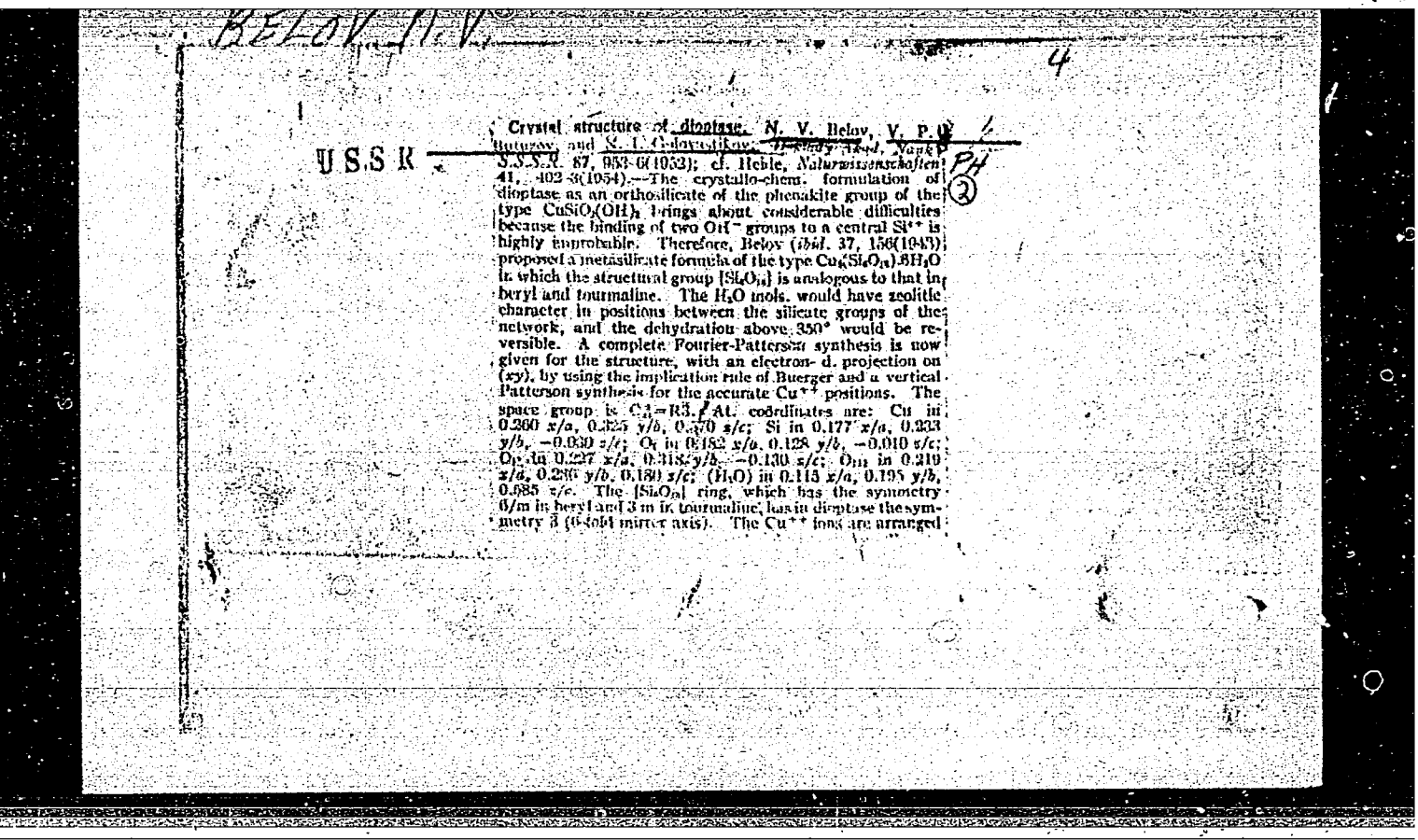
9. Monthly List of Russian Accessions, Library of Congress, April 1953, Uncl.

BELOV, N. V.

"Structure of Crystals," Nauk i Zhizn', 19, No.8, 1952

BELOV, N. V.

"Secrets of Crystals," Tekh. molod., 20, No.6, 1952



BELOV, N.V.

4

USSR

Crystal structure of dioptase. N. V. Belov, V. P. Butuzov, and S. I. Golovastikov. *Doklady Akad. Nauk S.S.S.R.* 87, 953-6(1953); cf. Heide, *Naturwissenschaften* 41, 402-3(1954).—The crystallo-chem. formulation of dioptase as an orthosilicate of the phenakite group of the type $CuSiO_2(OH)_2$ brings about considerable difficulties because the binding of two OH^- groups to a central Si^{++} is highly improbable. Therefore, Belov (*ibid.* 37, 156(1943)) proposed a metasilicate formula of the type $Cu_6(Si_6O_{18}).8H_2O$ in which the structural group $[Si_6O_{18}]$ is analogous to that in beryl and tourmaline. The H_2O mols. would have zeolitic character in positions between the silicate groups of the network, and the dehydration above 350° would be reversible. A complete Fourier-Patterson synthesis is now given for the structure, with an electron- d. projection on (*xy*), by using the implication rule of Buerger and a vertical Patterson synthesis for the accurate Cu^{++} positions. The space group is $C_{3i}^4 = R\bar{3}$. The at. coördinates are: Cu in 0.260 *x/a*, 0.325 *y/b*, 0.370 *z/c*; Si in 0.177 *x/a*, 0.233 *y/b*, −0.030 *z/c*; O_I in 0.182 *x/a*, 0.128 *y/b*, −0.010 *z/c*; O_{II} in 0.227 *x/a*, 0.318 *y/b*, −0.130 *z/c*; O_{III} in 0.219 *x/a*, 0.286 *y/b*, 0.180 *z/c*; (H_2O) in 0.115 *x/a*, 0.195 *y/b*, 0.685 *z/c*. The $[Si_6O_{18}]$ ring, which has the symmetry 6/m in beryl and 3 m in tourmaline, has in dioptase the symmetry $\bar{3}$ (6-fold mirror axis). The Cu^{++} ions are arranged

PH
(2)

in narrow "channels" between the rings corresponding to the pos. character of dioptase. At. distances: Cu – O_{II} = 2.07 A.; Cu – O_{III} = 1.97 A.; Cu – (H_2O) = 2.09 A. The coördination group $[CuO_4]$ is typical, with 3 O – nearer and 1 O – farther away from the Cu centers, similar to the corresponding coördination with S in xonotlite. The distances Si – O are 1.58, 1.61, 1.63, and 1.78 A., those O – O vary between 2.38 A. (for O_I – O_I in the tetrahedra) and 2.76 A. The H_2O mols. form a hexagonal arrangement in 2 levels, with the distance H_2O – H_2O = 2.82 A. Every H_2O mol. is 2.48 A. from the neighboring O_{III} with a H bonding. To every H_2O belong 4 neighbors in a somewhat distorted tetrahedron of the type $[2(H_2O) + Cu^{++} + O_{III}]$. The structure is in agreement with the prevailing macroscopic development of the form {0221} of dioptase. W. Eitel

BELOV, N.V.

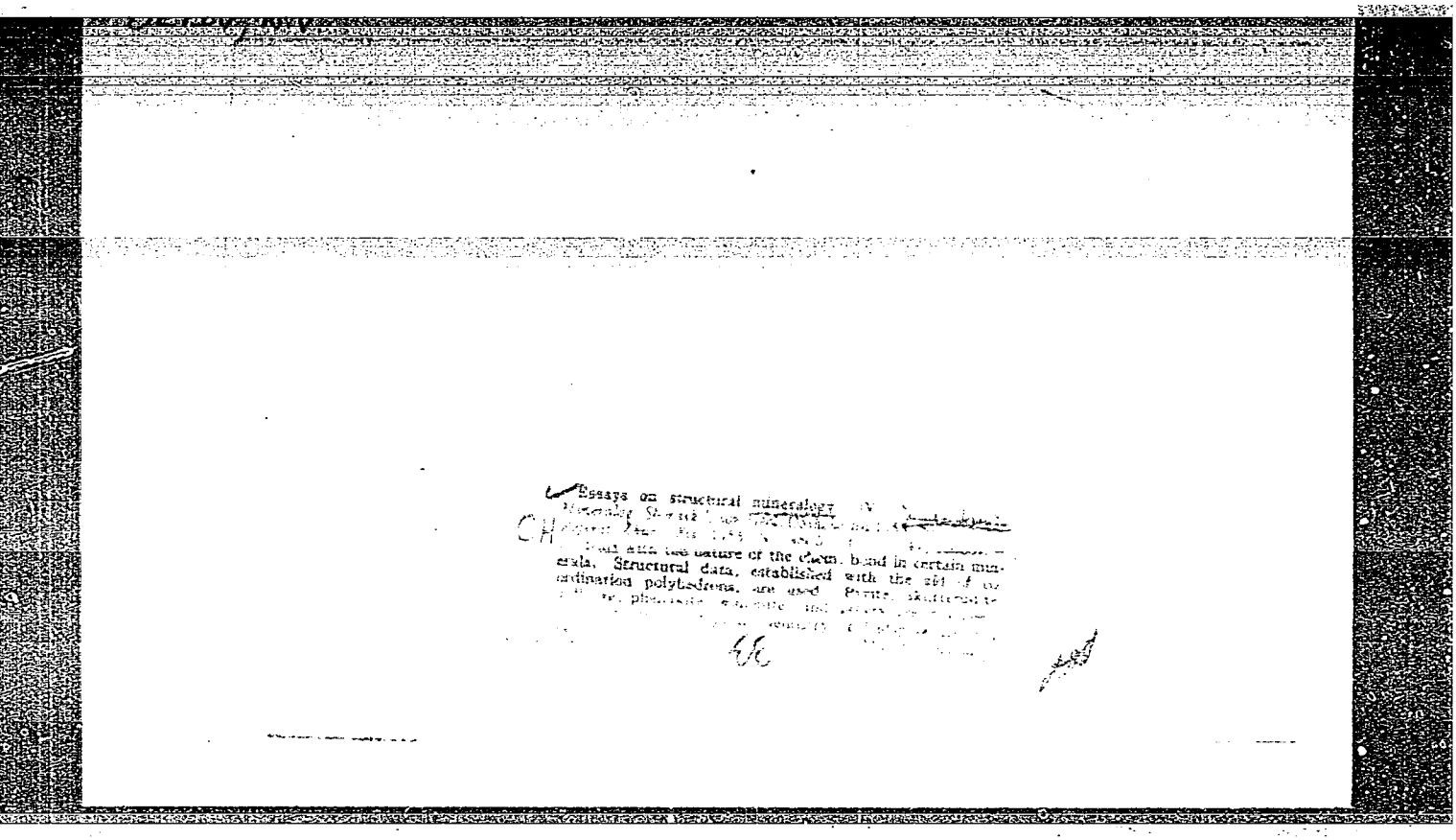
Some characteristics of the crystallochemistry of sulfides. (In: Akademiia nauk SSSR. Voprosy petrografii i mineralogii. Moskva, 1953. Vol. 2, p.7-13) (MLRA 7:4)

1. Chlen-korrespondent Akademii nauk SSSR. (Sulfides)

BELOV, N.V.

Characteristic features in the solidification of aluminosilicate melts. (In: Soveshchanie po eksperimental'noi mineralogii i petrografii. 4th, Moscow, 1952. Trudy, Moskva, 1953. No.2, p.133-136.)
(MLRA 7:3)

1. Institut kristallografii Akademii nauk SSSR.
(Crystallization) (Aluminum silicates)



Essays on structural mineralogy. IV

[illegible] with the nature of the chem. bond in certain inorganic polyhedrons, are used. Petrographic [illegible]

BELOV, N.V., akademik, laureat Stalinskoy premii [reviewer]; BERNAL, J.D. [author].

In defense of progressive science ("Science and society." J.D.Bernal. Reviewed by N.V.Belov). Nauka i zhizn' 20 no.11:46-48 N '53. (MLRA 6:11)
(Bernal, John Desmond, 1901-) (Science--Philosophy)

1 Jan 53

BELOV, N. V.

USSR/Physics - Crystallography

"The So-Called Law of Crystallographic Symmetry," N. V. Belov, Corr Mem Acad Sci USSR

DAN SSSR, Vol 88, No 1, pp 63-65

Proves that if a structure has an axis of 5th order, or in general of (2n + 1) order, then all plane networks perpendicular to this axis will possess axes of twice this order. Besides, a crystal cannot possess a symmetry greater than the geometrical figure of symmetrical element pertaining to the structure (see A. Schoenfliess, Theorie der Kristallstruktur, Berling, 1923). Received 28 Oct 52.

262T79

BELOV, N. V.

USSR

The crystalline structure of epidote $Ca_4Al_4FeSi_6O_{25}(OH)$. N. V. Belov and T. N. Kurnakova. *Doklady Akad. Nauk S.S.S.R.* 85, 833–6 (1953); cf. *C.A.* 47, 663c, 6852f; 48, 13559c.—The crystal structure of epidote was studied. Epidote is monoclinic with $a = 8.89$, $b = 5.62$, $c = 10.23$ Å, $\beta = 115° 24'$. The dark-green crystals of epidote were found to contain ~16% Fe_2O_4 which corresponds to the formula $Ca_4Al_4FeSi_6O_{24}(OH)$. Each cell contains 2 mols. J. Rovtar Leuch

USSR/Geology - Francolites

1 May 53

"Carbonate Apatites," I. D. Borneman-Starynkevich and N. V. Belov, Corr Mem Acad Sci USSR

DAN SSSR, Vol 90, No 1, pp 89-92

Authors state that since 1938 - 1940 they have succeeded 3 times (DAN SSSR, Vol 19, No 4, 255 (1938); ibid., Vol 22, No 2, 90 (1939); ibid., Vol 26, No 8, 811 (1940)) in pointing out objections to the possibility of isomorphic substitution of calcium by carbon in CO_2 apatites (francolites), this possibility was proposed in 1937 by Americans J. W. Gruner and D. McConnell.

259T44

(Chem. Abs. Vol. 48, No. 5, 10 Mar 54)

BELOV, N.V.

Cubically symmetrical space groups. Trudy Inst.kristallogr. no.9:21-34 '54. (MLRA 7:11)
(Crystallography)

BELOV, N. V.

Nature of Martensite Phase
Tr. Inst. Kristallogr. AN SSSR, No 9, 1954, pp 43-46

The former assumption by the author (Tr. Inst. Kristallogr.,No 6, 1951, 141) that the austenite carbon atoms tend to replace iron atoms in gamma-iron instead of occupying octahedral vacancies in dense iron atom cubes, as has been previously assumed, is extended to martensite, The transformation austi-te-martensite is considered as a transofrmation of one carbide phase into another. It is also assumed that the carbon ions (C^{2-}, C^{3-}, C^{4-}) replacing alpha-iron atoms have an elongated shape and locate themselves parallel to an axis, which may explain the tetragonal system of martensite. (RZhFiz, No 5, 1955)

SO: Sum. No. 639, 2 Sep 55

Belov, N.V.

USSR / Solid State Physics / Structural Crystallography E-4

Abs Jour : Ref Zhur - Fizika, No. 5, 1957 No. 11654

Author : Belov, N.V., Mokeyeva, V.I.
Inst : -
Title : The Crystalline Structure of Ilvaite.

Orig Pub : Trudy In-ta kristallografii AN SSSR, 1954, 9, 47 - 102

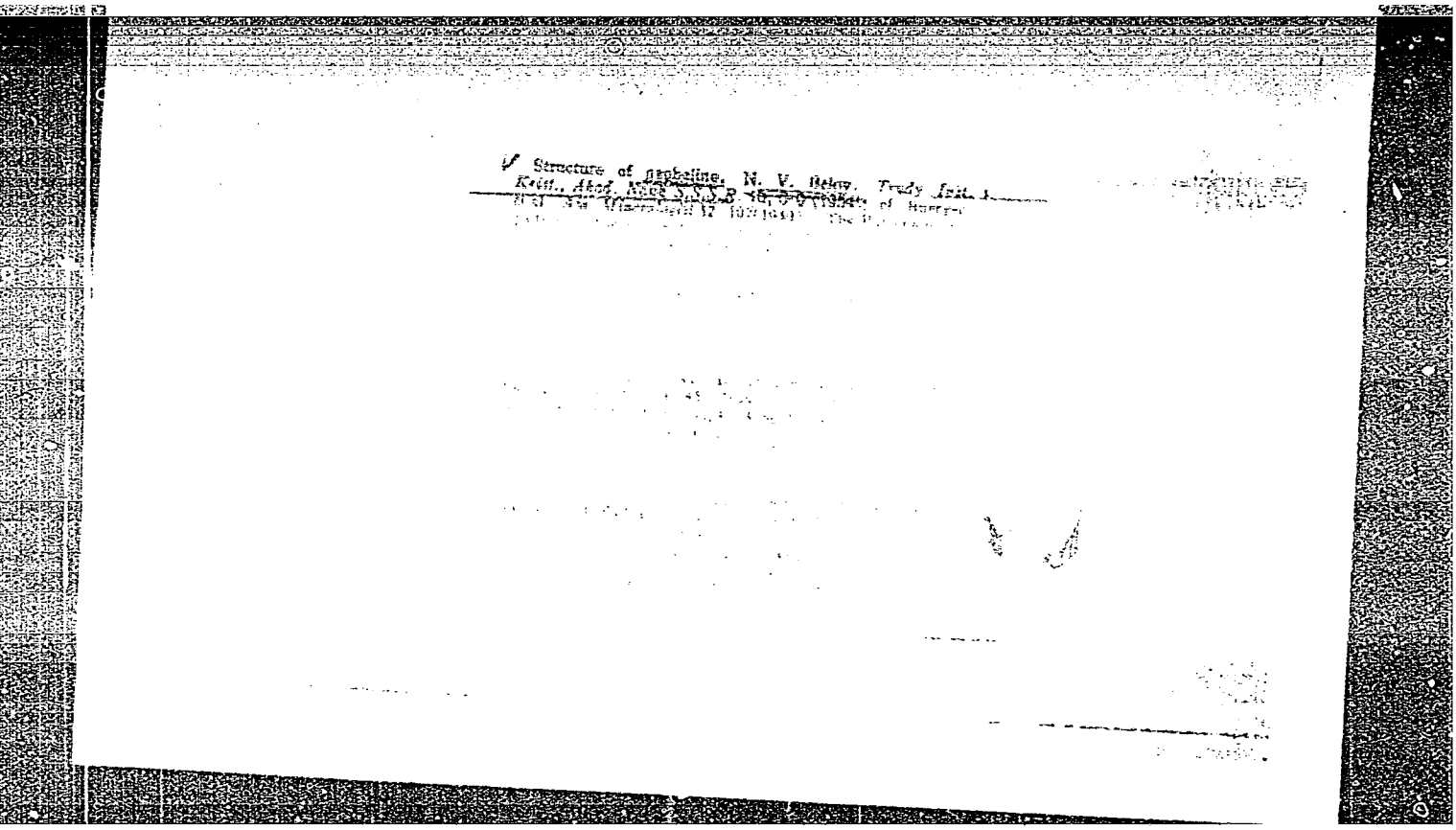
Abstract : See Referat Zhur Khimii, 1955, 31105.

Card: 1/1

The crystal structure of epidote. N. V. Belov and I. M. Rumanova. *Trudy Inst. Krist., Akad. Nauk S.S.S.R.* 9, 103–64(1954).—Epidote, $Ca_2Al_2FeSi_3O_{12}(OH)$, is a representative of a group of minerals, each of which has a short period ~5.5 Å. The earlier works have given only the parameters of the cell and the space group of symmetry (cf. Gossner and Mussgnug, *C.A.* 26, 670; Bejor, *C.A.* 25, 5514; Gossner and Reichel, *C.A.* 27, 5279). A structure of epidote proposed by Ito (cf. *C.A.* 41, 5666; 46, 9477f) was changed by him later (cf. *C.A.* 43, 6478e). But the structure proposed by the last work has some imperfections. The authors obtained new results; the parameters of the elementary cell are: $a = 8.89$ kX; $b = 5.62$ kX; $c = 10.23$ kX; $\beta = 115°24'$. The no. of mols. in a cell $z = 2$. The space group is holohedral C_{2h}-$P2_1/m$. The coördinates (×100) of the atoms of structure of epidote are: Al_I (0; 0; 0), Al_{II} (0; 0; 50), Fe (29.6; 25; 23.6), Ca_I (76.0; 75; 15.0), Ca_{II} (60.6; 75; 42.2), Si_I (33.8; 75; 4.8), Si_{II} (65.5; 25; 27.8), Si_{III} (18.5; 75; 31.8), O_I (23.3; 0; 4.2), O_{II} (30.9; 0; 35.8), O_{III} (69.0; 0; 33.6), O_{IV} (4.6; 25; 13.1), O_V (3.5; 75; 14.3), O_{VI} (7.0; 75; 41.5), O_{VII} (51.5; 75; 18.5), O_{VIII} (53.5; 25; 31.0), O_{IX} (62.8; 25; 10.0), OH (7.0; 25; 41.5). In the crystal structure there are Si tetrahedra, Al and Fe octahedra, and Ca polyhedra. The Al atoms have coördination no. 6. Epidote is a complex silicate with 2 types of radicals: diorthosilicate $[Si_2O_7]$ and orthosilicate $[SiO_4]$. One O atom and the OH group are not combined with a Si atom. Therefore the right formula of epidote is $Ca_2FeAl_2O(OH)[Si_2O_7][SiO_4]$. E. C. M.

BELOV, N.V.

Nomographic calculation methods in X-ray structural analysis.
Trudy Inst.krist. no.9:277-286 '54. (MLRA 7:11)
(Radiography) (Crystallography)



Structure of Depsline. N. V. Belov. Trudy Inst. [illegible]

USSR/ Miscellaneous - Conferences

Card 1/1 : Pub. 124 - 15/24

Authors : Belov, N. V. Academician

Title : At the third International Crystallographic Congress

Periodical : Vest. AN SSSR 11, 75-80, November 1954

Abstract : Notes and observations of the Soviet delegate to the third International Crystallographic Congress held in Paris, France during the last days of July 1954. Names of foreign scientists attending the congress are listed.

Institution : .....

Submitted : .....

15-57-2-1779

Translation from: Referativnyy zhurnal, Geologiya, 1957, Nr 2, pp 90-91 (USSR)

AUTHOR: Belov, N. V.

TITLE: The Atomic Structure of Glass (Ob atomnoy strukture stekla)

PERIODICAL: V sb: Stroyeniye stekla, Moscow-Leningrad, AN SSSR, 1955, pp 344-350

ABSTRACT: The two principal theories on the glassy state--the crystallite theory and the theory of an unordered three-dimensional bond of the principal structural elements (SiO_4 tetrahedra in silicate glasses)--are based on X-ray data. Detailed examinations of the possibilities of using X-ray analyses have shown that the crystallite theory and the other theory indicated should be set aside. It would be best, in investigating the atomic structure of glass, to begin with an

Card 1/4

idea on the structure of fluids and amorphous bodies, in which extensive order is absent but immediate order in the distribution of atoms is preserved. Assuming the basic principle of continuity, that even in the still fluid glass the structural elements of the crystalline phase are present (separating from it), a picture may be conceived of the structure of glass and the tendency toward an amorphous state may be explained. In the liquid silicate glass, "preparatory to crystallization," the structural elements of the future solid phase--skeletons, nets, chains--are already rather abundant. Their disposition, in the absence of any further ordering, cannot be parallel. The sizes of these structural elements are variable and the particles are differently oriented in space. This state explains the high viscosity of molten silicate glass and the tendency to solidify in amorphous bodies. In relation to the sizes of the parts of the structural elements, it may be said that their parallel contraction is possible only within the limits of 15 A, inasmuch as the regular spacing in glass, as determined by Ye. A.

The Atomic Structure of Glass (Cont.)

Poray-Koshits, does not exceed 15 A. The length of parts of the chains in metasilicates may exceed 300 A. These particles in metasilicates, however, are not detected on a debyeogram because of the unordered disposition of secondary cations and of the possible bending of the chains. Consequently, the principal mass of silicate glass is made up of more or less large scraps of endless (in one, two, three dimensions) anions of SiO_4 tetrahedra, which are present in the crystalline phase, and which separated during devitrification. Devitrification is facilitated by the introduction of mineralizers, which are effective in reducing the severing of the endless chains and nets. Concerning sodium boro-silicate glasses, the structure should be considered a dense packing of oxygen atoms, in which cations of Si^{4+}, B^{3+}, Na^{+} are arranged according to chemical and crystal-chemical rules. The concept of the existence of two three-dimensional nets, in one of which oxygen is bound only to Si^{4+} and in the other only to B^{3+}, the nets penetrating each other, is basically incorrect. Experiments on the leaching of boron and sodium

The Atomic Structure of Glass (Cont.)

atoms and the determination of pore sizes in "silica glass," conducted by Ye. A. Poray-Koshits, are not proof of the existence in borosilicate glasses of two kinds of oxygen atoms, one bound only to silicon and the other bound only to boron. The explanation of the phenomena of leaching in borosilicate glasses must be sought for in the fact that boron may have the fourth coordination next to oxygen. The existence of boron in the fourth coordination has been established in many minerals and in boron glasses. The structure of solid B_2O_3 is composed of tetrahedra of BO_4^{5-}. At high temperatures the boron is predominantly found in the third coordination. At lower temperatures it changes to the fourth coordination, a process that takes a considerable length of time and does not reach completion during the solidification of the glass. The continuous process of changing to the fourth coordination destroys the wholeness of the skeletal structures. The result is the development of weak places in the glass where the leaching action of water appears.

Card 4/4 A. A. L.

USSR/Physical Chemistry - Crystals

Abs Jour : Referat Zhur - Khimiya, No 2, 1957, 3524 P-5

Author : Belov, N.V.
Inst : Mineralogical Society at the Lvov University
Title : VI. Conspectus of structural Mineralogy.

Orig Pub : Mineralog. sb. L'vovsk. geol. o-vo pri un-te, 1955, No 9, 3-14.

Abstract : The publication consists of two independent parts. Part 1 is a supplement of previously published wirk (RZhKhim, 1955, 15799). Considered is the problem of the mechanism of polarization effects in crystalline structures CoAsS, NiAsS, NiS, MoS_2, CuCl, AgCl, CuBr and other compounds. Coordination numbers of cathions-polarizers in the structures under consideration are very closely related, according to the author, with the tendency of cathions to form about them symmetrical configurations of 18 (or 32) electrons. In interpretations of characteristic features of

Card 1/3

- 14 -

BELOV, N.V.

SUBJECT USSR/MATHEMATICS/Algebra CARD 1/2 PG - 396
AUTHOR BELOV N.V., NERONOVA N.N., SMIRNOVA T.S.
TITLE 1651 Subnikov groups.
PERIODICAL Trudy Inst. Kristallogr. 11, 33-67 (1955)
reviewed 11/1956

Pólya and Niggli (Z.Kristallogr. 60, (1924)) have established the 17 motion groups of the plane. Assuming the plane to be reflecting, then one obtains 80 motion groups (Weber, Z.Kristallogr. 70, (1929); Alexander und Hermann, ibid. 69, and 70,). These can be denoted as bicoloured groups by giving the points the two colours white and black instead of the reflection at the carrier plane. Therefore the authors call them the 80 bicoloured groups. The authors solve the following problem: Analogously how the 17 onecoloured groups can be generalized to the 80 bicoloured ones, so the 230 onecoloured space groups (due to Schönflies and Fedorov) can be generalized to bicoloured groups. The authors find 1651 groups which are named Subnikov groups. The authors' method is geometric: At first the 36 bicoloured Bravais-Lattices are established, they are obtained by centering of the edges, the surfaces and the cells of the 14 Bravais-lattices. Then there follow 10 theorems which describe the mutual behavior of the symmetry elements for the bicoloured groups, they correspond to the rules of combination for the onecoloured symmetry elements. Then the 1651 Subnikov groups or bicoloured motion groups are obtained by combining the 36 bicoloured Bravais-lattices with all possible one- and bicoloured

Trudy Inst. Kristallogr. 11, 33-67 (1955) CARD 2/2 PG - 396

symmetry elements. The method is described in detail with the example of the rhombic hemimorphy C_{2v} and leads to 192 bicoloured space groups. The authors have found the following numbers of bicoloured space groups belonging to the several crystal systems:
Triclinic: 7, monoclinic: 91, rhombic: 562, tetragonal: 570, trigonal (rhombohedric): 108, hexagonal: 164, cubic: 149.
The problem of the bicoloured space groups has firstly been put by Heesch (Z.Kristallogr. 73, (1930)) and has been solved for the case of the triclin and monoclin system. His groups No. 1-19 and 40 -118 agree with the above 7 + 91. Then Burckhardt (Comment. Math.Helv. 6, (1934)) has treated the problem with arithmetic methods and has given a number of bicoloured groups for the hexagonal and the rhombohedric system. But the comparison with Belov's results shows that this establishment was incomplete.

SMIRNOVA,R.F.; RUMANOVA,I.M.; BELOV,N.V.

Crystallic structure of cuspidine. Zap.Vses.min.ob-va 84:no.2: 159-169 '55. (MIRA 8:10)

(Cuspidine)

BELOV, N. V.

USSR/Solid State Physics - Structural Crystallography, E-3

Abst Journal: Referat Zhur - Fizika, No 12, 1956, 34626

Author: Golovastikov, N. I., Belova, Ye. N., Belov, N. V.

Institution: None

Title: Crystalline Structure of Eremeyevite (Eichwaltite)

Original Periodical: Zap. Vses. Mineralog. o-va, 1955, 84, No 4, 405-414

Abstract: See Referat Zhur - Fizika, 1956, 28612

1 of 1

Category : USSR/Solid State Physics - Structural crystallography

E-3

Abs Jour.: Ref Zhur - Fizika, No 1, 1957, No 1130

Author : Fesenko, Ye.G., Rumanova, I.M., Belov, N.V.
Title : Crystal Structure of Cyosite.

Orig Pub : Dokl. AN SSSR, 1955, 102, No 2, 275-278

Abstract : An x-ray diffraction study was made of cyosite $Ca_2Al_3Si_3O_{12}(OH)$: a 16.20, b 5.50, c 10.14 kX, Z = 4, Fedorov group D_{2h}^{16} -- Pnma. The structure was determined from the usual and generalized projections of the electron density on xz. The large number of F_{h0l} and F_{hll} amplitudes determined in molybdenum radiation (407 and 277 respectively) make it possible to apply the statistical method to the determination of the signs. The single amplitudes were obtained from the relative ones taking into account the temperature correction at B = 0.7 kX^2. The reference group of signs was determined using a method previously described (Referat Zhurnal Fizika, 1956, 34590); this method made it possible to determine 21 signs of F_{h0l} and 218 F_{hll}. The projections constructed from these data gave the approximate coordinates of almost all the atoms; they were used to determine the signs of all the amplitudes. The foundation of the structure is made up of single columns of Al-octahedra, which extend along the

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Category : USSR/Solid State Physics - Structural crystallography

Abs Jour : Ref Zhur - Fizika, No 1, 1957, No 1130

E-3

b axis; adjacent to the columns are single octahedra, corresponding to the Fe-octahedra in opidote. The columns of octahedra are joined by ortho-groups (SiO_4), diortho-groups (Si_2O_7) and Ca- seven-cornered structures. The inter-atomic distances for Si -- O range from 1.53 to 1.70 kX, for O -- O (ribs of the tetrahedra) from 2.52 to 2.82, for Al -- O (in the octahedra comprising the columns) from 1.93 to 2.02, and for Al -- O (in the single octahedra) from 1.79 to 2.08 kX. The Si-O-Si valence angle is 162°.

Card : 1/1

GOLOVASTIKOV, N.I.; BELOVA, Ye.N.; BELOV, N.V., akademik.

Crystal structure of eremeyevite. Dokl.AN SSSR 104 no.1:78-81 S '55. (MLRA 9:2)

1.Institut kristallografii Akademii nauk SSSR.
(Aluminum borate) (Crystallography)

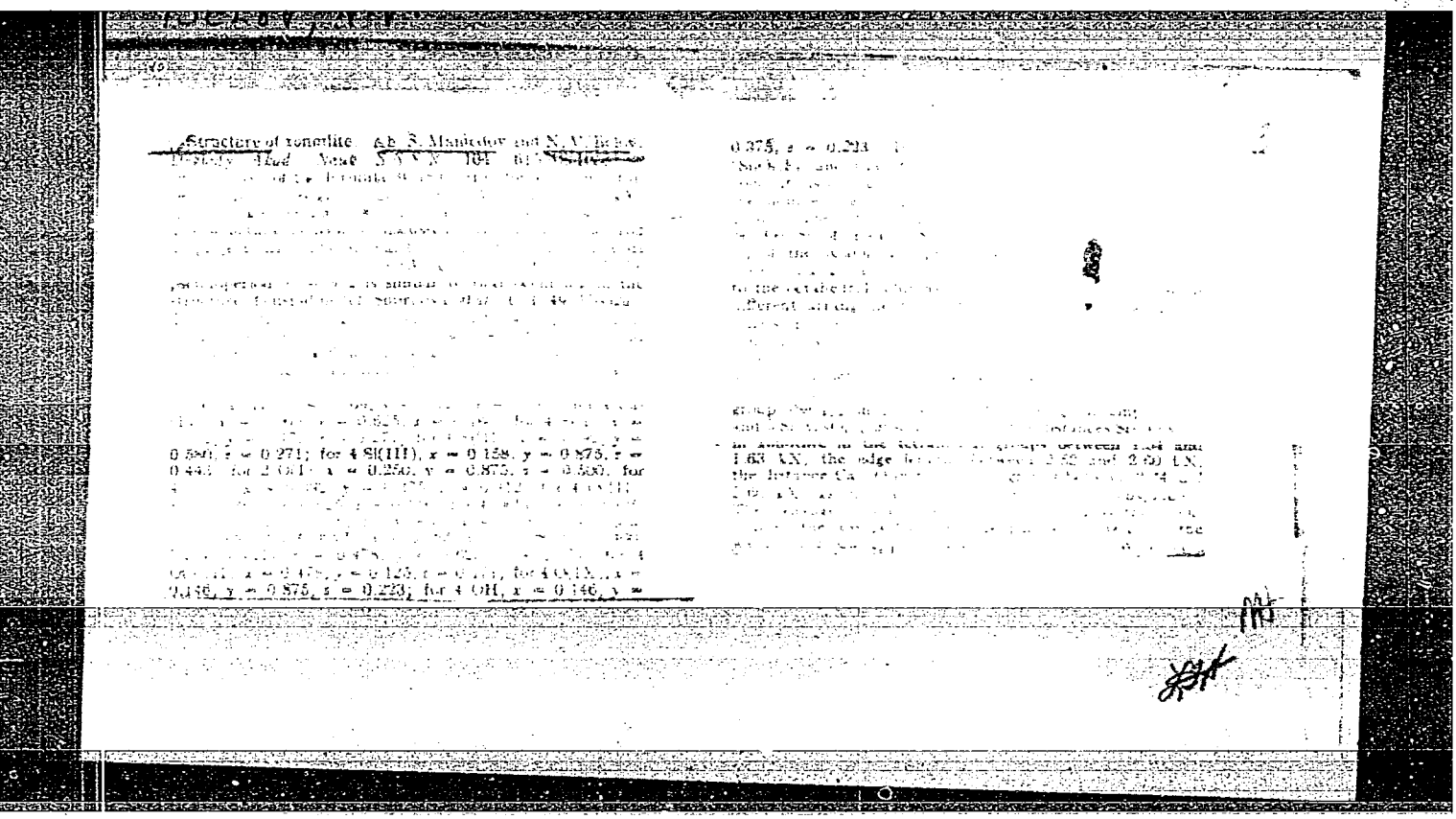
BELOV, N.V.

SUBJECT USSR/MATHEMATICS/Statistics CARD 1/2 PG - 695
AUTHOR GOLOVASTIKOV N.I., BELOV N.V.
TITLE Geometric interpretation of the statistic equation of Zachariasen.
PERIODICAL Doklady Akad.Nauk 104, 540-542 (1955)
reviewed 4/1957

The equation of Zachariasen $S_{H+K} = S(\overline{S_H \cdot S_K})$ (Acta Cryst. 5, 68 (1952)) has a geometric interpretation by relating with all possible situations of the atoms in the elementary cell. For a twodimensional centro symmetric crystal we have $F_H = F_{hk} = \sum_j f_j \cos 2\pi(hx_j+ky_j)$. The straight lines $hx = ky = n =$ = integwr coincide with the maxima of that cos-plane which in the Fourier series corresponds to the amplitude F_H; analogously for F_K. The straight lines which correspond to F_{H+K} go through the intersection points of the two first families. If two atoms are in the cell, then the structure amplitudes F_H, F_K, F_{H+K} are equal 2 cos $2\pi\alpha$, 2 cos $2\pi\beta$, 2 cos $2\pi(\alpha+\beta)$ resp., where α and β are the ratios of the distances of the atom up to the next lines of the families H and K to the periods of lattice lines of these families; analogously for $\alpha+\beta$. Now the relation of Zachariasen is satisfied for certain regions (triangles) but not for other ones. It results that

Doklady Akad.Nauk 104, 540-542 (1955) CARD 2/2 PG - 695

for values of the structure product $\cos 2\pi\alpha \cdot \cos 2\pi\beta \cdot \cos 2\pi(\alpha+\beta) > 1/8$ the equation of Zachariasen is satisfied positively. With increasing number of atoms in the cell the applicability of the equation diminishes and symmetry elements enjoin characteristic restrictions on it.



BELOV, N.V.

SUBJECT USSR/MATHEMATICS/Statistics CARD 1/1 PG - 687
AUTHOR BELOV N.V., GOLOVASTIKOV N.I.
TITLE On strong and weak statistical relations between the signs of structural amplitudes.
PERIODICAL Doklady Akad.Nauk 105, 978-980 (1955)
reviewed 4/1957

The author investigate the question of probability of other relations between the unitary structural amplitudes than the equation of Zachariasen ($S_{H+K}=S_H \cdot S_K$), e.g. $S_{H+2K} = S_H \cdot S_K$, and they find that the following relations have the probabilities of satisfaction in the margin for two atoms:

$S_{3H} = S_{2H} \cdot S_H$	0,83
$S_{4H} = S_{3H} \cdot S_H$	0,67
$S_{5H} = S_{4H} \cdot S_H$	0,80
$S_{6H} = S_{5H} \cdot S_H$	0,70
$S_{5H} = S_{3H} \cdot S_{2H}$	0,77
$S_{7H} = S_{5H} \cdot S_{2H}$	0,76
$S_{8H} = S_{5H} \cdot S_{3H}$	0,73.

DOLGOPOLOV, N.N.; SHCHERBAKOV, D.I., akademik, otvetstvennyy redaktor; BELOV, N.V., akademik, redaktor; VOROB'YEV, O.A., redaktor; CHUKHROV, F.V., redaktor; KUN, N.P., redaktor izdatel'stva; ASTAF'YEVA, G.A., tekhnicheskiy redaktor

[Problems in geochemistry and mineralogy] Voprosy geokhimii i mineralogii. Moskva, 1956. 174 p. (MLRA 9:7)

1. Chlen-korrespondent AN SSSR (for Chukhrov). 2. Akademiya nauk SSSR. Otdeleniye geologo-geograficheskikh nauk.
(Geochemistry) (Mineralogy)

BELOV, N.V.

Category : USSR/Solid State Physics - Solid State Theory. Geometric Crystallography E-2

Abs Jour : Ref Zhur - Fizika, No 2, 1957 No 3680

Author : Belov, N.V., Tarkhova, T.N.
Inst : Institute of Crystallography, Academy of Sciences USSR Gor'kiy University, USSR
Title : Color Symmetry Groups

Orig Pub : Kristallografiya, 1956, 1, No 1, 4-13

Abstract : Description of a new method of obtaining 46 infinite flat two-color groups of symmetry by selecting from among the 230 Fedorov groups those which produce from a single initial symmetric figure derivatives that are located only in two levels. The corresponding symmetry elements will be 2_1, 4_2, 6_3, c, n, and the Bravet lattices A, B, J, F. The new derivation of 46 two-color groups is compared with others. The extension of the new principle of the derivation to groups containing symmetry elements 3_1, 3_2, 6_1, 6_5, 6_2, 6_4, d, and the Bravet lattice R has made it possible to establish 15 colored Fedorov groups of symmetry. On the basis of the theory of the Bravet lattice, and explanation is given for

Card : 1/2

Category : USSR/Solid State Physics - Solid State Theory. Geometric Crystallography E-2

Abs Jour : Ref Zhur - Fiziks, No 2, 1957 No 3680

the existence of non-crystallographic colored groups with 5, 7, and more colors for the case of the low syngonies.

Card : 2/2

BELOV, N.V.

Category : USSR/Solid State Physics - Structural Crystallography E-3

Abs Jour : Ref Zhur - Fizika, No 2, 1957 No 3703

Author : Belov, N.V., Tarkhova, T.N.
Inst : Institute of Crystallography, Academy of Sciences USSR
Title : On Stripping Methods of Calculating the Fourier Synthesis in Structural Analysis of Crystals

Orig Pub : Kristallografiya, 1956, 1, No 1, 132-136

Abstract : The use of the complements to 100 in ordinary strips instead of negative numbers makes it possible to replace the addition and substraction operation with addition alove. New types of strips are described, and a scheme is given for obtaining any strip with the axis divided into 60 parts, and also tables for the cosine and sine strips for h from 1 to 30 and for the amplitude 100, and which tables it is possible to obtain new strips for any amplitude.

Card : 1/1

Belov, N. V.

USSR / Solid State Physics / Structural Crystallography E-4

Abs Jour : Ref Zhur - Fizika, No. 5, 1957 No. 11655

Author : Fesenkp, Ye. G., Rumanova, I. M., Belov, N. V.
Inst : -
Title : Crystalline Structure of Zoisite.

Orig Pub : Kristallografuja, 1956, 1, No.2, 171 - 196.

Abstract : The elementary cell of zoisite $Ca_2Al_3[SiO_4]_3O(OH)$, determined from the X-ray patterns of totation and from the far pinacoids of the zero development, is rhombic: a=16,20, b=5,50, c=10.14kX; Fedorov group D_{2h}^{16} = Pnma. The total determination of the crystallihe structure of zoisite is effected through a direct determination of the soience of the structural amplitudes by statistical equations. A procedure is developed in detail for the separation of the reference group of signs for such a distribution.

Card: 1/1

Category : USSR/Solid State Physics - Structural Crystallography E-3

Abs Jour : Ref Zhur - Fizika, No 2, 1957 No 3698

Author : Belov, N.V., Torkhova, T.N.
Title : Nomographic Method of Computing Structural Factors

Orig Pub : Kristallografiya, 1956, 1, No 2, 235-238

Abstract : No abstract

Card 1/1

BELOV, N.V.

USSR/Crystals. B-5

Abs Jour : Referat Zhur - Khimiya, No 6, 1957, 18220

Author : N.V. Belov, T.N. Tarkhova.
Title : On the Hexoctahedron Group.

Orig Pub : Kristallografiya, 1956, 1, No 3, 360-361.

Abstract : A simple way to find the results of operations of axes of symmetry and rotary-inversion axes on obliquely situated planes of symmetry is proposed and discussed taking the hexoctahedral group as an example. On the attached schematic picture of a hexoctahedron, the indices of all its faces and the only operations, by means of which any face is obtainable from the initial face hkl, are shown.

Card 1/1 - 44 -

BELOV, N.V.

Category: USSR / Physical Chemistry - Crystals B-5

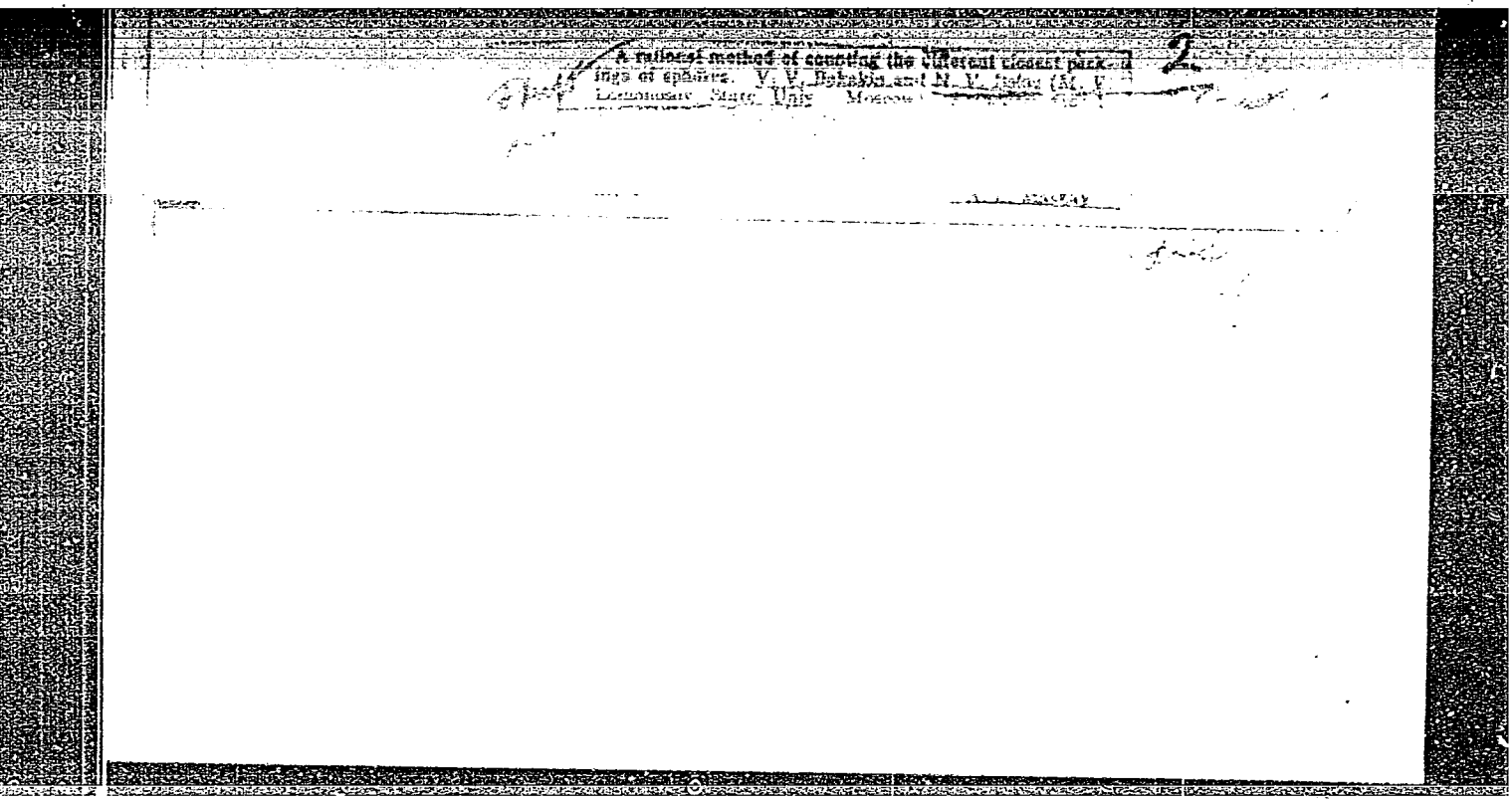
Abs Jour: Referat Zhur-Khimiya, No 9, 1957, 29631

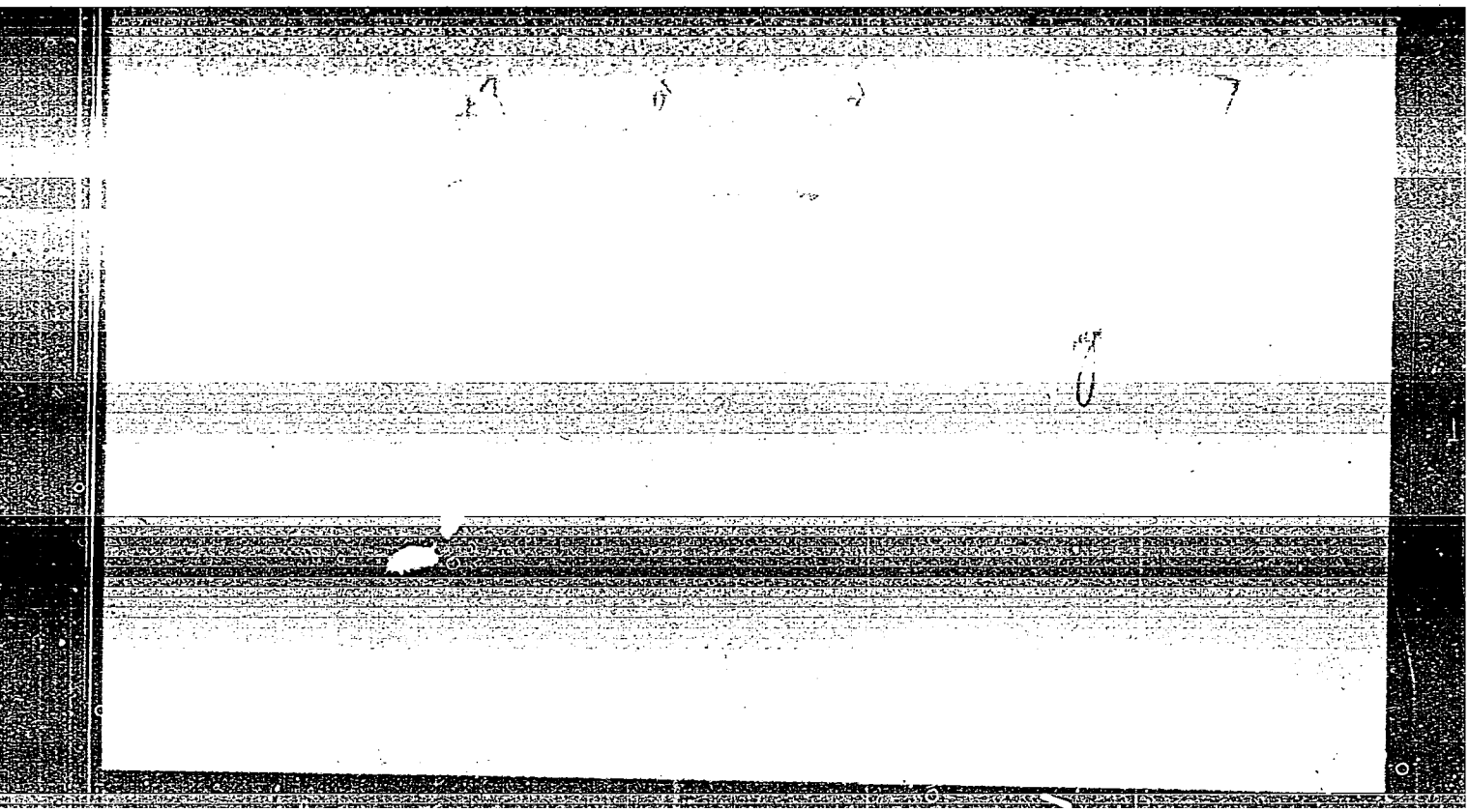
Author : Belov N. V.
Inst : not given
Title : On One-Dimensional Infinite Crystallographic Groups

Orig Pub: Kristallografiya, 1956, 1, No 4, 474-476

Abstract: Utilizing the generally accepted "international" symbol system of denotation of crystallographic groups the author segregates all possible groups of one-sided and two-sided infinite one-dimensional patterns (borders and ribbons), and also groups of those stems having a main proportion axis of 3, 4 and 6. It is shown that in the case of borders (one-sided patterns) there are 7 groups (p111, pm11, p1m1, o1a1, pmm2, pma2, p112), for ribbons -- 31 and for "crystallographic stems" -- 53 groups.

Card : 1/1 -1-





BELOV, N.V.

Medieval Mauretanian ornamentation designed in ranges of symmetry groups. Kristallografiia 1 no.5:610-613 '56.

(MLRA 10:2)

1. Institut kristallografii AN SSSR.
(Decoration and ornament, Mohammedan)

BELOV, N.V.; TARKHOVA, T.N.

Correction to the article "Color symmetry groups." Kristallografiia 1 no.5:615 '56. (MLRA 10:2)

1. Institut kristallografii AN SSSR; Gor'kovskiy Gosudarstvennyy universitet im. N.I. Lobachevskogo.
(Crystallography)

BELOV, N.V.; TARKHOVA, T.N.

Color-group symmetry. Kristallografiia 1 no.6:619-620 '56. (MLRA 10:5)

1.Institut kristallografii AN SSSR i Gor'kovskiy gosudarstvennyy universitet.

(Crystals--Models)

BELOV, N. V.

BELOV, N.V.

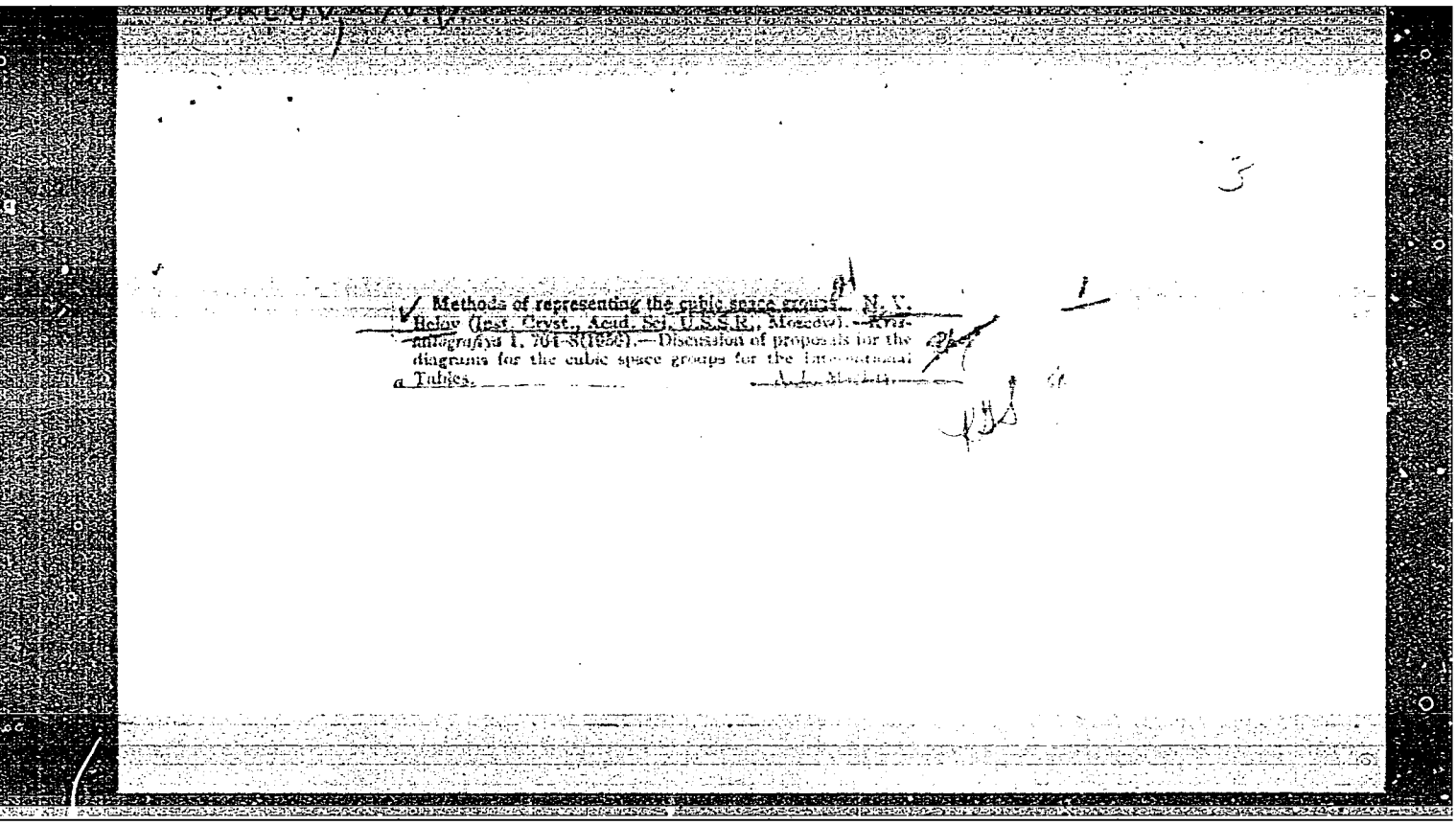
Three-dimensional mosaics with color symmetry. Kristallografiia 1 no.6:621-625 '56. (MLRA 10:5)

1.Institut kristallografii AN SSSR.
(Crystals--Models)

BELOV, N.V.

Appliances used for modeling crystal structures and crystallochemical patterns. Kristallografiia 1 no.6:733-734 '56. (MLRA 10:5)

1.Institut kristallografii AN SSSR.
(Crystals--Models)



Methods of representing the cubic space groups. N. V. Belov (Inst. Cryst., Acad. Sci. U.S.S.R., Moscow). Kristallografiya 1, 201–8(1956).—Discussion of proposals for the diagrams for the cubic space groups for the International Tables.

BELOV, N.V.

Part 7: Studies in structural mineralogy. Min.sbor. no. 10:10-32 '56. (MLRA 9:12)

(Mineralogy)

Belov, N.V.

USSR / Structural Crystallography. E-3

Abs Jour : Ref Zhur - Fizika, No 4, 1957, No 9229

Author : Mamedov, Kh. S., Belov, N.V.
Title : Crystalline Structure of Minerals of the Wollastonite Group. I. Structure of Xonotlite.

Orig Pub : Zap. Vses. mineralog. o-va, 1956, 85, No 1, 13-38

Abstract : Results of X-ray diffraction investigations are reported for the crystalline structure of a mineral of the Wollastonite group, namely Xonotlite 6 $CaSiO_3 \cdot H_2O$. Only the Weissenberg method and rotation were used and the radiation was Mo K_α. Owing to the fibrous structure of the mineral, X-ray diffraction patterns were obtained only when rotating about the b axis of the needles. The lattice periods were a 16.50, b 7.32 (with a pseudo-period b 3.66) and c 7.03 kX, $\beta 90^0$, Z = 4, and Fedorov group P2/a. The signs of the F_{hol} amplitudes were determined with the aid of the Harper and Casper inequalities and the Zachariasen statistical equation. On the basis of the projection of the electron density $\rho(xz)$, and also with

Card : 1/3

USSR / Structural Crystallography. E-3

Abs Jour : Ref Zhur - Fizika, No 4, 1957, No 9229

Abstract : allowance of the analogy between Xonotlite and cuspidine and telleite, a model of the structure was found and was subjected to consecutive refinement by the arbitrary projection method. The base of the structure ofthe Xonotlite are Ca-octahedra, connectex together by the oppositely-placed ribs, and extending along the b axis. The octahedra contain 1/3 of the atoms of calcium, while the remaining atoms of calcium are located in the trigonal prisms, connected along the ribs into columns placed on both sides of the columns of the Ca-octahedra along the second-order axis. Columns of the octahedra and the prisms combine to form layers parallel to the (001) plane. The structure of the Xonotlite displays a characteristic new type of silicon-oxide radical, namely a chain (ribbon) of composition $[Si_6O_{17}]_\infty$,

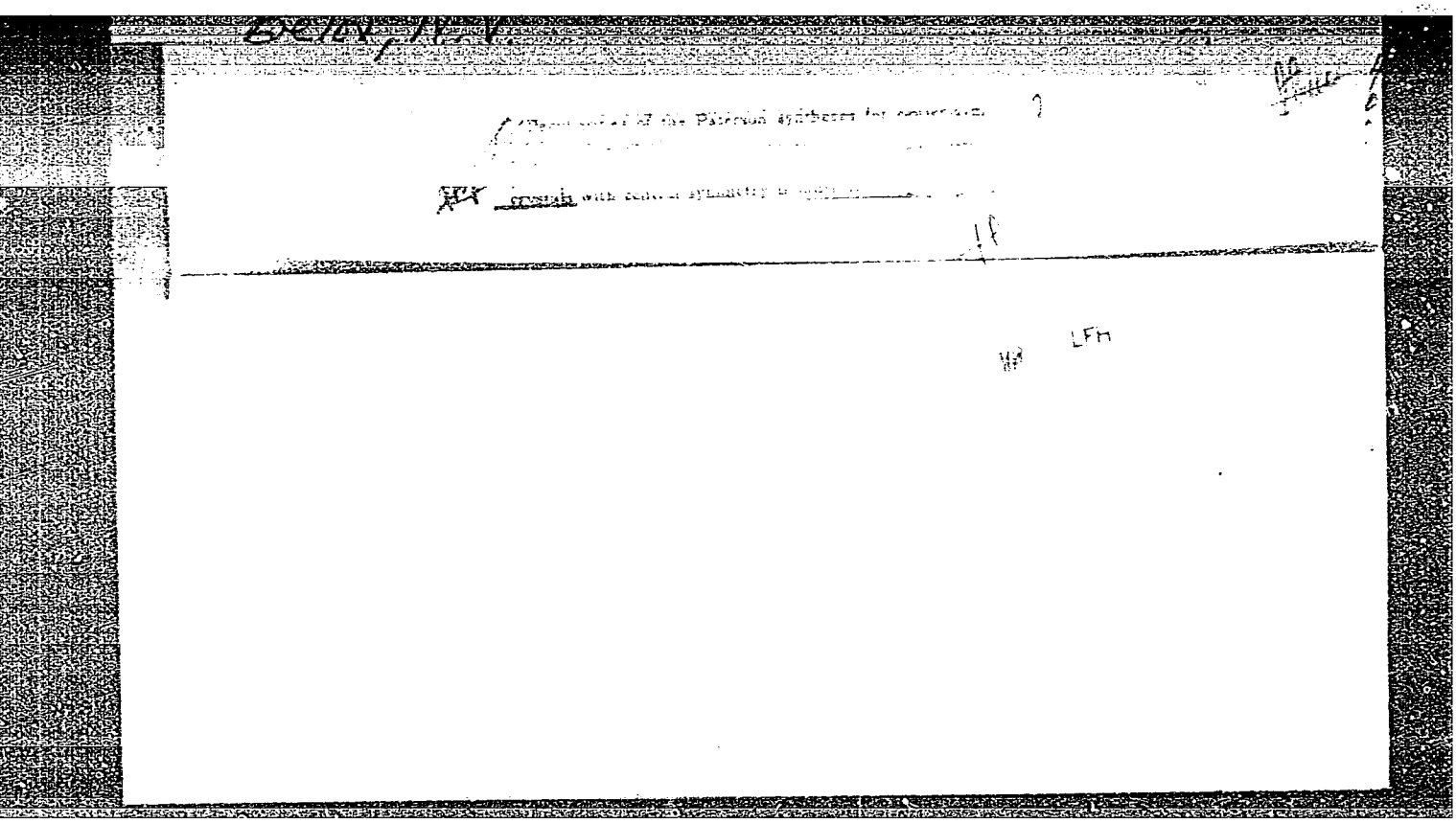
Card : 2/3

USSR / Structural Crystallography. E-3

Abs Jour : Ref Zhur - Fizika, No 4, 1957, No 9229

Abstract : which are located parallel to the columns of the octahedra and the prisms. The Si-O distances in the tetrahedra are 1.54 -- 1.63 kX. The length of the ribs of the Si-tetrahedra are 2.52 -- 2.60 kX. The Ca-O distances in the octahedra and in the prisms fluctuate in the range 2.34 -- 2.60 kX. The structural features of Xonotlite explain well the fibrous nature and both cleavages of the minerals. The defects and faults in the structure of Xonotlite and of other minerals of the Wollastonite group are examined.

Card : 3/3



M. S. Mamedov and N. V. Belov

direction. Two pyroxene chains form by condensation the
motif [illegible] of the [illegible] are
those of xonotlite of the type [illegible]
somewhat different from those in xonotlite and rosenhahnite.
The structure of wollastonite is [illegible]
the chains is better [illegible]
The [illegible]
in the [illegible]
unit of the [illegible]
parameter
optically [illegible]

[redacted]LOV, N. V.

USSR/ Physical Chemistry - Crystals B-5

Abs Jour : Referat Zhur - Khimiya, No 3, 1957, 7269

Author : Pyatenko, Yu.A., Bokiy, G.B., and Belov, N.V.
Inst : Academy of Sciences USSR
Title : Radiographic Investigation of the Structure of Chkalovite

Orig Pub : Dokl. AN SSSR, 1956, Vol 108, No 6, 1077-1080

Abstract : Radiographic methods (X-ray goniometer and oscillation method, using Fe-K$_\alpha$, Cu-K$_\alpha$, and Mo-K$_\alpha$ radiation) have been applied to the investigation of the structure of Chkalovite $Na_2(BeSi_2O_6)$. The crystals are rhimbic (pseudotetragonal) with lattice parameters: a 21.1, b 21.1, c 6.87Å, (exper.) 2.66, Z = 24.; the space group notation is F2dd. The structure was determined by the interpretation of the P(uw) and P(vw) projections and cross-sections P(uv0) and P(uv$\frac{1}{4}$) (assuming the structure to be analogous to β-cristobalite and using crystal structure analysis); the results were refined by the

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Abs Jour : Referat Zhur - Khimiya, No 3, 1957, 7269

application of successive approximations in carrying out a Fourier analysis. The structure of chkalovite appears to be derived from that of β-cristobalite. The filling of 2/3 of the total number of Lavsov polyhedra by Na atoms and the substitution of 1/3 of the Si atoms by Be atoms lead to a tripling of the a and b periods in chkalovite compared with the edge lengths of β-cristobalite. This leads to a small displacement of the atomic coordinates from their ideal positions.

BELOV, N.V.; KUROCHKIN, M.I., konstruktor.

Mechanizing turntables for cars used in unloading brick clay from the press. [Suggested by N.V.Belov and M.I.Kurochkin] Rats.i izobr. predl.v stroi. no.146:3-6 '56. (MLRA 10:2)

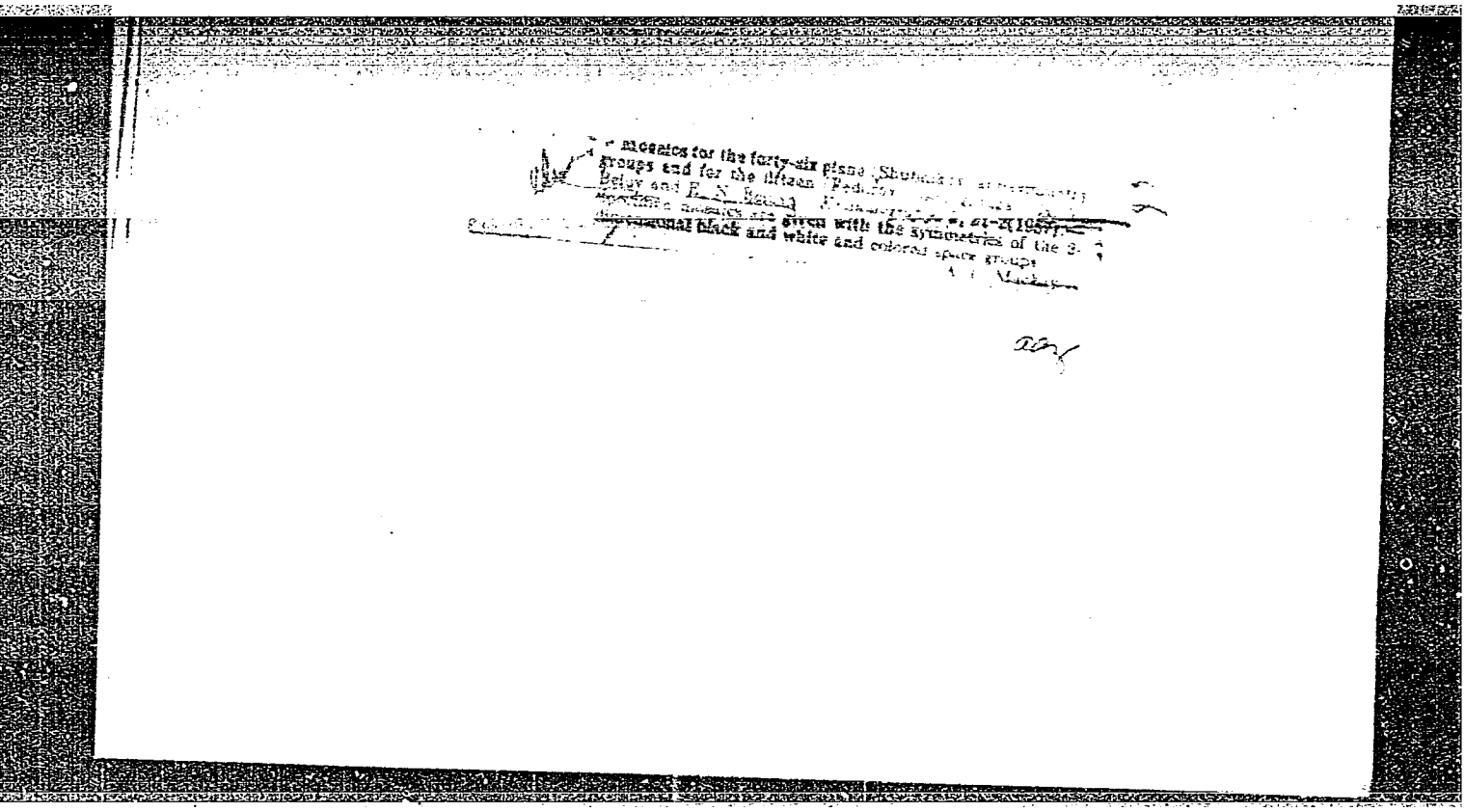
1. Glavnyy mekhanik Lyuberetskogo zavoda silikatnogo kirpicha (for Belov).

(Brickmaking)

AS USSR

"The Structure of Silicates" (Section 2-1; "The 1651 Shubnikov Groups" (Section 16-3)- papers submitted at the General Assembly and International Congress of Crystallography, 10-19 Jul 57, Montreal, Canada.

C-3,800,189



70-3-1/20

AUTHOR: Belov, N.V., Neronova, N.N. and Smirnova, T.S.

TITLE: Shubnikov groups (Shubnikovskiye gruppy)

PERIODICAL: "Kristallografiya" (Crystallography), 1957, Vol. 2, No. 3, pp. 315 - 325 (U.S.S.R.)

ABSTRACT: 1 651 Shubnikov groups are presented in the new international notation, prefaced by few fundamental theorems, which govern their derivation.

The derivation of these groups is easily performed if we start from two-coloured translation groups; 36 such groups exist, of which 22 are two-coloured and 14 are ordinary Bravais lattices.

An obvious theorem states that with a two-coloured lattice every (two)-coloured element of symmetry either coincides with a non-coloured element of the same kind (plane, axis, centre) or alternates with it. In the notation of such Shubnikov groups it is sufficient to place behind the symbol of the coloured lattice only non-coloured elements of symmetry, i.e. one of the Fedorov groups.

With the non-coloured lattice, i.e. when we have the ordinary Bravais lattice, we have in the notation coloured elements. Introduction of them is governed by two simple theorems. According to the first one, odd elements of

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symmetry (threefold axes) can be only uncoloured or grey, i.e. Shubnikov groups with these elements of symmetry do not exist. According to the second, if we have a finite or infinite two-coloured (black-white) pattern and then restitute the black half of components for the white ones, we obtain one of the ordinary (one-coloured) Fedorov groups. This means that when the lattice is an ordinary Bravais lattice all two-coloured groups can be derived by systematic substituting of one, two or three independent symbols in the appropriate Fedorov group by the two-coloured symbols.

A complete list is given of the 1 651 Shubnikov groups (pp. 318 - 325), which includes also the 230 Fedorov groups and an equal number of grey groups. Two-coloured elements are denoted by an apostrophe. Grey groups are denoted by an additional 1'. This symbol does not appear in cubic groups, where we consider it appropriate to displace this apostrophe to the symbol of the (odd) axis 3.

The derivation of Shubnikov groups was first accomplished in 1953, by A.M. Zamorzaev (2,3,4). In 1954 the authors derived them by the more crystallographic method, which had been used in a short textbook of Fedorov groups by N.V.Belov. In these two papers one can find all the theorems which are

Shubnikov groups (Cont.) 70-3-1/20

of use in this derivation.
This is an almost complete translation of the text.
There are 1 table and 6 references, all of which are Slavic.

ASSOCIATION: Institute of Crystallography, Ac.Sc. U.S.S.R. (Institut Kristallografii, AN SSSR)

SUBMITTED: March 9, 1957.

AVAILABLE: Library of Congress

Card 3/3

AUTHOR: Belov, N.V. 70-3-7/20

TITLE: New silicate structures. (Novye silikatnyye struktury)

PERIODICAL: "Kristallografiya" (Crystallography), 1957, Vol.2, No.3, pp. 366 - 370 (U.S.S.R.)

ABSTRACT: Numerous textbooks on crystal chemistry and mineralogy contain essentially much material, published by W.L. Bragg about twenty-five years ago, and do not reflect advances made in this field during the last 5 - 7 years. Particularly, much important work, which has been carried out in the Soviet Union, has not been included in book literature. In this paper, a short review is given of about 10 new silicon structures, all from the author's laboratory, which represent a substantial addition to the classical system of silicates of Bragg; particular attention is paid to six types of chain structures at present known instead of the two classical types and also the reasons which govern their existence.

Some of these new silicate structures make some of the classical structures not so unique as they appear in textbooks. Dioptase, $Cu_6[Si_6O_{18}] \cdot 6H_2O$, is, after beryl, another instance of a silicate with sixfold rings of Si tetrahedra. Katapleite, $Na_2Zr[Si_3O_9] \cdot 2H_2O$, is also, after benitoite, the second

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instance of a silicate with threefold rings $[Si_3O_9]$.

Another representative of silicates with endless chains $[SiO_3]_\infty$ in every respect similar to those in pyroxenes is ramsayite, $Na_2Ti_2Si_2O_9$. Instead of the metasilicate ratio Si:O = 1:3, which is characteristic for pyroxenes, we have in ramsayite Si:O = 1:4 1/2. Three oxygen atoms out of every nine do not participate in the Si-O radical, and the correct formula is $Na_2Ti_2O_3[Si_2O_6]$.

Important is the discovery of another Si-O radical with hexagonal symmetry, which is two-storeyed $[Si_{12}O_{30}]$, in the rare Swiss mineral milarite, $KCa_2(Al_2Be)[Si_{12}O_{30}]$. A reservation about the rarity of this mineral loses its significance after the discovery that similar rings $[(Si,Al)_{12}O_{30}]$ are characteristic for uniaxial (high) cordierites as compared to biaxial (low) cordierites with rings $[(Si,Al)_6O_{18}]$ of the beryl type.

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'Pyrosilicate' groups Si_2O_7 have been found in a number of minerals. In some of them the existence of these radicals is suggested by the formula itself: cuspidine, $Ca_4[Si_2O_7]F_2$, tilleyite, $Ca_5[Si_2O_7](CO_3)_2$; but in such minerals as ilvaite, epidote, zoisite these groups were a surprise as the formulae of these minerals gave no reasons to suspect their ortho-properties. In ilvaite all Si atoms are in these pyrosilicate groups, but in epidote and zoisite the same structure contains two kinds of radicals: $[SiO_7]$ and $[SiO_4]$. The eighth atom O in ilvaite and the twelfth in epidote-zoisite do not enter the Si-O radical, and the corresponding formulae are:

$CaFe^{\cdots}Fe_2^{\cdots}O[Si_2O_7]OH$ (ilvaite)

and

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$Ca_2Al_2FeO[SiO_4][Si_2O_7]OH$ (epidote).

The chains $[SiO_3]_\infty$ in pyroxenes and ramsayite are identical, but in the pyroxenoid-wollastonite, $CaSiO_3$, we have

New silicate structures. (Cont.) 70-3-7/20

discovered a radical of the chain type with the same formula $[SiO_3]_\infty$ but with very different geometry. When doubling the pyroxene chain by a plane of symmetry we obtain a lath of amphibole with a formula $4\ SiO_3 - O = [Si_4O_{11}]_\infty$, but when doubling the chain of the wollastonite type we obtain a lath of another type, $6\ SiO_3 - O = [Si_6O_{17}]_\infty$, which is characteristic for xonotlite $Ca_6[Si_6O_{17}](OH)_2$.

Instead of two classical types of chains (Bragg) we distinguish now six of them: three with the same formula $[SiO_3]_\infty$ but with different geometries and three doubled types (laths) with formulae: $[Si_2O_5]_\infty$ (sillimanite), $[Si_4O_{11}]_\infty$ (amphiboles), $[Si_6O_{17}]_\infty$ (xonotlite).

The Si-O radicals are strong but not rigid, and accordingly morphological peculiarities of silicates depend on the configurations of cathions such as Mg(Fe), Al, on one side and Ca(Na) on another. In all stretched (columnar, needle-like) minerals we find endless columns of Mg(Fe), Al-octahedra or of Ca-octahedra. As a result of very different lengths of edges in these

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two kinds of octahedra (2.8 and 3,8 Å) different Si-O-radicals arrange themselves along the cathion columns: pyroxene and amphibole chains along the edges of Mg(Fe) and Al-octahedra, wollastonite and xonotlite chains (laths) along the edges of Ca-octahedra. In silicates with groups $[Si_2O_7]$ these groups arrange themselves with their axes at right angles to the columns of Al- or Fe-octahedra (ilvaite, epidote) but parallel to the columns of Ca-octahedra (cuspidine, tilleyite).

When cathion-octahedra are arranged in sheets, as in micas and similar minerals, Si-tetrahedra form also sheets; but these sheets are (pseudo) hexagonal with sixfold rings when over sheets of Mg(Fe) and Al-octahedra, but tetragonal with alternating tetragonal and octagonal rings over Ca-octahedra (apophyllite). The following step in Ca minerals is the association (condensation) of these sheets in three-dimensional frameworks also with tetragonal and octagonal meshes with are characteristic for felspars.

The great partition of rock silicates in two categories, melanocratic with high densities and leucocratic with low densities, is entirely determined by the size of cathions and their octahedra. The small Mg and Al cathions associate with

close-packed (pseudo) hexagonal Si-O radicals. whereas the large Ca cathions and their octahedra associate with (pseudo) tetragonal Si-O frameworks with large meshes. The size of Mg and Al cathions is similar to the sizes of a great many cathions, a large part of which are coloured. The (isomorphic) entrance of these cathions in (Mg, Al)-minerals results in their melanocratic character. The large size of Ca cathions restricts the possible isomorphic substitutions only to Na and K and hence leucocratic characteristics of felspars and a small number of similar minerals. (This is an almost complete translation of the text.)

There are 4 figures and 16 references, 12 of which are Slavic.

ASSOCIATION: Institute of Crystallography, Ac.Sc. U.S.S.R. (Institut Kristallografii AN SSSR)

SUBMITTED: March 11, 1957.

AVAILABLE: Library of Congress

Card 6/6

AUTHOR: Belov, N.V.

TITLE: On a Course in Geometrical Crystallography for Physicists (O kurse geometricheskoy kristallografii dlya fizikov)

70-5-19/31

PERIODICAL: Kristallografiya, 1957, Vol.2, No.5, pp. 678-685 (USSR)

ABSTRACT: Crystallography, lying midway between physics, chemistry and mineralogy, was formerly closer to mineralogy and is now closer to physics. Teaching courses have correspondingly moved. Points are here discussed in which more understanding of the bases of crystallography should be shown when the subject is being taught to physicists. The Miller indices are more than coefficients in the equation of a plane. By introducing a fourth (dummy) index the three-fold symmetry of expressions in the appropriate system can be preserved. The symmetry groups T=23, O=432, I=532 can be demonstrated by spherical triangles on a sphere. The combinations of axes can also be best seen in this way. The meaning of the term dihedron needs clarification. Group theory, useful elsewhere in physics, helps in the combination of symmetry elements. Fedorov's terminology for certain solids is defended against those who would prefer purer Greek terms. The use of models is very important. The deduction of the crystal classes based on a five-fold axis is of pedagogic value. The more mathematical

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On a Course in Geometrical Crystallography for Physicists. 70-5-19/31

theory of polyhedra is useful and interesting to physicists. The demise of the Fedorov notation (L_4, P, C; L_4, $4L_2$, 5P, C; etc.) is regretted but the international symbols have great advantages, although they do not describe symmetry without introducing a particular aspect. Group theory should be thoroughly inculcated. The rhombohedral system cannot be entirely absorbed in the hexagonal as it is pseudo-cubic. The change of co-ordinates with oblique axes is rarely carried out in geometry but is an easy and frequent operation in crystallography.
There are 5 figures and 3 Slavic references.

ASSOCIATION: Institute of Crystallography Ac.Sc. USSR. (Institut Kristallografii AN SSSR)

SUBMITTED: April 18, 1957.

AVAILABLE: Library of Congress.

Card 2/2

AUTHOR: Belov, N.V.

TITLE: On the Groups of Tetartohedry (T=23) and Gyrohedry (O=432). (O gruppakh tetartoedra (T=23) i giroedra (O=432).

PERIODICAL: Kristallografiya, 1957, Vol. 2 No.6 pp. 722 - 724 (USSR)

70-6-2/12

ABSTRACT: The inter-relationship of the elements of symmetry in the point groups 23 and 432 is expounded by a treatment like that in Kristallografiya, Vol.1, p.360, (1956). The group 23 can be represented by a cube, each face of which is halved by an oblique line (the whole system having the symmetry 23). The first face is marked 1, hkl and the other equivalent faces are marked with the operation deriving them from the first and with the equivalent index as follows: 2_x, $h\bar{k}\bar{l}$; 3_{--+}, $\bar{l}k\bar{h}$; 3_{+++}, lhk ; 3^{-1}_{+++}, klh ; 3^{-1}_{-+-}, $\bar{k}lh$; 2_z , $\bar{h}\bar{k}l$; 2_y , $\bar{h}k\bar{l}$; 3^{-1}_{+--} , $\bar{k}l\bar{h}$; 3_{+--} , $\bar{l}hk$; 3_{-+-} , $l\bar{h}\bar{k}$; 3^{-1}_{--+} , $kl\bar{h}$. The simplest figure is the pentagonal dihexahedron. The group 432 is similarly treated (there are 24 faces forming a pentagonal tetrahexahedron) and the additional elements 4_x, 4_y, 4_z and their inverses appear. The full multiplication table for the group 23 is written out and shows how any two of the above

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On the Groups of Tetartohedry (T=23) and Gyrohedry (O=432). 70-6-2/12

mentioned 12 operations when multiplied together give a third which is also a member of the group. For 432 with 24 elements in the group the table 24 x 24 would be too big to reproduce usefully. Specimen combinations from it are given. There are 3 figures and 2 Slavic references.

ASSOCIATION: Institute of Crystallography Ac.Sc. USSR. (Institut Kristallografii AN SSSR)

SUBMITTED: October 7, 1957.

AVAILABLE: Library of Congress

Card 2/2

Belov, N.V.

AUTHOR: Belov, N.V.

70-6-3/12

TITLE: The Theorem of the Primitiveness (Emptiness) of the Fundamental Parallelepiped and a Crystal Lattice (Teorema primitivnosti (pustoty) osnovnogo parallelepipeda kristallicheskoy reshetki)

PERIODICAL: Kristallografiya, 1957, Vol.2, No.6, pp. 725 - 727 (USSR).

ABSTRACT: The theorem that in a crystal lattice all points with absolutely identical surroundings must lie at the vertices of the fundamental parallelepipeds whose sides are the 3 shortest translations and that no points can occur inside or on the edges or faces has been proved, although it is an apparently obvious theorem, only at great length. In 1951, Belov (Dokl. Ak.Nauk, SSSR, Vol.78, No.1, 1951) produced a proof occupying only 3 pages but this was not as elementary a one as is possible. This proof satisfactorily excluded all cases but those of body-centering and face centering. Calculating the lengths of the face and body diagonals readily shows that the existence of an extra point contradicts the assumption that the parallelepiped was chosen as defined by the three shortest translations. If there are two extra points they can only lie one-third and

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The Theorem of the Primitiveness (Emptiness) of the Fundamental Parallelepiped of a Crystal Lattice.

two-thirds of the way along a body diagonal. It has been shown (Structural Crystallography, N.V. Belov, 1951) that in the primitive parallelepiped $60^{o} \leq \alpha, \beta, \gamma \leq 120^{o}$ so that one-third of the longest diagonal is less than 0.82c and this case falls. Three extra points can only lie at the centres of three faces and are similarly excluded. If there are 4 or more points, then they must lie on a subsidiary lattice rationally related to the basic parallelepiped and on this basis the case can be excluded.

There are 2 figures and 3 Slavic references.

ASSOCIATION: Institute of Crystallography Ac.Sc. USSR.
(Institut Kristallografii AN SSSR)

SUBMITTED: October 7, 1957.

AVAILABLE: Library of Congress.

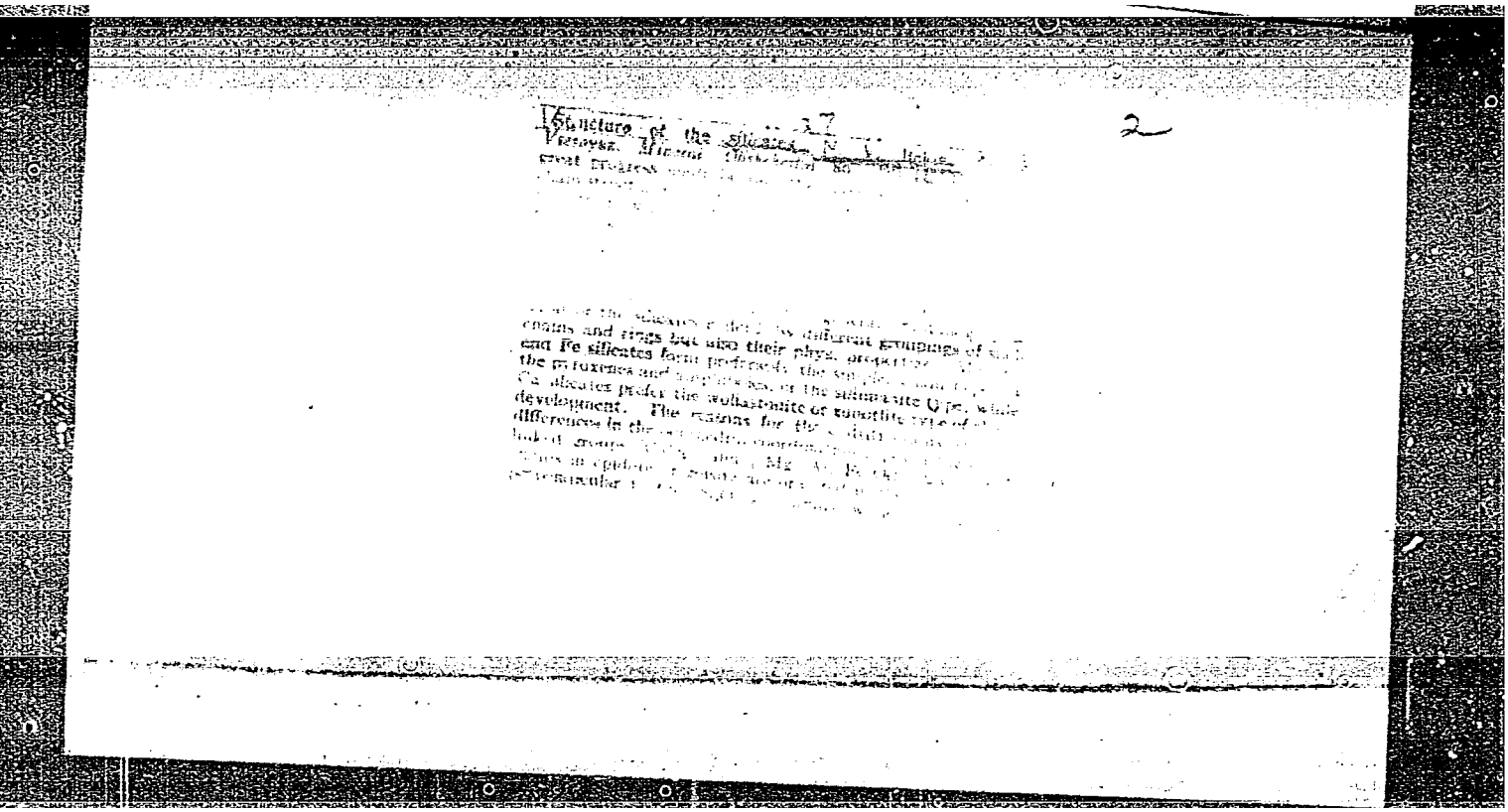
Card 2/2

BELOV, N.V., akademik; LEBEDEV, V.I., doktor geologo-mineralogicheskikh nauk.

Energy sources of geochemical processes. Priroda 46 no.5:11-20 My '57. (MLRA 10:6)

1. Institut kristallografii Akademii nauk SSSR (Moskva) (for Belov). 2. Leningradskiy gosudarstvennyy universitet im. A.A. Zhdanova (for Lebedev).

(Geochemistry) (Thermochemistry)



Structure of the silicates

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chains and rings but also their phys. properties
and Fe silicates form preferred the
the pyroxenes and
Ca silicates prefer the wollastonite or xonotlite
development. The reasons for the
differences in the

BELOV, N.V.

Studies on structural mineralogy. Part 8. Min.sbor. no.11: 3-21 '57. (MIRA 13:2)

1. Institut kristallografii AN SSSR, Moskva.
(Crystallography)

LEBEDEV, V.I.; BELOV, N.V.

Concerning O.P.Mchedlov-Petrosian's critique of the hypothesis of the accumulation of solar energy by crystalline substance. Min.sbor. no.11:371-374 '57 (MIRA 13:2)

1. Institut kristallografii AN SSSR, Moskva.
(Solar energy)

AUTHORS: Pavlov, P. B. , and Belov, N. V. , Academician SOV/20-114-4-56/63

TITLE: The Crystalline Structure of Herderite, Datolite and Gadolinite (Kristallicheskaya struktura gerderita, datolita i gadolinita)

PERIODICAL: Doklady AN SSSR, 1957, Vol. 114, Nr 4, pp. 884 - 887 (USSR)

ABSTRACT: The structure of herderite $CaBePO_4F$ was solved by direct methods (references 1, 2). The simultaneously determined temperature-coefficient 0,58 was used to exclude the temperature-factor from F_{hko}. 15 among the afterwards calculated (absolute) individual amplitudes U_{hko} had a value of $>0,5$. For 56 (36 %) of largest U_{hko} signs were found according to the method of inequality. Again checked according to the statistic method by Zakhariasen (references 1, 2) they formed a supporting group. Based on the latter the signs of the other F_{hko} were merely statistically determined. Altogether 128 from 155 signs were determined with a probability of not less than 71 %. The electron-density-diagram built up on the basis of the F_{hko} provided with signs, in a projection along $c = 4,80$ Å, at once yielded a well resolvable image with powerful Ca-peaks and 2 kinds of tetrahedrons. One half of these was identified as P, in the other tetrahedrons with a triple axis normal to the projection

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under the 4. O-(F)-atom lying on it a Be-atom was assumed. Figure 1 gives the structure of herderite according to the atom-coordinates (table 1). Figure 2 gives the same structure in polyhedrons of Pauling and this proves the existence of two layers. In the lower layer lie (somewhat deformed) twisted cubes, in the upper layer a net of bound PO_4 tetrahedrons in one orientation and the BeO_3F-tetrahedrons in another orientation. After the deciphering of the herderite-structure was concluded, its great similarity with datolite earlier interpreted by Ito (reference 5) became evident. The coordinates of Ito are given in column 2 of table 1. As far as the structure was solved by Ito by the method of the (medium-) heavy atom the authors again calculated it by means of the same direct 2-stage method, but with the use of a much larger number of reflections (150 F_{hko} as against 95 of Ito) in the range up to $\sin\vartheta/\lambda = 1{,}1$ (Mo-radiation). The application of the direct method to the projection xz was especially successful. Here the B-atoms distinctly appeared. The obtained atom-coordinates are given in the third column of table 1. The difference as compared with Ito's results is up to 0,025 (0,12 Å in z-coordinates). The tetrahedrons of two types became much more regular. The same direct method (with inequalities in the first stage) was employed in the deciphering