169

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

BIBLIOGRAPHY OF ION EXCHANGE SELECTIVITY

BY

lfred emengway) 1933–

1907–

A. H. Truesdell, Dorothy Carroll and Marian Schnepfe

pl
em
tw anal

Open-file report

1967

This report is preliminary
and has not been edited or
reviewed for conformity with
Geological Survey standards

Weld - Int. 2905

GEOLOGIC DIVISION
U.S. GEOLOGICAL SURVEY
Washington, D. C.
20242

For release OCTOBER 17, 1967

The U. S. Geological Survey is releasing in open files the following reports. Copies are available for consultation in the Geological Survey Libraries, 1033 GSA Bldg., Washington, D. C. 20242; Bldg. 25, Federal Center, Denver, Colo. 80225; 345 Middlefield Rd., Menlo Park, Calif. 94025; and in other offices as listed:

1. Reconnaissance geologic map of the Yadkin Valley region, North Carolina, by G. H. Espenshade. 2 sheets. Scale 1:200,000. Room 11, Post Office Bldg., Knoxville, Tenn. 37902; Office of the State Geologist, Division of Mineral Resources, Dept. of Conservation and Development, Raleigh, N.C. 27602.

2. Principal facts for gravity stations in the Yuma, Arizona, and Blythe, California, areas, by Donald L. Peterson, Arthur Conradi, and Adel A. R. Zohdy. 34 data pages. 15426 Federal Bldg., Denver, Colo. 80202; 8102 Federal Office Bldg., Salt Lake City, Utah 84111; 504 Custom House, San Francisco, Calif. 94111; 7638 Federal Bldg., Los Angeles, Calif. 90012; Arizona Bureau of Mines, University of Arizona, Tucson, Ariz. 85721.

3. Availability of palynological material from Naval Petroleum Reserve No. 4, I: Simpson Test Well No. 1 and Simpson Core Tests Nos. 13 and 14, by Richard A. Scott. 2 p.

4. Bibliography of ion exchange selectivity, by A. H. Truesdell, Dorothy Carroll, and Marian Schnepfe. 90 p.

5. Seismic measurements of explosions in the Tatum Salt Dome, Mississippi, by R. D. Borcherdt, J. H. Healy, W. H. Jackson, and D. R. Warren. 11 p., incl. 2 tables; 53 p. of text figures.

6. Preliminary notes on sulfur and associated diamonds in the Santo Inacio area of northwestern Brazil, by J. B. Pomerene, Wanderlei Mansanares, Juarez Fonseca, and Urias Rodrigues. 6 p., 1 fig.

Departamento Mineral Produção Nacional, Rio de Janeiro, Brazil.

BIBLIOGRAPHY OF ION EXCHANGE SELECTIVITY

By

A. H. Truesdell, Dorothy Carroll and Marian Schnepfe

Menlo Park, California and Washington, D. C.

In recent years ion exchange has come to be appreciated as the most acessible of the many phenomena exhibiting selective differentiation between ions. Ion selectivity is known to occur in shallow and deep-seated geologic processes. Feldspars crystallizing from a magma undergo alkali ion exchange with the parent magma as the temperature decreases and the selectivity changes. Hydrothermal solutions exchange ions with the rocks they contact and a solution's composition at any point may reflect more its travel path than its original composition. Clay minerals and zeolites produced by weathering processes have exchange sites occupied by the available cations. Transport by erosional processes can carry these minerals into different environments where cations are released. Ion exchange of H^+ for Na^+ during weathering natural glasses seems to be a major source of saline ground waters and possibly of mineralizing solutions. The role of natural ion exchanging membranes in modifying the composition pressure and salinity of ground waters has been increasingly recognized. Thus ion exchange has a pervasive influence on geologic processes.

Ion exchange is also known to play a part in the life processes of animals and plants. The seat of this selectivity in life processes is the unit membrane which separates the internal milieu of the cell from the external solutions. In a resting state the intracellular fluid is rich in potassium ions and has very few sodium ions. These conditions are reversed in the fluid outside the cell. The cell membrane must thus selectively pass potassium into, and sodium out of, the cell. The transmittal of nerve impulses is effected by changing the selectivity of the cell membrane and allowing the flow of potassium and sodium ions to be reversed.

Selective differentiation between sodium and potassium ions also occurs in ion exchanges. If ultramarine and chabazite are both immersed in a solution containing equal quantities of Na^+ and K^+ ions the ultramarine will absorb more Na^+ than K^+ ions, and the chabazite will absorb more K^+ than Na^+. This analogy between ion exchangers and cell membranes led Eisenman (1961a) to formulate his theories on the atomic basis of ion specificity. These theories have stimulated research on ion exchange and ion-exchange membrane electrodes.

The older studies of selectivity were limited to sulfonate resin ion exchangers and synthetic aluminosilicate gels for which a single selectivity order obtains

$$Cs^+ > Rb^+ > K^+ > Na^+ > Li \text{ and } Ba^{++} > Sr^{++} > Ca^{++} > Mg^{++}$$

(Walton, 1949). This "lyotropic" sequence was explained by assuming that the ions remained hydrated in the exchanger and that the negative sites of the exchanger exerted an attraction on the ions inversely with their <u>hydrated</u> ionic radius. In developing this theory, experimental results showing that certain ion exchangers gave sequences differing from or even reversed to the "lyotropic" series (e.g., ultramarine, Barrer and Raitt, 1954) were ignored. These experiments cast doubt on the ion exchange theories which concentrated on the properties of the ions alone and neglected differences in the structure of the exchangers. In 1961, Eisenman (1961a) published a simple theory of ion exchange selectivity which has explained the "anomalous" exchange sequences observed by others as well as a large amount of new data on the ion exchange behavior of Na aluminosilicate glasses (Eisenman, Rudin, and Casby, 1957).

Eisenman's theory considers ion exchange as a competition for cations between the negatively charged sites on the exchanger and the water dipoles in the aqueous solution. Since the properties of the cations and the aqueous solution are the same for exchange on different exchangers, the variation in selectivity must depend solely on the properties of the exchanger. Eisenman considered only coulombic interactions between the cations and the exchange sites and he introduced the idea of an effective anionic radius to represent differences of electronegativity of the sites. The effective anionic radius (r^-) is the radius of a hypothetical spherical ion with a charge of minus one, having the same electronegativity as the exchange site. When combined with experimental cation hydration energies, this abstraction allowed the calculation of ion exchange energies (Fig. 1). By varying r^-, a series of eleven exchange orders were generated for the five alkali cations (instead of $5! = 125$). At large values of r^- the differences of ΔU_{diss} (Fig. 1) are smaller than the differences of ΔU_{hyd} and the lyotropic series is obtained. At small values of r^- the energy differences of ΔU_{diss} dominate the differences in ΔU_{hyd} and the reversed sequence occurs. At intermediate values of r^- intermediate sequences are generated.

The selectivity of ion-exchange materials is also of great current interest in the search for less expensive methods of desalting water, and in the need for purification of fissionable materials for power reactors. The need in reactor technology for ion exchangers which will withstand high temperatures and high radioactive flux densities has led to discoveries of highly selective inorganic ion-exchange materials. The need for the disposal of radioactive waste products has produced studies of the selectivity for cesium and strontium of natural soils and rocks.

The selective adsorption and accumulation of cations by biological materials and by synthetic and natural ion exchangers is considered by the compilers of this bibliography to be among the most important processes that have shaped man's nature and environment. This bibliography attempts to emphasize selectivity and the mechanisms by which it originates; it lists all the pertinent papers published in this field up to and including 1960; some of the most important later publications are also given.

BIBLIOGRAPHY

Adamson, A. W., and Grossman, J. J., 1949, A kinetic mechanism for ion-exchange: Jour. Chem. Physics, v. 17, p. 1002-1003.

Adhikari, M., 1961, Clay membrane electrode as a tool for cationic activity measurement in soln.: Jour. Indian Chem. Soc., v. 38, no. 10, p. 817-822.

_____1962, Free-energy change of exchange reactions: Jour. Indian Chem. Soc., v. 39, p. 175-179.

Ahrens, L. H., 1952, The use of ionization potentials, pt. 2, Ionic radii of the elements: Geochim. et Cosmochim. Acta, v. 2, p. 155-169.

Ahrland, Sten; Grenthe, Ingmar, and Noren, Bertil, 1960, Ion-exchange properties of silica gel. I. The sorption of Na^{+}, Ca^{++}, Ba^{++}, UO_2^{++}, Gd^{+++}, Zr(IV) + Nb, U(IV), and PU(IV): Acta Chem. Scand., v. 14, p. 1059-1076.

Albareda-Herrera, J. M., Ferrandis, V. A., and Fernandez, T., 1953, Effect of the mineralogical composition of clays and of the exchangeable composition of cations on the catalytic oxidation of ethyl alcohol in the vapor phase, II.: Anales Edafol. y Fisiol. Vegetal (Madrid) v. 12, p. 281-308.

Albareda-Herrera, J. M., Ferrandez, V. H., and Pilar Sanchez Conde, Maria del, 1958, Interaction of the calcium/potassium ratio in the absorption of these elements by the wheat plant. III. The influence of this ratio on the assimilation of various elements: Anales Edafol. y Fisiol. Vegetal (Madrid) v. 17, p. 893-934.

Alberti, Giulio, 1961, The selective permeability of an inorganic ion-exchange membrane made from zirconium phosphate (zirconyl phosphate) supported on glass-wool fiber: Atti. Accad. Nazl. Lincei Rendu, Classe Sci. Fis. Nat., v. 31, p. 427-428.

Aleksandrova, L. S., Yelovich, S. U., Chmutov, K. V., 1959, Dinamika sorbtsii ionov na kationitakh raznykh tipov. I. [Dynamics of the sorption of ions on various types of cation exchangers]: Zhur. fizicheskoy khimii, v. 33, no. 3, p. 627-635 (USSR).

Aleshin, S. N., and Boldyrev, 1962, Determining sorbed sodium by means of the sodium-glass electrode: Pochvovedenie 1962, no. 1, p. 114-121.

Allen, F., 1952, Chemistry of acid exchange processes in soils: Zeitschr-Pflanzenernähr. Düng. u. Bodenk., v. 56, p. 72-75.

Allison, F. E., Doetsch, J. H., and Roller, E. M., 1953, Availability of fixed ammonium in soils containing different clay minerals: Soil Sci., v. 75, p. 373-381.

Allison, F. E., Kefauver, M., and Roller, E. M., 1953, Ammonium fixation in soils: Soil Sci. Soc. America Proc., v. 17, p. 107-110.

Allison, F. E., Roller, E. M., and Doetsch, J. H., 1953, Ammonium fixation and availability in vermiculite: Soil Sci., v. 75, p. 137-180.

Ames, L. L., 1960, Anion replacement reactions for the removal of strontium from aqueous solutions: U.S. Atomic Energy Comm. HW-66, 383, 30 p.

_____1962, Kinetics of cesium reactions with some inorganic cation exchange materials: Am. Mineralogist, v. 47, p. 1067-1078.

_____1962, Effect of base cation on the cesium kinetics of clinoptilolite: Am. Mineralogist, v. 47, p. 1310-1316.

_____1963, Mass action relations of some zeolites in the region of high competing cation concentrations: Am. Mineralogist, v. 48, p. 868-882.

Amphlett, C. B., 1964, Inorganic ion exchangers: Amsterdam. Elsevier Pub. Co., 141 p.

Andelin, J., and Davidson, N., 1953, The adsorption of cupric and mercuric ions by a weak-base anion-exchange resin: Am. Chem. Soc. Jour., v. 75, p. 5413-5415.

Andelman, J. B., 1960, Biionic Systems in Ion-Exchange Membranes. Univ. Microfilms (Ann Arbor, Mich.), L. C. Card no. Mic 60-3847,

Association of Official Agricultural Chemists, 1950, Official methods of analysis, 7th ed.: Washington, D. C., 910 p.

Augood, D. R., 1958, Chemical exchange: Indus. Chemist, v. 34, p. 16-26, 181-190, 245-248, 435-441, 533-542.

Austerweil, G. V., 1962, Selectivity and ionophoresis in ion exchange: Acad. Sci. [Paris] Comptes, rendus, v. 254, p. 2558-2560.

Azizov, Kh. F., and Nabiev, M. N., 1963, Ion-exchange processes between the KU-2 cation exchanger in the H^+, K^+, Mg^{2+} forms and some electrolytes: Uzbeksk. Khim. Zh., v. 7, no. 3, p. 5-12.

Babcock, K. L., Davis, L. E., and Overstreet, Roy, 1951, Ionic activities in ion-exchange systems: Soil Sci., v. 72, p. 253-260.

Bacon, R. C., 1936, A study of the laws governing the cation exchange properties of a precipitated aluminum silicate: Jour. Phys. Chem., v. 40, p. 747-761.

Baetsle, L., 1963, Ion-exchange properties of zirconyl phosphates. III. Influence of temperature on tracer ion equilibriums: Jour. Inorganic Nuclear Chemistry, v. 25, p. 271-282.

Baetsle, L., and Pleamakers, J., 1961, Ion-exchange properties of zirconyl phosphates. I. Contribution to the structure of zirconyl phosphates: Jour. Inorganic Nuclear Chemistry, v. 21, p. 124-132.

Baker, J. H., and Wahlberg, J. S., Effect of sodium and calcium on strontium adsorption by albite, kaolinite, and montmorillonite.

Barber, S. A., and Marshall, C. E., 1951, Ionization of soils and soil colloids. II. Potassium-calcium relationships in montmorillonite group clays and in attapulgite: Soil Sci., v. 72, p. 373-385.

Barbier, G., and Duval, L., 1958, Exchange of cations present in very small quantities: Bull. Groupe Franc. Argiles, v. 10, no. 5, p. 41-43.

_____1958, Exchange of cations present in minute quantities as applied to the retention of radioactive strontium and cesium in soil: Ann. Inst. Natl. Recherche Agron., ser. A, Agron., v. 9, p. 695-712.

Barrer, R. M., 1948, Syntheses and reactions of mordenite: Chem. Soc. (London) Jour., p. 2158-2163.

_____1949, Ion exchange in crystals: Soc. Chemique de France, p. D71-D83.

_____1958, Crystalline ion-exchangers: Chem. Soc. (London) Proc., April, p. 99-112.

_____1962, Features of ion-exchange in crystals: Chem. Indus. (London) p. 1258-1266.

Barrer, R. M., Bartholomew, R. F., and Rees, L. V. C., 1963, Ion-exchange in porous crystals. II. The relation between self- and exchange-diffusion coefficients: Jour. Phys. Chem. Solids, v. 24, p. 309-317.

Barrer, R. M., and Brook, D. W., 1953, Molecular diffusion in chabazite mordenite, and levynite: Faraday Soc., Trans., v. 49, p. 1049-1059.

Barrer, R. M., and Falconer, J. D., 1956, Ion-exchange in feldspathoids as a solid-state reaction: Royal Soc. (London) Proc. A, v. 236, p. 227-249.

Barrer, R. M., and Hinds, L., 1953, Ion-exchange in crystals of analcite and leucite: Chem. Soc (London) Jour., p. 1879-1888.

Barrer, R. M., and Mackenzie, N., 1954, Sorption by attapulgite. I. Availability of intracrystalline channels: Jour. Phys. Chem., v. 58, p. 560-568.

Barrer, R. M., and Reay, J. S. S., 1957, Sorption and intercalation by methyl-ammonium montmorillonites: Faraday Soc. Trans., v. 53, p. 1253-1261.

Barrows, H. L., and Drosdoff, Matthew, 1958, A comparison of methods for determining the base-exchange capacity of some soils of the lower Coastal Plain of the southeastern United States: Soil Sci. Soc. America Proc., v. 22, p. 119-122.

Barshad, Isaac, 1950, The effect of interlayer cations on the expansion of the mica type of crystal lattice: Am. Mineralogist, v. 35, p. 225-238.

_____1954a, Cation exchange in micaceous minerals. II. Replaceability of ammonium and potassium from vermiculite, biotite, and montmorillonite: Soil Science, v. 78, p. 57-76.

_____1954b, Vermiculite and its relation to biotite as revealed by base-exchange reactions, X-ray analysis, differential thermal curves, and water content: Am. Mineralogist, v. 35, p. 655-278.

Bartlett, R. J., 1958, Cationic Activities in Soil, Clay, and Solution Systems and Their Relation to Plant Uptake. Univ. Microfilms (Ann Arbor, Mich.), L. C. Card no. Mic 58-3403

Basty, W. M. du, 1963, Ion exchange on lamellar colloid (clay) suspensions: Acad. Sci. [Paris] Comptes rendus, v. 256, p. 927-930.

Basu, A. N., Seal, B. K., and Mukherjee, S. K., 1962, Selectivity coefficients of trace elements on a montmorillonite clay and humic acid system: Indian Chem. Soc. Jour, v. 39, no. 2, p. 71-78.

Baver, L. D., 1940, Soil physics: New York, John Wiley and Sons, Inc., 489 p.

_____1959, Cation exchange equilibria in soils: Soil Sci., v. 88, p. 32-35.

Beattie, I. R., and Davies, D. R., 1957, The inter-diffusion of two charged particles (with particular reference to ion exchange in zeolites). Philos. Mag., ser. 8, v. 2, p. 599-606.

Belinskaya, F. A., and Materove, E. A., 1957, Electrode properties of ion-exchange membranes: Vestnik Leningrad. Univ. v. 12, no. 16, ser. fiz. i. Khim. no. 3, p. 85-102.

Beljustin, A. A., 1963, Infra-red absorption spectra of the water, containing in surface layers of electrode glasses: Vestnik Leningrad. Univ. no. 4(1), p. 171.

Beljustin, A. A., and Shultz, M. M., 1963, The electrode behavior sodiumsilicate glasses, containing oxides of the elements of the principal subgroups of the 4th and 5th groups of the periodic System: Vestnik Leningrad. Univ. no. 4(1), p. 149.

Belloni, Jacqueline, 1959, Application of the Langmuir isotherm to mixed adsorption of lanthanids and hydrogenatoms: Acad. Sci. [Paris] Comptes rendus, v. 248, p. 1322-1325.

Bergsman, F., 1952, Selective membranes consisting of ion exchangers: Chem. Week blud, v. 48, p. 361-364.

Bersier, J., Bersier, P., Truebb, W., and Hibli, F., 1959, Membrane electrodes. Determination of the equivalence point by means of the membrane potential, pt. 1. Precipitation - titration of silver salts: Helv. Chim. Acta, v. 421, p. 56-60. (Germ)

Bhatnagar, R. P., 1962, Ion-exchange equilibriums. I. Exchange of univalent cations on resins of various types: Indian Chem. Soc. Jour., v. 39, no. 2, p. 79-83.

_____1962, Ion-exchange equilibriums. II. Exchange of univalent anions on amberlite IR-4B and amberlite IRA-410: Indian Chem. Soc. Jour., v. 39, p. 708-710.

Blackmon, P. D., 1958, Neutralization curves and the formulation of monovalent cation exchange properties of clay minerals: Am. Jour. Sci., v. 256, p. 733-743.

Blackmore, A. V., and Warentin, B. P., 1960, Swelling of calcium montmorillonite: Nature, v. 186, p. 823-824.

Blanchet, R., 1959, Pouvoir absorbant de divers constituents du soil a l'égard des ions phosphoriques et examen des réserves des terre: Comptes rendus Agrio. Fr., v. 45, p. 247-252.

Blaszkowska, Zofia, Wisniewski, Wojciech, and Techert, Andrzej, 1955, Selective sorption and swelling of cation exchangers: Roczniki Chem. v. 29, p. 921-925. (English summary).

Bloch, R., Kedem, O., and Vofsi, D., 1963, Ion specific polymer membrane: Nature, v. 199, (4895), p. 802-803.

Bobleter von, Dr. O., und Buchtela, K., 1963, Anionenaustauscher auf Holz-nzw. Cellulosebasis zur dekontamination von oberflachen und flussigkeiten: Atomkernenergie, v. 8, p. 415.

Bobrov, V. S., Shultz, M. M., 1963, The electrode properties of non-silicate glasses: Vestnik Leningrad. Univ. no. 4(1), p. 166.

Bockris, J. O'M., ed., 1960, Physical chemistry of ion exchange in modern aspects of electrochemistry No. 2: Washington, D. C., Butterworths Science Publishing.

Bogoyavlenskii, A. F., Belov, V. T., and Kozyrev, E. M., 1960, Investigation of the adsorption of the phosphate ion on an anode oxide film on aluminum by the method of labeled atoms: Izv. Vysshikh Uchebn Zavedenii, Khim. i Khim. Tekhnol, v. 3, no. 4, p. 616-619.

Bohnsack, G., 1962, Behavior of anion-exchange resins toward humic acids: Mitt. Ver. Grosskesselbesitzer no. 76, p. 53-58.

Bolt, G. H., 1955, Ion adsorption by clays: Soil Sci., v. 79, p. 267-276.

_____1961, Cations in relation to clay surfaces: Trans. Intern. Congr. Soil Sci., 7th Madison, Wis., 1960, v. 2, p. 321-327.

Bolt, G. H., and Peech, Michael, 1953, The applicationability of the Gouy theory to soil-water systems: Soil Sci. Soc. Am. Proc., v. 17, p. 210-213.

Bonner, O. D., 1957, Use of ion-exchange resins with nonaqueous and mixed solvents: Chem. Educ. Jour., v. 34, p. 174-177.

Bonner, O. D., and Overton, J. R., 1961, Effects of temperature on ion-exchange equilibria. Part 4. Comparison of enthalpy changes calculated from equilibrium measurements and calorimetrically measured values: Phys. Chem. Jour., v. 65, p. 1599-1602.

Jour. (Phys. Chemistry)

Borland, J. W., and Reitemeier, R. F., 1950, Kinetic exchange studies on clay with radioactive calcium: Soil Sci., v. 69, p. 251-259.

Bose, S. K., 1958, Calcium-sodium ion exchange equilibrium with the help of membrane electrodes: Indian Soc. Soil Sci. Jour., v. 6, p. 233-238.

_____1960, A Study of Ca-K ion-exchange equilibrium with the help of membrane electrodes: Indian Chem. Soc. Jour., v. 37, p. 465-472.

Bosmond, H., and Fripiat, J. J., 1958, Ion exchange capacity and density of charge on the surface of SiO_2-Al_2O_3 gels. Pedologie 8, p. 184-198.

Bott, G. H., 1955, Ion adsorption by clays: Soil Sci., v. 79, p. 267-276.

Bower, C. A., 1955, Determination of exchangeable magnesium in soils containing dolomite: Soil Sci. Soc. Am. Proc., v. 19, p. 40-42.

_____1961, Sodium electrode and its use for salinity investigations: Trans. Intern. Congr. Soil Sci., 7th Madison, Wis., 1960, v. 2, p. 16-21.

Bower, C. A., and Goertzen, J. O., 1958, Replacement of adsorbed sodium in soils by hydrolysis of calcium carbonate: Soil Sci. Soc. Am. Proc., v. 22, p. 33-37.

Bower, C. A., Reitemeir, R. F., and Fireman, Milton, 1952, Exchangeable cation analysis of saline and alkaline soils: Soil Sci., v. 73, p. 251-261.

Bower, C. A., and Truog, Emil, 1940, Base exchange capacity determination of soils and other materials, using colorimetric methods: Indus. Eng. Chem. Anal. ed., v. 12, p. 411-413.

Boyd, G. E., Schubert, J., and Adamson, A. W., 1947, The exchange adsorption of ions from aqueous solutions by organic zeolites. I. Ion-exchange equilibria: Am. Chem. Soc. Jour., v. 69, p. 2818-2829.

Bradley, W. F., 1940, The structural scheme of attapulgite: Am. Mineralogist, v. 25, p. 405-440.

____1945, Molecular associations between montmorillonite and some polyfunctional organic liquids: Am. Chem. Soc. Jour., v. 67, p. 975-981.

Bragg, W. L., 1937, The atomic structure of minerals: Ithaca, New York, Cornell University Press, 292 p.

Bragg, W. L., and Claringbull, G. C., Crystal structures of minerals: London, Bell Publishing Company.

Breault, E. A., 1963, Ion exchange resin separation of calcium and strontium: Assoc. Official Agr. Chemists Jour., v. 46 ('4), p. 675-676.

Brindley, G. W., 1954, Structural aspects of some thermal and chemical transformations of layer silicate minerals: Intern Sym. Reactivity of Solids: Göthenburg, Proc., pt. 1, p. 349-361.

Brindley, G. W., and MacEwan, D. M. C., 1953, Structural aspects of the mineralogy of clays and related silicates: in Green, A. T., and Stewart, G. H., eds., Ceramics--a symposium: British Ceramic Soc. Trans., Stoke-on-Trent, p. 15-59.

Brouwer, R., 1959, Diffusible and exchangeable rubidium ions in pea roots: Acta Botan. Neerl., v. 8, p. 68-76. (In English).

Brown, George, 1955, Report of the clay minerals sub-committee on nomenclature of clay minerals: Clay Minerals Bull., v. 2, p. 294-302.

Brown, George, and Norrish, Keith, 1952, Hydrous micas: Mineralog. Mag., v. 29, p. 929-932.

Brun, T. S., 1955, Ion-exchange membranes. I. Membrane potentials. Univ. i Bergen Arbok: Naturvitenskap. Rekke 1954, no. 15, p. 1-18. (In English).

Brun, T. S., and Engan, Sigmund, 1956, Ion-exchanger membranes. II. Bionic potentials in systems with univalent salts. Univ. i Bergen Arbok: Naturvitanskap. Rekke, no. 5, p. 1-16.

Bukata, S. W., 1930, Ion-exchange equilibria of synthetic type A zeolites: Dissertation Abs., v. 24, no. 114, p. 63-5871.

Carr, C. W., and Sollner, Karl, 1944, The structure of the collodion membrane and its electrical behavior. XI. The preparation and properties of "megapermselective" collorion membranes combining extreme ionic selectivity with high permeability: Jour. Gen. Physiol., v. 28, p. 119-130.

Carroll, Dorothy, 1959, Ion exchange in clays and other minerals: Geol. Soc. America Bull., v. 70, p. 749-780.

Carroll, Dorothy, and Starkey, H. C., 1960, Effect of sea water on clay minerals: 7th Natl. Clay Conf. Proc., Pergamon Press, London, no. 5, Earth Sciences ser., p. 80-101.

Cashen, G. H., 1961, Electric charges on clays: Chem. Ind. (London), v. 28, p. 1060.

Cerana, L. A., and Bielsa, L. B. de, 1959, Exchange by contact. I. Ca^{++}-Na^{++} exchange in polystyrene sulfonic resins. Rev. Fac. Ing. Quim. (Univ. Nac. Litoral, Santa Fe, Arg.) v. 28, p. 87-92.

Charreton, B., and Dupont, A. M., 1961, Separation of magnesium and calcium by displacement on a cation-exchange resin. Comptes rendus, v. 253, p. 664-666.

Chatterjee, A., 1960, Cation exchange between colloidal clays and resins in water and aqueous alcohol as a function of the concentration of the dispersed phase: Indian Chem. Soc. Jour., v. 27, p. 395-400.

Chaterjee, B., 1949, Clay-membrane electrodes for the measurement of cation activities in soil and clay suspensions: Indian Chem. Soc. Jour., Ind. and News ed., 12, p. 73-80.

Chaussidon, Jean, 1957, The potentials of ion-exchange resins: a method of measuring ionic activities: Comptes rendus, v. 244, p. 2798-2800

Chenebaux, M. J., 1960, Exchange reactions of alkali ions on granitic glasses: Obsidians and retinities: Comptes rendus, v. 250, p. 1046-1049.

Cherneva, E. P., Pashkov, A. G., Barabanov, S. R., and Tunitskii, N. N., 1959, Variation in selectivity for strong acidic monofunctional cation exchangers as a function of concentration of sulfonic acid groups and the degree of cross-linking in the exchanger: Issled. v Obl. Ionoobmen. Raspredelitel. Osad. Khromatogr., Acad. Nauk SSSR, Otd. Khim. Nauk, 1959, p. 70-75.

Cherneva, E. P., Barabanov, S. R., Bryukhanov, V. A., Pashkov, A. B., and Tunitskii, N. N., 1961, Changes in the selectivity of monofunctional sulfonated cation-exchange resins as a function of the concentration of the initial electrolyte solutions and the charges of the exchanging ions: Zh. Fiz. Khim., v. 35, p. 189-191.

Chernov, V. A., 1944, Potentiometric determinations of the activity of alkali and alkaline earth cations as determined by C. E. Marshall (1944): Pedology (USSR), 1944, no. 6, p. 294-297.

Chernov, V. A., and Kislitsyna, L. P., 1955, The mechanism of the exchange of adsorbed hydrogen ions by aluminium ions in soils: Pochvovedenie, no. 3, p. 7-16.

Chipanin, I. V., Anikin, A. F., Kogan, D. I., and Morgen, E. A., 1961, Sorption of certain ions on spodumene and beryl and their effect on sorption of a collector: Nauchn. Tr. Irkutsk. Nauchm. Issled. Inst. Redk. Metal., 1961, no. 10, v. 244-254.

Christ, C. L., and Truesdell, A. H., 1963, Cation exchange in clays interpreted by regular solution theory, [abs.]: Geol. Soc. America Spec. Paper 76, 32 p.

Chu, A. C., and Sherman, G. D., 1952, Differential fixation of phosphate by typical soils of the Hawaiian Great Soil groups: Univ. Hawaii Agr. Expt. Sta. Tech. Bull., v. 16, 20 p.

Chu, B., Whitney, D. C., and Diamond, R. M., 1962, Anion-exchange resin selectivities: Jour. Inorganic and Nuclear Chemistry, v. 24, p. 1405-1415.

Chu, T. d'-N, The prediction of selectivity of anions on resins: Cornell Univ.

Chuveleva, E. A., Chmutov, K. V., and Mazarov, P. O., 1962, Investigation of the ion exchange sorption of radio elements by soils. II. Study of the ion exchange equilibrium Ce-Ca on humic acid: Zh. Fiz. Khim., v. 36, no. 4, p. 830-832.

Cilley, W. A., 1963, The ion exchange properties of cerium (IV) phosphate. Univ. Microfilms (Ann Arbor, Mich.) L. C. Card no. 63-5739, Ciric, J., and Graydon, W. F., 1962, Ion-exchange membranes. IV. Univalent cation transfer rates: Jour. Phys. Chem, v. 66, p. 1549-1551.

Cloos, Paul, and Fripiat, J. J., 1960, The electrochemical behavior of membranes. II. Permselective membranes: ion-exchange membranes: Bull. Soc. Chim. France, 1960, p. 2105-2109.

Cole, C. V., and Jackson, M. L., 1951, Solubility equilibrium constant of dihydroxy aluminum dihydrogen phosphate relating to a mechanism of phosphate fixation in soils: Soil Sci. Soc. America Proc., v. 15, p. 84-89.

Coleman, N. T., 1952, A thermochemical approach to the study of ion-exchange: Soil Sci., v. 74, p. 115-125.

Coleman, N. T., and Harward, M. E., 1953, The heats of neutralization of acid clays and cation-exchange resins: Am. Chem. Soc. Jour., v. 75, p. 6045-6046.

Coleman, N. T., and Jakoby, W. J., 1954, Ion activities and osmotic pressures in clay-water systems: Soil Sci. Soc. America Proc., v. 18, p. 19-21.

Collander, Runar, 1941, Selective absorption of cations by higher plants: Plant Physiol., v. 16, p. 691-720.

_____1942, Diffusion and "adenoid" activity in the ionic uptake of plant cells: Naturwissenschaften, v. 30, p. 484-489.

Conway, E. J., 1954, Some aspects of ion transport through membranes: Symposia Soc. Exptl. Biol., v. 8, Active transport and secretion, p. 297-324.

Cook, M. A., Cutler, I. B., Hill, G. R., and Wadsworth, M. E., 1953, A mechanism of cation and anion exchange capacity: Jour. Phys. Chemistry, v. 57, p. 1.

Correns, C. W., 1924, Adsorptionsversuche mit sehr verdünnten Kupfer- und Blei-lösungen und ihre Bedeutung für die Erzlagerstattenkunde: Kolloid Zeits., v. 34, p. 341-349.

_____1951, Nomenclature of clay minerals, report of special meeting held at the Internat. Soil Sci. Cong., Amsterdam, 1950: Clay Minerals Bull., v. 1, p. 195.

Crabtree, J. M., and Glueckauf, E., 1963, Structural analysis of ion semipermeable membranes by co-ion uptake and diffusion studies: Trans. Faraday Soc., v. 59, no. 491, p. 2639-2654.

Cruickshank, E. H., and Meares, 1958, Thermodynamics of cation exchanger. III. Thermodynamic properties of resins containing a mixture of cations: Faraday Soc. Trans., v. 54, p. 174-185.

Dalton, R. W., McClanahan, J. L., and Maatman, R. W., 1962, Partial exclusion of electrolytes from the pores of silica gel: Jour. Colloid. Sci., v. 17, p. 207-219.

Damour, A. A., and Salvetat, D., 1847, Et analysis sur un hydrosilicate d'alumine trouve a Montmorrilon (Vienne): Ann. Chem. Phys., 3d ser., v. 21, p. 376-383.

Danielli, J. F., 1944, Concentration of ions and drugs at surfaces of cells and protein molecules: Jour. Exp. Biol., v. 20, p. 167-176.

Danielli, J. F., 1954, Present position in the field of facilitated diffusion and selective active transport: Recent Develop. Cell Physiol., Proc., 7th Symposium Colston Research Soc. Univ. Bristol, p. 1-14.

Darab, Katalin, and Schoenfeld, T., 1961, The adsorption of cesium ion on clay minerals: Agrokem. Talajtan, v. 10, p. 539-546.

Davidson, D. T., and Sheeler, J. B., 1953, Cation exchange capacity of the clay fraction of loess in southwest Iowa: Iowa Acad. Sci. Proc., v. 60, p. 354-361.

Davies, C. W., and Yoeman, G. D., 1953, Swelling equilibria with some cation exchange resins: Trans. Faraday Soc., v. 49, p. 968-974.

_____1953, Cation exchange equilibria: Faraday Soc. Trans., v. 49, p. 975-980.

Davies, J. T., 1950, The mechanism of diffusion of ions across a phase boundary and through cell walls: Jour. Phys. Chemistry, v. 54, p. 185-203.

_____1945a, Theories of base-exchange equilibrium: Soil Sci., v. 59, p. 379-395.

_____1945b, Simple kinetic theory of ionic exchange for ions of unequal charge: Jour. Phys. Chemistry, v. 49, p. 473-479.

_____1950a, Ionic exchange and statistical thermodynamics. I. Equilibria in simple exchange systems: Jour. Colloid Sci., v. 5, p. 71-79.

_____1950b, Ionic exchange and statistical thermodynamics. II. Equilibria in irregular systems: Jour. Colloid Sci., v. 5, p. 107-113.

Davydov, A. T., and Levitskii, I. Ya., 1950, Dependence of the amount of absorbed cation on the weight of the absorbent: Jour. Obshch. Khim., v. 20, p. 1776-1779.

Davydov, A. T., and Skoblionok, R. F., 1953, Exchange adsorption in mixed media. I. Quantitative rules of cation exchange in mixed media: Nauchn. Issled. Inst. Truda., v. 10, p. 195-203.

_____1956, The exchange of absorbed cations from mixed media on volchmskoite: Zh. Obshch. Khim., v. 26, p. 350-355.

_____1958, Effects of the medium on ion-exchange adsorption. The relation of the exchange constant to the dielectric constant of the solvent: Zhur. Fiz. Khim., v. 32, p. 1703-1710.

Davydov, A. T., Ponirovskaya, L. I., and Skoblionok, R. F., 1960a, Absorption of organic cations and anions by an ion-exchanger. Khromatog., ee Teoriya i Primenenie: Akad. Nauk USSR, Tr. Vses. Soveshch. Moscow, 1958, p. 116-121.

Davydov, A. T., and Skoblionok, R. F., 1960b, Dependence of exchange absorption on the cation-exchanger "KU-1" on the dielectric constant of the solvent. Khromatog., ee Teoriya i Primenenie: Akad. Nauk USSR, Tr. Vses. Soveshch. Moscow, 1958, p. 128-135.

Davydov, A. T., and Tolmacheva, Yu. A., 1961a, Ion-exchange on anion exchangers. III. Kinetics of exchange of sulfate ions on halide ions. Uch. Zap. Khar'Kovsk. Univ., v. 110, Tr. Khim. Fak. I Nauchn-Issled. Inst. Khim., Khar'Kovsk. Gos. Univ., v. 76, Tr. Khim. Fak. I Nauchn-Issled. Inst. Khim., 1956, p. 19-22, 23-26.

Davydov, A. T., and Skoblionok, R. F., 1961b, Use of analytical concentrations in exchange absorption. Uch. Zap. Khar'kovsk. Univ. v. 10, Tr. Khim. Fak. i Nauchn-Issled. Inst. Khim. Khar'kovsk. Gos. Univ. v. 17, p. 155-160.

Davydov, A. T., and Lisovina, G. M., 1962, Mechanism of exchange sorption of ions of salts and acids by weak basic anion-exchange resins: Zhur. Fiz. Khim., v. 36, p. 1993-1998.

Dean, L. A., and Rubins, E. J., 1947, Anion exchange in soils: Soil Sci., v. 63, p. 377-406.

Denel, H., and Hutschneker, K., 1954, Selectivity of ion exchangers. Potassium Symposium, Ann. Meeting Board Tech. Advisers Intern. Potash. Inst., Zurich, 1954, p. 41-70. (English summary).

Denisov, P. V., 1959, Rose of cation exchange in the genesis of the salt composition of weakly mineralized thermal waters. Uchenye Zap. Krasnodarsk, Gosudarst: Pedagog. Inst. 1959, no. 24, p. 281-285.

DiBenedetto, A. T., and Lightfoot, E. N., 1958, Ion fractionation by permselective membranes. Factors affecting relative transfer of glycine and chloride ions. Ind. Eng. Chem., v. 50, p. 691-696.

______1962, The separation of ions with permselective membranes. A.I.Ch.E. Jour., v. 8, p. 79-86.

Dickel, G., 1958, Selectivity of ion exchangers. Chem. Tech. (Berlin) v. 10, p. 449-453.

______1960, Thermodynamic treatment of the ion-exchange equilibrium according to the Gibbs-Donnan-Guggenheim membrane model: Zh. Fiz. Chim. (Frankfurt) v. 25, p. 233-252.

Dietzel, A., and Schmidt, O., 1954, Acid-alkali titration curves of clay suspensions: Deut. Keramischen Gesell. Ber., v. 31, p. 77-79.

Dima, M., and Scondac, I., 1962, Theoretical connection between exchange capacity of ion exchangers and the number and type of structural units: Acad. Rep. Populare Filiala Iasi, Studii Cercetari Stiint. Chim., v. 1, no. 2, p. 191-203.

Dodd, C. G., and Satyabrata, Ray, 1960, Semiquinone cation adsorption on montmorillonite as a function of surface acidity: 8th Natl. clays-clay-minerals Conf. Proc., Pergamon Press, London, Earth Science ser., no. 9, p. 237-251.

Dranoff, J. S., 1961, Ion exchange in ternary systems. Univ. Microfilms (Ann Arbor, Mich.), L. C. Card no. Mic 61-1985, 297 p.

Dranoff, J. S., and Lapidus, Leon, 1961, Ion exchange in ternary systems: Ind. Eng. Chem., v. 53, no. 1, p. 71-6.

Dray, Sheldon, 1956, A quantitative theory of dynamic polyionic potentials across membranes of ideal ionic selectivity in terms of transference numbers and its experimental test with permselective membranes. Univ. Microfilms (Ann Arbor, Mich.), Publ. no. 15,974, 229 p.

Duncan, B. C., 1962, Ion transport across membranes. I. Definitions of membrane electromotive forces and of flows of electrolytic solutes: Jour. Res. Natl. Bur. Std., 66A, p. 83-96.

Dyal, R. S., and Hendricks, S. B., 1952, Formation of mexed layer minerals by potassium fixation in montmorillonite: Soil Sci. Soc. America Proc., v. 16, p. 45-48.

Edelman, C. H., 1936, Relation between the crystal structure of minerals and their base-exchange capacity: Internat. Soil Sci. Cong. Trans., Oxford, v. 3, p. 97-99.

Edelman, I., 1961, Transport through biological membrane: Ann. Rev. Physiol. v. 23, p. 37-

Ehrmann, P., Billy, M. de, and Zarzycki, Y., 1941, Migration of H^+ ions into glasses: Verres et Refractaires, v. 15, p. 63-72

Eirish, M. V., 1960, Adsorption of cations and water in bentonite clays. III. Clay colloidal electrolyte: Izv. Vysshykh Uchebn. Zavedenii, Khim. i Khim. Tekhnolo., v. 3, p. 1022-1026.

Eisenman, George, 1961, On the elementary atomic origin of equilibrium ion specificity in: Symposium on membrane transport and metabolism, Kleuzeller, A., and Kotyk, A., eds., Academic Press, Inc., N.Y.C.

_____1962, Cation-selective glass electrodes and their mode of operation: Biophys. Jour., v. 2, p. 259-323.

_____1963, The influence of Na, K, Li, Rb, and Cs, on cellular potentials and related phenomena: Bol. Inst. Estud. Med. Biol., v. 21, p. 155-183.

Eisenman, George, Rudin, D. O., and Casby, J. U., 1957, Glass electrode for measuring sodium ion: Science, v. 126, p. 831-834.

Elgabaly, M. M., 1950, Mechanism of zinc fixation by colloidal clays: Soil Sci., v. 69, p. 167-173.

Eliezer, I., and Marcus, Y., 1963, The anion exchange of metal complexes. XI. Application of the constant ionic medium method to the mercury halide system: Jour. Inorganic Nuclear Chemistry, v. 25, no. 11 p. 1465-70

Elovin, S. Yu, and Larionov, O. G., Application of law of mass action to adsorption equilibrium: Izv. Akad. Nauk SSSR, Otd. Khim. Nauk, 1962, p. 531-533.

Emerson, W. W., 1957, Organo-clay complexes: Nature, v. 180, p. 48-49.

Eppley, R. W., 1958, Potassium dependent sodium extrusion by cells of Porphyra perforata, a marine red alga: Jour. Gen. Physiol., v. 42, p. 281-288.

Epstein, Emanuel, 1956, Mineral nutrition of plants; mechanism of uptake and transport: Ann. Rev. Plant Physiol., v. 7, p. 1-24.

_____1961, Selective ion transport in plants and its genetic control: Natl. Acad. Sci.-Natl. Research Council, v. 942, p. 284-298.

Eriksson, Erik, 1949, Ionic diffusion through membranes: Kgl. Lantbruks-Hogskol. Ann., v. 16, p. 420-440.

_____1952, Cation exchange equilibria of clay minerals: Soil Sci., v. 74, p. 103-113.

Ermolenko, N. F., and Shirinskaya, L. P., 1962, Selective exchange on a molecular sieve of the NaA type: Zhur. Fiz. Khim., v. 36, p. 2432-2435.

_____1962, Investigation of cation exchange of cations of different valency on clays: Izv. Vysshikh Uchebn. Zabedenii, Khim. i Khim. Tekhnol., v. 5, p 468-473.

Ermolenko, N. F., Shirinskaya, L. P., and Zaretskii, M. V., 1963, Cation-exchange reactions of alkaline earth metals on a synthetic Na A-type zeolite: Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz.--, Tekhn, Navuk, 1963, no. 2, p. 111-114 (in Russian).

Eugster, Hans, 1955, The cesium-potassium equilibrium in the system sanadine-water: Carnegie Inst. Washington Yearbook, v. 54, p. 112-113.

Faucher, J. A., and Thomas, N. C., 1954, Adsorption studies on clay minerals. IV. The system montmorillonite-cesium-potassium: Jour. Chem. Physics., v. 22, p 258-261.

Faust, G. T., and Murata, K. J., 1953, Stevensite, redefined as a member of the montmorillonite group: Am. Mineralogist, v. 38, p. 973-987.

Fedoseeva, O. P., and Tunitskii, N. N., 1960, Ion-exchange kinetics in resins and membranes: Khromatogr., ee Teoriya i Primenenie, Akad. Nauk SSSR. Tr. Vses. Soveschch. Moscow, 1958, p. 150-156.

Feitelson, Jehuda, 1962, Electrostatic interactions between simple ions and highly swollen polyelectrolyte gels. Selectivity in the alkali ion series: Jour. Phys. Chem., v. 66, p. 1295-1298.

Ferrier, P. J. J. de, 1952, Argiles et cations: Ann. Inst. Natl. Rech. Ag., Ser. A, v. 3, no. 5, p. 819-828.

Fischbeck, K., and Messmer, E., 1953, Reactivity and titration of clay minerals: Zeit. Anorg. u Allg. Chemie., v. 274, p. 1-10.

Fischer, R. B., and Babcock, R. F., 1958, Electrodes consisting of membranes of precipitates: Anal. Chemistry, v. 30, p. 1732-1736.

Fischer, R. B., and Yates, M. L., 1960, Inorganic membrane electrodes: Indiana Acad. Sci. Proc., v. 69, p. 136-139.

Flett, D. S., 1963, A selectivity reversal in solvent extraction: Nature, v. 200, no. 4905, p. 465.

Follenius, Marguerite, and Platzer, Roger, 1957, Study of ion exchangers by interferometry: Comptes rendus, v. 244, p. 2603-2605.

Forslind, E., 1952, The clay-water system. II. Water adsorption and cation-exchange in montmorillonite: Acta Polytech., no. 115, Chem. Met. Ser. 3, no. 5, p. 3-12.

Foster, M. D., 1951, The importance of exchangeable magnesium and cation-exchange in the study of montmorillonitic clays: Am. Mineralogist, v. 36, p. 717-730.

_____1953, The determination of free silica and free alumina in montmorillonites: Geochim. et Cosmochim. Acta, v. 3, p. 143-154.

_____1956, Correlation of diocthedral potassium micas on the basis of their charge relations: U.S. Geol. Survey Bull., v. 1036-D, p. 57-67.

Freeman, D. H., 1961, Thermodynamics of binary ion-exchange systems: Jour. Chem. Physics, v. 35, p. 189-191.

Fried, Maurice, and Noggle, J. C., 1958, Multiple site uptake of individual cations by roots as affected by hydrogen ion: Plant Physiol., v. 33, p. 139-144.

Friedman, S. M., and Jamieson, J. D., 1959, Sodium and potassium-sensitive glass electrodes for biological use: Science, v. 130, p. 1252-1254.

Fripiat, J. J., and Gastuche, M. C., 1952, Etude physico-chimique des surfaces des argiles: Inst. Natl. Etude Agr. Congo Belge (INEAC) Ser. Sci. no. 54, 60 p.

Frysinger, G. R., 1962, Cesium-sodium ion exchange on clinoptilolite: Nature, v. 194, p. 351-353.

Frysinger, G. R., and Thomas, H. C., 1960, Cs-Na ion exchange on clinoptilolite: U.S. Atomic Energy Comm. TID-7613, v. 2, p. 675-690.

Gaertner, K., 1963, Thermodynamics of exchange adsorption. I. Experimental determination of the thermodynamic standard functions for the exchange process on strongly basic anion exchangers: A. Physik. Chem. (Leipzig), v. 223(1/2), p. 132-140.

Gaines, G. L., Jr., 1957, The ion exchange properties of muscovite mica: Jour. Chem. Physics, v. 61, p. 1408-1413.

Gaines, G. L., and Thomas, H. C., 1955, Adsorption studies on clay minerals, V. Montmorillonite, Cs-Sr at several temperatures: Jour. Chem. Physics v. 23, 2322-2326.

Ganguly, A. K., 1949, Reactivity of exchange spots of silicate minerals: Sci. and Cult. (India), v. 14, p. 341-342.

_____1951, Base-exchange capacity of silica and silicate minerals: Jour. Phys. Colloid Chem., v. 55, p. 1417-1428.

Ganguly, A. K., and Mukherjee, S. K., 1951, The cation exchange behavior of heterionic and homoionic clays of silicate minerals: Jour. Phys. Colloid Chem., v. 55, p. 1429-1446.

Gapon, E. N., 1933, Theory of exchange adsorption in soils: Jour. Gen. Chem., USSR., v. 3, p. 144-158.

_____1943, Dependence of the adsorption capacity upon the concentration of H and metallic cations: Jour. Gen. Chem., USSR., v. 13, p. 382-390.

_____1946, Ion exchange between solid and liquid phases III: Jour. Physical Chem., USSR., v. 20, p. 297-302.

Garrels, R. M., and Christ, C. L., 1956, Application of cation exchange reactions to the beidellite of the Putnam silt loam soil. Am. Jour. Sci., v. 254, p. 372-379.

Garrels, R. M., Sato, M., Thompson, M. E., and Truesdell, A. H., 1962, Glass electrodes sensitive to bivalent cations: Science, v. 135, p. 1045-1048.

Gieseking, J. E., and Jenny, Hans, 1936, Behavior of polyvalent cations in base exchange: Soil Sci., v. 42, p. 273-280.

Girod, J., and Lacrois, J., 1960, Influence de l' des mouvements de l'aluminum dans un melage d'argiles: Acad. Sci. [Paris] Compte rendu, v. 250, p. 4182-4183.

Gladel, Y. L., 1958, Ion exchange: Rev. Inst. Franc. Petrole Ann. Combust. Liquides, v. 13, p. 177-193.

Goates, J. R., and Anderson, K. H., 1955, Acidic properties of clay minerals: Soil Sci., v. 80, p. 19-25.

Goldberg, Irving, and Klein, Alexander, 1952, Some effects of treating expansive clays with calcium hydroxide: Am. Soc. Testing and Materials Spec. Tech. Pub., no. 142, p. 53-66.

Goldberg, N. A., and Kucheryavyi, V. I., 1961, Modeling of chemical absorption processes: Jour. Appl. Chem. USSR, v. 34, no. 4.

Golden, L. B., Gammon, N., and Thomas, R. P. A., 1943, A comparison of methods of determining the exchangeable cations and the exchange capacity of Maryland soils: Soil Sci. Soc. America Proc., v. 7, p. 154-161.

Goldschmidt, V. M., 1954, Geochemistry: Oxford, Clarendon Press, 730 p.

Gorbacheva, N. A., 1960, Kinetics of ion exchange: Tr. Leningr. Khim.-Farmatsevt. Inst., 1960, no. 11, p. 132-139.

Goremykin, V. E., 1959, Influence of calcium and magnesium ions on the sodium function of the glass electrode: Gidrokhim. Materialy, v. 29, p. 205-210.

Goremykin, V. E., and Kryukov, P. A., 1957, Potentiometric method of determining sodium ions by means of a glass electrode with a sodium function: Izv. Akad. Nauk SSSR, Otd, Khim. Nauk 1957, p. 1387-1389.

Gorshkiv, V. I., Panchenkov, G. M., and Ivanova, T. V., 1962, Kinetics of ion-exchange of alkali metals on sulfonated resin KU-2 in water and in 60 pct. methanol: Zh. Fiz. Khim., v. 36, p. 1690-1694.

Govindan, K. P., and Krishnaswamy, N., 1958, Studies on the cation-exchange resin from cashew nut shell liquid. II. Cation-exchange equilibrium: Jour. Sci. Indian Res., v. 17B, p. 416-419.

Graf-Petersen, P., 1956, On cation exchange capacity determinations using the radiometric method with Ca^{45}: Medd. Dansk. Geol. Foren., Bd. 13, H.3, p. 153-157.

Gregor, H. P., 1948, A general thermodynamic theory of ion-exchange processes: Am. Chem. Soc. Jour., v. 70, p. 1293.

______1949, A general thermodynamic theory of ion-exchange processes: Polytech. Inst. Brooklyn, Contract N6-ORN-263, IO.4.

______1951, Ion-pair formation in ion-exchange systems: Am. Chem. Soc. Jour., v. 73, p. 3537-3538.

Gregor, H. P., and Bregman, J. I., 1951, Selectivity coefficients of various cation exchangers toward univalent cations: Jour. Colloid Sci., v. 6, p. 323-347.

Gregor, H. P., and Schonhorn, Harold, 1957, Multilayer membrane electrodes: Am. Chem. Soc. Jour., v. 79, p. 1507-1508.

Gregor, H. P., and Schonhorn, Harold, 1959, Multilayer membrane electrodes. II. Preparation and use in double concentration cells: Am. Chem. Soc. Jour., v. 81, p. 3911-3915.

Gregor, H. P., and Sollner, Karl, 1946, Improved methods of preparation of "permselective" collodion membrane combining extreme ionic selectivity with high permeability: Jour. Phys. Chemistry, v. 50, p. 53-70.

Griessbach, R., 1954, Selective action of ion exchangers: Angew. Chem., v. 66, p. 17-27.

_____1955, Selectivity and specificity of ion exchangers: Angew. Chem., v. 67, p. 606-613.

Grim, R. E., 1951, Relation of frost action to the clay mineral composition of soil materials: Highway Res. Board Spec. Rept. no. 2, p. 167-172.

_____1952, Ion-exchange in relation to some properties of soil-water systems: Am. Soc. Testing Mater. Spec. Tech. Publ., no. 142, p. 3-8.

_____1953, Clay mineralogy: New York, McGraw Hill, Inc., ch. 7, 384 p.

Gromov, V. V., 1960, Desorption of trace amounts of strontium and cesium from montmorillonite and kaolinite: Zh. Fiz. Khim., v. 34, p. 1357-1363.

Guedes de Carvalho, R. A., 1960, The influence of water and acid concentration on the chromatographic behavior of inorganic ions: Jour. Chromatography, v. 4, p. 353-368.

Gupta, S. L., 1958, Mechanism of ion adsorption and ion exchange: Sci. and Cult., v. 23, p 366-369.

Hallsworth, E. G., 1954, Nomenclature of ion-exchange phenomena: Soils and Fertilizers, v. 17, no. 1, p. 1-3.

Hanna, W. J., and Reed, J. F. A., 1948, A comparison of ammonium acetate and buffered barium chloride methods for determining cation-exchange properties of limed soils: Soil Sci., v. 66, p. 447-458.

Hanshaw, B. B., 1962, Electrochemical determination of cation-exchange constants for compacted clays: U.S. Geol. Survey Spec. Paper 73, p. 166.

Hanss, M., Heaulme, M. de, and Morin, P., 1963, Utilization d'une electrode de verre pour le dosage de l'ion sodium en solution: Bull. Soc. Chim., France, no. 11, p. 2658.

Harati, I., 1956, Ion exchange: Rev. Chim. (Bucharest) v. 7, p. 343-348.

Harward, M. E., and Coleman, N. T., 1952, Ion-exchange equilibria in the presence of small amounts of electrolyte: Soil Sci. Soc. America Proc., v. 17, p. 339-342.

Harward, M. E., and Mehlich, A., 1953, Factors affecting distribution of cations in clay-electrolyte systems: Soil Sci. Soc. America Proc. (1952), v. 17, p. 227-230.

Haseman, J. F., Brown, E. H., and Whitt, C. D., 1950, Some reactions of phosphate with clays and hydrous oxides of iron and aluminum: Soil Sci., v. 70, p. 357-371.

Haseman, J. F., Lehr, J. R., and Smith, J. P., 1951, Mineralogical character of some iron and aluminum phosphates containing potassium and ammonium: Soil Sci. Soc. America Proc., v. 15, p. 76-84.

Hathaway, J. C., and Carroll, Dorothy, 1954, Distribution of clay minerals and ion-exchange capacities in some sedimentary materials: in Proceedings 2d Natl. Clay Conf: Natl. Acad. Sci. Natl. Research Council Pub., no. 327, p. 264-276.

Hattori, T, Kawaguchi, K., and Furni, K., 1959, Cation exchange capacity of coarse sand, fine sand, and silt fractions of soils: Jour. Sci. soil, Tokyo, v. 30, p. 333-336.

Hauser, E. A., 1941, Colloid chemistry in ceramics: Am. Ceramic Soc. Jour., v. 24, p. 179-187.

Hauth, W. E., and Davidson, D. T., 1952, Clay fraction in engineering soils. I. Identification by thermal analysis; II. Particle size distribution and cation exchange capacity: Iowa Eng. Conf. Sta. Eng. Rept., no. 10, p. 449-464.

Hechter, O. M., Polleri, A., Lester, G., and Gregor, H. P., 1959, Model for cellular cation discrimination: Am. Chem. Soc. Jour., v. 81, p. 3798-3799.

Heitner-Wirguin, Carla, 1960, A comparative study of ion-exchange equilibriums in triphosphate and copper triphosphate solutions: Bull. Res. Council Israel 9A, p. 37-42.

Heitner-Wirguin, Carla, and Markovits, G., 1963, Kinetics of ion exchange in the chelating resin bio-chelex 100. I. The exchange of the alkaline earth ions. Jour. Phys. Chemistry, V. 67, no. 11, p. 2263-2266.

Helfferich, F., 1956, Kinetics of ion exchange: Angew. Chem., v. 68, p. 693-698.

Helfferich, F., 1959, Ion exchange--new developments and problems of theory, J. D. Ferry, et al. eds.: Fortsch. Hochpolymer. Forsch., Springer-Verlag, no. 3, p. 329-381.

_____1962, Ion exchange: New York, McGraw Hill, Inc., 624 p.

Helfferich, F., and Ocker, H. D., 1957, Ion exchange membranes in bi-ionic systems: Z. Physik. Chem., v. 10, p. 213-235.

Hendricks, S. B., 1941, Base exchange of the clay mineral montmorillonite for organic cations and its dependence on adsorption due to van der Waals forces: Jour. Phys. Chemistry, v. 45, p. 65-81.

_____1945, Base exchange in the crystalline silicates: Ind. Eng. Chem., v. 37, p. 625-630.

Hendricks, S. B., and Alexander, L. T., 1939, The mechanism of cation exchange in the montmorillonite-beidellite-nontronite type of clay minerals: Soil Sci., v. 47, p 1-13.

Hendricks, S. B., and Fry, W. H., 1930, The results of x-ray and microscopical examinations of soil colloids: Soil Sci., v. 29, p. 457-478.

Hendricks, S. B., and Ross, C. S., 1941, Chemical composition and genesis of glauconite and celadonite: Am. Mineralogist, v. 26, p. 683-708.

Higdon, W. T., and Marshall, C. E., 1959, The uptake of Ca and K by young soybean plants: Research Bull, no. 716, 28 p.

Hills, G. J., 1961, Membrane electrodes, in Reference electrodes, D.J.G. Ives, and G. J. Janz, eds.: New York, Academic Press, p. 411-432.

Hills, G. J., Jacobs, P.W.M., and Lahshminarayanaiah, N., 1961, Membrane potentials. I. The theory of the emf of cells containing ion-exchange membranes: Royal Soc. (London) Proc., v. A262, p. 246-256.

Hirsch-Ayalon, P., 1957, Impregnated membranes with specific permeabilities for different ions: Jour. Polymer. Sci., v. 23, p. 697-703.

Hissink, D. J., 1925, Base exchange in soils: Faraday Soc. Trans., v. 20, p. 551-566.

Hofmann, U., and Giese, K., 1939, Uber den kationenaustausch an tonmineralen: Kolloid-Zeitschrift, v. 87, p. 21-36.

Hofmann, U., and Burck, W., 1961, Activities of exchangeable Ca, Ba, and La ions that are bonded to kaolinite: Angew. Chem., v. 73, p. 342.

Hogfeldt, E., 1952, On ion exchange equilibria, II: Activities of the components in ion exchangers: Arkiv Kemi, v. 5, p. 147-171.

______1952, Sorption isotherms on ion exchangers by emf titrations: Acta Chem. Scand., v. 6, p. 610-611.

______1954, On ion exchange equilibria, IV. The silver-hydrogen equilibrium on Wofatit KS at low silver concentrations: Arkiv Kemi, v. 7, p. 561-564.

______1955, On ion exchange equilibria, III. An investigation of some empirical equations: Acta Chem. Scand., v. 9, p. 151-165.

______1959, On ion exchange equilibria, VI. The heterogeneity of ion exchangers: Arkiv Kemi, v. 13, p. 491-506.

Hogfeldt, E., Ekedahl, E., and Sillen, L. G., 1950, On ion exchange equilibria. I. The silver-hydrogen equilibrium on Wofatit KS and Dowex 50: Acta Chem. Scand., v. 4, p. 1471-1489.

Holdredge, D. A., and Moore, F., 1953, The significance of clay-water relationships in ceramics: Clay Minerals Bull., v. 2, p. 26-33.

Holm, W. L., 1956, Thermodynamics of ion exchange equilibriums. I. The thermodynamic equilibrium equation in relation to reference states and components: Arkiv Kemi, v. 10, p. 151-166 (in English).

______1956, Thermodynamics of ion exchange equilibriums. II. Relative magnitude of formal osmotic free energy and formal ionic interaction free energy: Arkiv Kemi, v. 10, p. 445-453.

Holt, F. R., 1956, Amperometric titration for cation-exchange capacity of soils: Soil Sci., v. 81, p. 121-124.

Honstead, J. F., Ames, L. L., Jr., and Nelson, J. L., 1962, Mineral reactions--a new waste decontamination process: Health Phys., v. 8, p. 191-196.

Hope, A. B., and Robertson, R. N., 1956, Initial absorption of ions by plant tissue: Nature, v. 177, p. 43-44.

Hosking, J. S., 1948, The cation exchange capacity of soils and soil colloids. II. The contribution from the sand, silt, and clay fractions and organic matter: Jour. Council Sci. Indus. Research (Australia), v. 21, p. 38-50.

Hoss, H., and Roy, R., 1960, Zeolite studies. III. On natural phillipsite, gismondite, harmotome, chabazite, and gmelinite: Beitr. Mineral. u Petrog., v. 7, p. 389-408.

Hovland, Dwight, 1959, Soil-plant relation of potassium and magnesium: Univ. Micro-films (Ann Arbor, Mich.), L. C. Card No. Mic. 59-2354, 95 p. Dissert. Abstr. 20, 3.

Hoyos de Castro, A., and Rodriguez, J., 1954, Changes in surface properties of homionic bentonites on thermal treatment. I. Total exchange capacity and rehydration: Anales Edafol. Fisiol. Vegetal (Madrid), v. 13, p. 225-266.

Huf, E. G., Parrish, J., and Weatherford, C., 1951, Active salt and water uptake by isolated frog skin: Am. Jour. Physiol., v. 164, p. 137-142.

Hutcheon, J. M., 1954, Ion exchange I. Theory, materials, new techniques: Chem. and Process Eng., v. 35, p. 379-383.

Iberg, R., 1954, Clay minerals as cation exchangers-a Potassium Symposium: Ann. Meeting Board Tech. Advisers Intern. Potash Inst., Zurich, 1954, p. 71-79.

Iimura, K., 1961, Acidic property and ion exchange in allophane: Clay Sci. (Tokyo) 1, p. 28-32.

_____1961, Ion adsorption curves in allophane: Clay Sci. (Tokyo) 1, p. 40-44.

Ikeda, T., and Tarumoto, K., 1963, Preparation of colloidan membrane of different permselectivity to cations. II.: Rept. Liberal Arts Sci. Fac. Shizuoka Univ., Nat. Sci., v. 3, no. 4, p. 165-172.

Inden, T., Hori, S., and Okuda, A., 1958, Cation adsorption of crops. II. Cation adsorption of roots and tissues, and the relation between cation exchange capacity and nitrogen content: Nippon Dojo Hiryogaku, Zasshi, v. 29, p. 380-382.

Innes, R. F., and Birch, H. F., 1945, A comparison of four methods for the estimation of the exchangeable hydrogen content of soils: Jour. Agric. Sci., v. 35, p. 236-238.

Izmailov, N. A., 1957, Principles of the technology of adsorption. Issledovan. v Oblasti Ionoobmennoi Khomatog. Akad. Nauk SSSR, Otd. Khim. Nauk, Tr. Soveshch., 1957, p. 55-66.

Izmailov, N. A., and Mushinskaya, S. Kh., 1962, Problems in the thermodynamics of ion exchange of organic ions: Zhur. Fiz. Khim., v. 36, p. 1210-1218.

Izmailov, N. A., and Vasilev, A. G., 1956, Study of a glass electrode by means of radioactive indicators. II. Behavior of a glass electrode in the alkaline region: Zhur.Fiz. Khim., v. 30, p. 1500-1512.

Jackson, M. L., 1958, Soil chemical analysis: Englewood Cliffs, N. J., Prentice Hall, Inc., p. 57-109.

Janak, Jaroslav, 1959, Ionic equilibrium in the formation and metamorphism of natural waters in regions of wedimentation: Geol. Prace Zpravy, v. 15, p. 107-137. German summary.

Jangg, G., 1958, Ternary ion-exchange equilibrium calculations: Osterr. Chemiker-Ztg., v. 59, p. 331-344.

Jarusov, S. S., 1937, On the mobility of exchangeable cations in the soil: Soil Sci., v. 43, p. 285-303.

Jasz, A., and Lengyel, T., 1961, Investigations of binary ion-exchange equilibriums with isotopes: Magy. Kem. Folyoirat, v. 67, p. 351-360.

______1962, Investigation of multicomponent ion-exchange equilibriums with radioactive isotopes: Magy. Kem. Folyoirat, v. 68, p. 167-171.

Jasz, A., Lengyel, T., and Schay, G., 1962, Investigations of ion-exchange equilibriums by the radioactive tracer method. I. Thermodynamic relations of the ion-exchange equilibriums of binary univalent cationic systems: Acta Chim. Acad. Sci. Hung., v. 30, no. 1, p. 49-61.

Jasz, A., and Lengyel, T., 1962, Investigations on ion exchange equilibria with radioactive tracer method. II. Investigations relating to the removal factor in binary monovalent cationic systems: Acta Chim. Acad. Sci. Hung., v. 27, p. 247.

Jasz, A., Lengyel, T., and Schay, G., 1962, III. The removal factor in binary multivalent cationic systems. Acta Chim. Acad Sci. Hung., v. 27, p. 253-260

Jasz, A., and Lengyel, T., 1962, Investigations on ion-exchange equilibriums by radioactive-tracer method. IV. The ion-exchange equilibriums of ternary univalent cationic systems: Acta Chim. Acad. Sci. Hung., v. 33, p. 395-398.

Jenny, H., 1932, Studies on the mechanism of ionic exchange in colloidal aluminum silicates: Jour. Phys. Chemistry, v. 36, p. 2217-2258.

_____1936, Simple kinetic theory of ionic exchange. Ions of equal valency: Jour. Phys. Chemistry, v. 40, p. 501-517.

_____1941, Factors of soil formation: New York, McGraw-Hill, Inc., 281 p.

Jenny, H., and Engabaly, M. M., 1943, Cation and anion interchange with zinc montmorillonite clays: Jour. Phys. Chemistry, v. 47, p. 399-410.

Jenny, H., and Overstreet, R., 1939, Surface migration of ions and contact exchange: Jour. Phys. Chemistry, v. 43, p. 1185-1196.

Jenny, H., and Reitemeier, R. F., 1935, Ionic exchange in relation to the stability of colloidal systems: Jour. Phys. Chemistry, v. 39, p. 593-604.

Johnson, A. L., 1949, Surface area and its effect on exchange capacity of montmorillonite: Am. Ceramic Soc. Jour., v. 32, p. 210-214.

Joiner, J. N., and Dickey, R. D., 1961, Effects of nitrogen, potassium, and magnesium levels on growth and chemical composition of the lychee grown in sand culture: Am. Soc. Hort. Sci. Proc., v. 77, p. 270-277

Jordan, D. E., 1962, Equilibrium constants of cadmium, lead, and uranyl ions in reaction with Dowex 50 resin exchanger: Univ. Microfilms (Ann Arbor, Mich.)

Kajomtzeff, I., 1953, The problem of the selectivity of ion-exchange resins: Comptes rendus, v. 237, p. 609-611.

Kakihana, Hidetake, Ohtaki, Hitoshi, 1960, Thermodynamic theory of ion-exchange: Bull. Tokyo Inst. Tech. Ser. B, no. 1, p. 1-13.

Kakihana, Hidetake, and Sekiguchi, Keji, 1955, Ion exchange in acetone-water mixture with cation exchangers: Jour. Pharm. Soc., Japan, v. 75, p. 111-112.

Kamienski, B., 1948, Dielectric theory of selective adsorption: Bull. Intern. Acad. Polon. Sci., Math. Nat., Ser. A, 1947, p. 1-4. (In English)

Kamii, Ichiro, 1962, Permselectivities of barium ions across heterogeneous cation-exchange membranes: Kogyo Kagaku Zasshi, v. 65, p. 863-865.

Karreman, George, 1953, A carrier mechanism as a model for ion accumulation: Bull. Math. Biophys., v. 15, p. 161-165, 167-171.

Kawaguchi, K., and Matsuo, Y., 1958: A study of available silica in paddy soils, I and II: Jour. Soil Sci., Tokyo, v. 28, p.493-496, v. 29, p. 9-12.

Keeling, P. S., 1961, Examination of clays by IL/MAL: British Ceramic Soc. Trans., v. 60, p. 217-244.

Keller, P., and Devel, H., 1957, Cation-exchange capacity and pectin content of plant roots: Z. Pflanzenernaehr. Dueng. Bodenk., v. 79, p. 119-131.

Kellermann, Albin, and Lange, Erich, 1939, The adsorption of potential-determining ions. II. Influence of the kind and concentration of opposite ions on the adsorption of potential-determining ions: Kolloid-Zeitschr., v. 88, p. 341-347.

Kelley, W. P., 1929, The determination of the base exchange capacity of soils and a brief discussion of the underlying principles: Am. Soc. Agronomy Jour., v. 21, p. 1021-1029.

_____1948, Cation exchange: New York Reinhold Pub. Corp., 144 p.

Kelley, W. P., and Brown, S. M., 1926, Ion exchange in relation to soil acidity: Soil Sci., v. 21, p. 289-302.

Kelley, W. P., and Jenny, Hans, 1936, The relation of crystal structure to base-exchange and its bearing on base-exchange in soils: Soil Sci., v. 41, p. 367-382.

Kelley, W. P., and Liebig, 1934, Base exchange in relation to composition of clay with special reference to effect of sea water: Am. Assoc. Petroleum Geologists Bull., v. 18, p. 358-367.

Kerr, H. W., 1928a, The nature of base exchange and soil acidity: Am. Soc. Agronomy Jour., v. 20, p. 309-335.

_____1928b, The identification and composition of the soil alumino--silicates active in base exchange and soil acidity: Soil Sci., v. 26, p. 384-398.

Khilko, V. V., Nichiporenki, S. O., Kostenki, E. A., and Panasevich, O. O., 1963, Effect of cation exchange on the structural and mechanical properties of palygorskite suspensions: Dopovidi Akad., Nauk Ukr. RSR 1963, no. 2, p. 237-240.

Kingery, W. D., and Francl, J., 1954, Fundamental study of clay, XIII, drying behavior and plastic properties: Am. Ceramic Soc. Jour., v. 37, p. 596-602.

Kingery, W. D., Halden, F. A., and Kurkjian, C. R., 1955, Base exchange capacity of talc: Jour. Phys. Chemistry, v. 59, p. 378-380.

Kittrick, J. A., and Jackson, M. L., 1956, Electron microscope observations of the reaction of phosphate with minerals, leading to a unified theory of phosphate fixation in soils: Jour. Soil Sci., v. 7, p. 81-88.

Klassen, V. I., and Lyaskovskii, Ya. T., 1962, Influence of inorganic salts on the overall potential drop at the interface anthracite-aqueous solution: Dokl. Akad. Nauk SSSR, v. 145, p. 857-859.

Komai, Yutaka, and Noda, Masaya, 1957, Complementary ion effects between magnesium and other cations in the ionic environment of plant roots. III. Adsorption of cations by barley roots: Nippon Dojo-Hiryogaku Zasshi, v. 28, p. 279-282.

Kots, Ya M., and Zarinskii, V. A., 1961, Diffusion through ion-exchange membranes and their electrochemical characteristics: Zhur. Fiz Khim., v. 35, p. 1103-1104.

Kraus, K. A., Nelson, F., and Smith, G. W., 1954, Anion-exchange studies IX. Absorbability of a number of metals in HCl solutions: Jour. Phys. Chemistry, v. 58, p. 11-17.

Kraus, K. A., and Raridon, R. J., 1959, Temperature dependence of some cation exchange equilibria in the range 0 to 200°. Jour. Phys. Chemistry, v. 63, p. 1901-1907.

Kressman, T. R. E., 1956, Advances in ion exchange: Mfg. Chemist, v. 27, p. 454-458.

_____1958, Ion exchange: The present and the future: Indus. Chemist, v. 34, p. 333-336.

Kressman, T. R. E., and Kitchener, J. A., 1949, Cation exchange with a synthetic phenolsulfonate resin. I. Equilibria with univalent cations. II. Equilibria with multivalent cations. III. Equilibria with large organic cations. IV. A note on equilibria in presence of nonaqueous solvents: Jour. Chem. Soc., p. 1190-1213.

Kressman, T. R. E., Stanbridge, P. A., and Tye, F. L., 1963, Transference studies with ion-selective membranes. I. Measurement of transference numbers: Faraday Soc. Trans., v. 59, no. 489, pt. 9, p. 2129-2132.

Krishnamoorthy, C., ad Overstreet, Roy, 1949, Theory of ion-exchange relationships: Soil Sci., v. 68, p. 307-315.

_____1950a, An experimental evaluation of ion-exchange relationships: Soil Sci., v. 69, p. 41-53.

_____1950b, Behavior of hydrogen in ion exchange reactions: Soil Sci., v. 69, p. 87-93.

Krishnaswamy, N., 1956, Synthetic ion-exchange membrane discs. II. Donnan diffusion characteristics of cation-exchange membranes: Jour. Sci., Indus. Research, India, v. 15B, p. 530-534.

_____1961, Preparation and application of ion-exchange membranes: Jour. Sci. Indus. Research, India, v. 20A, p. 256-265.

Krogh, August, 1943, Exchange of ions between cells and extra cellular fluid. I. Uptake of potassium into the chorion membrane from the hen egg: Acta Physiol. Scand., v. 6, p. 203-221.

_____1946, Active and passive exchanges of inorganic ions through the surfaces of living cells and through living membranes generally: Royal Soc. Proc., London, v., B133, p. 140-200.

Kruchinia, Z. A., and Alishin, S. N., 1959, The change in some clay minerals under the influence of protein sorption: Izv. Timirvazev. Sel'skokhoz. Akad., no. 1., p. 213-222.

Kryukov, P. A., and Zhuckhova, A. A., 1962, Phase potentials arising on squeezing solutions out of ion exchangers: Kolloid. Zhur., v. 24, p. 344-356.

Kunze, G. W., and Jeffries, C. D., 1952, X-ray characteristics of clay minerals as related to potassium fixation: Soil Sci. Soc. America Proc., v. 17, p. 242-244.

Kurbatov, J. D., Kulp, J. L., and Marck, E. F., 1945, Adsorption of strontium and barium ions and their exchange anhydrous ferric oxide: Jour. Amer. Chem. Soc., v. 67, p. 1923-1929.

Langmuir, I., 1918, The adsorption of gases on planes of surfaces of glass, mica, and platinum: Am. Chem. Soc. Jour., v. 40, p. 1361-1403.

Larson, E. M., and Vissers, D. R., 1960, The exchange of Li^+, Na^+, and K^+ with H^+ on zirconium phosphate: Jour. Phys. Chemistry, v. 64, p. 1732-1736.

Latiu, E., and Cicoare-Metes, Lucia, 1960, Exchange adsorption of some tuffs, bentonites, and indigenous diatomites: Acad. Rep. Populare Romine, Baza Cercetari Stiint. Timisoara, Studii, Cercetari Stiint., Ser. Stiinte Chim., v. 7, p. 341-345.

Laudelout, H., 1957, Distribution of surface charges on clay particles: Bull. Groupe Franc. Argiles, v. 9, no. 4, p. 61-65.

Leanpere, H., 1960, Exchange adsorption of Li^+ and K^+ ions on Iosu clay: Uch. Zap. Tartusk, Gosudarst. Univ. 1960, no. 95, p. 148-154.

Leenheer, L. de., and Appelmans, F., 1953, Het sorptievermogen van de Polderkleien en van Schelde-alluvium: Mededel. Landbouwhogeschool Opzoekings-Stat. Gent, Deel XVIII, p. 521-543.

Leifer, Leslie, Davidson, W., and Argersinger, W. J.,Jr., 1961, The effect of ionic strength on equilibrium in silver hydrogen ion exchange: Jour. Phys. Chemistry, v. 65, p. 2220-2222.

Lengyel, B., Csakvari, B., and Kiksay, Z., 1960, The alkali error of the glass electrode. I. Problem of interpretation of the alkali error: Acta Chim. Acad. Sci. Hung., v. 25, p. 225-242. (In German).

Lengyel, Tamas, and Jasz, Arpad, 1962, Ion-exchange equilibriums by a radioactive tracermethod. V. Ion-exchanging equilibriums in the quaternary system Cs-Rb-Na-H: Acta Chim. Acad. Sci. Hung., v. 34, no. 1, p. 19-28. (In English).

Lenskaya, V. N., and Bryantseva, I. N., 1962, Dependence of the selective action of a cation exchanger on the quantity of new active groups introduced: Uch. Zap. Saratovsk. Gos. Univ., v. 75, p. 88-90.

Lester, Gabriel, and Hechter, Oscar, 1958, Dissociation of rubidium uptake by Newospora crassa into entry and binding phases: Natl. Acad. Sci., Proc., U.S., v. 44, p. 1141-1149.

Levin, H., Diamond, W. J., and Brown, B. J., 1959, Effect of ionic strength on ion exchange: Indus. Eng. Chem., v. 51, p. 313-318.

Lewis, D. R., 1953, Replacement of cations of clay by ion-exchange resins: Indus. Eng. Chem., v. 45, p. 1782.

_____1955, Ion-exchange reactions of clays: Calif. Div. Mines Bull., v. 169, p. 54-69.

Lieser, K. H., and Hild, W., 1960, Selective separation of radioactive strontium: Naturwissenschaften, v. 47, p. 494-495. (In German).

Ling, G. N., 1960, The interpretation of selective ion permeability and cellular potentials in terms of the fixed charge-induction hypothesis: Jour. Gen. Physiology, v. 43, no. 5, pt. 2, p. 149-174.

Lopez-Gonzales, J. de D., and Deitz, V. R., 1952, Surface changes in an original and activated bentonite: U.S. Natl. Bur. Standards Jour. Research, v. 48, p. 325-333.

Lopez-Gonzales, J. de D., and Jenny, Hans, 1960, Comment of the paper "Diffusion of strontium in ion-exchange membranes.": Jour. Colloid Sci., v. 15, p. 483-484.

Lopez-Gonzales, J. de D., and Vazquiz, C. del Pino, 1959, Structure and bonding forces between montmorillonite layers in aqueous suspension: Annales real Soc. Espagnol Fis. Quim., v. 55, B, p. 711-716.

Loven, A. W., 1963, A study of ion-exchange properties of natural and heated montmorillonite: Univ. Micro-films (Ann Arbor, Mich.), Order No. 63-3501, 77 p., Dissert. Abstr. 23, 4549.

Lowenhaupt, Benjamin, 1958, Active transport in submerged aquatic plants. I. Effect of light upon the absorption and excretion of calcium by Potamogeton crispus leaves. II. Effect of aeration upon the equilibrium content of calcium in Potamogeton crispus leaves: Jour. Cellular Comp. Physiol., v. 51, p. 199-219.

Lundegardh, H., 1955, Mechanism of absorption, transport, accumulation, and secretion of ions: Ann. Rev. Plant Physiol., v. 6, p. 1-24.

MacEwan, D. M. C., 1948, Adsorption by montmorillonite and its relation to surface adsorption: Nature, v. 162, p. 935.

_____1951, The montmorillonite minerals (montmorillinoids), in Brindley, G. E., ed., X-ray identification and crystal structures of clay minerals: Mineralog. Soc., London, p. 86-137.

Mackay, D., and Meares, P., 1960, Ion exchange across a cationic membrane in dilute solutions: Kolloid Zhur., v. 171, p. 139-149.

_____1961, Ion exchange across a cationic membrane in concentrated solutions: Kolloid Zhur., v. 176, p. 23-29.

Madgwich, G. G., 1957, The selective behavior of ion-exchange membranes at high concentrations: Chem. Eng. Sci., v. 6, p. 97-104.

Magistad, O. C., 1928, The action of aluminum, ferrous and ferric iron on manganese in base-exchange reactions: Arizona Agric. Expt. Sta. Tech. Bull., no. 18, p. 445-463.

Manacke, A., 1952, Electronic conductance of cation-exchange membranes: Zeitschr. Physik. Chemie, v. 201, p. 193-210.

Manecke, G., 1958, Applications of ion-exchange membranes: Chem. Ing. Tech., v. 30, p. 311-317.

Marel, H. W., van der, 1954, Potassium fixation in the Dutch soils; mineralogical analysis: Soil Sci., v. 78, p. 163-179.

Markh, A. T., and Kharin, Yu. S., 1961, Potassium ion-exchange adsorptinn from acid potassium tartrate solution on cation exchangers: Izv. Vysshikh Ucheb. Zabedenii, Pishchevaya Tekhnol., 1964, no. 5, p. 20-27.

Markhasev, B. I., and Sedletskii, I. D., 1963, Absorption energetics and cation exchange on clays: Dokl. Akad. Nauk SSSR, v. 15, no. 5, p. 1144-1145.

Marshall, C. E., 1939, The use of zeolitic membrane electrodes: Jour. Phys. Chemistry, v. 43, p. 1155-1164.

_____1941, The electrochemical properties of mineral membranes: JACS, v. 63, p. 1911.

_____1942, The use of membrane electrodes in the study of soils: Soil Sci. Soc. Am. Proc., v. 7, p. 182-186.

_____1942b, The clays as colloidal electrolytes: Jour. Phys. Chemistry, v. 46, p. 1077-1090.

_____1944, Uses and limitations of membrane electrodes: Jour. Phys. Chemistry, v. 48, p. 67-75.

_____1948, Theory of selective membrane behavior: Jour. Phys. Chemistry, v. 52, p. 1284-1295.

_____1948b, Electrochemical properties of mineral membranes. VIII.: Jour. Phys. Colloid Chem., v. 52, p. 1284-1295.

_____1949, The colloid chemistry of the silicate minerals: New York, Academic Press, 195 p.

_____1950, The electrochemistry of the clay minerals in relation to pedology: Internat. Soil Sci. Cong. Trans., Amsterdam, v. 2, p. 71-81.

_____1951, The activities of cations held by soil colloids and the chemical environment of plant roots, <u>in</u> Truog, Emil, <u>Editor</u>, Mineral nutrition of plants: Madison, Univ. Wis. Press, p. 57-77.

Marshall, C. E., 1954, Multifunctional ionization as illustrated by the clay minerals, in Proceedings 2d Natl. Clay Conf.: Natl. Acad. Sci. Natl. Research Council Pub. no. 327, p. 364-384.

_____1964, The physical chemistry and mineralogy of soils. Vol. 1. Soil materials. (Ch. 7).: New York, John Wiley & Sons, Inc., 338 p.

Marshall, C. E., and Ayers, A. D., 1946, Clay membrane electrodes for determining calcium activities: Soil Sci. Soc. Am. Proc., v. 11, p. 171-174.

_____1948, The electrochemical properties of mineral membranes. VI. Clay membranes for the determination of calcium: Jour. Appl. Chem. Soc. v. 20, p. 1297-1302.

Marshall, C. E., and Barber, S. S., 1949, The calcium-potassium relationships of clay minerals as revealed by activity measurements: Soil Sci. Soc. America Proc., v. 14, p. 86-88.

Marshall, C. E., and Bergman, 1942, The electrochemical properties of mineral membranes. II. Measurement of potassium-ion activities in colloidal clays: Jour. Phys. Chemistry, v. 46, p. 52-61.

_____1942b, The electrochemical properties of mineral membranes. III, IV. The estimation of NH_4 activities: Jour. Phys. Chemistry, v. 46, p. 325-334.

Marshall, C. E., and Caldwell, O. G., 1947, The colloid chemistry of the clay mineral attapulgite: Jour. Phys. Colloid Chemistry, v. 51, p. 311-320.

Marshall, C. E., and Krinbill, C. A., 1942a, The electrochemical properties of mineral membranes. V. Beidellite membranes and the determination of sodium: Am. Chem. Soc. Jour., v. 64, p. 1814-1819.

Marshall, C. E., and Krinbill, C. A., 1942b, The clays as colloidal electrolytes: Jour. Phys. Chemistry, v. 46, p. 1077-1090.

Marshall, C. E., and Patnaik, N., 1953, Ionization of soils and soil colloids. IV. Humic and hymatomelanic acids and their salts: Soil Sci., v. 75, p. 153-165.

Martin, Henri, and Laudelout, Henri, 1963, Thermodynamics of the exchange of alkali metal cations in clays: Jour. Chim. Phys., v. 60, no. 9, p. 1086-1099.

Martin, R. P., Newbould, P., and Russell, R. S., 1958, Discrimination between strontium and calcium in plants and soils: Radioisotopes Sci. Res., Proc. Intern. Conf., Paris, 1957, v. 4, p. 173-190.

Materova, E. A., 1960, Ion-exchange and electrode properties of ion exchangers: Vestn. Leningr. Univ., v. 15, no. 22, Ser. Fiz i Khim., no. 4, p. 26-39.

Materova, E. A., and Alagova, Z. S., 1960, Study of the electrode properties of anion-exchanging membranes: Zhur. Fiz. Khim., v. 34, no. 12, p. 2752-2758.

Materova, E. A., and Belinskaya, F. A., 1960, Electrodes from ion-exchange resins. Khromatog., ee Teriya i Primenenie: Akad. Nauk SSSR., Tr. Vses. Soveshch., Moscow, 1958, p. 144-149.

_____1961, Electrode properties of ion-exchange membranes: Uspekhi Khim., v. 30, p 914-931.

Materova, E. A., and Moiseyev, V. V., 1959, Comparative study of the electrodic and exchange properties of glass electrodes by the use of radioactive indicators. I. Behavior of sodium glass electrode in solutions of silver nitrate: Zhur. Fiz. Khim., 1959, v. 33, no. 4, p. 893-902.

Materova, E. A., Moiseyev, V. V., and Belyustin, A. A., 1961, Radioactive-indicator study of the glass electrode and its exchange properties. II. Behavior of the potassium glass electrode in solutions of alkali metal salts: Zhur. Fiz. Khim., v. 35, p. 1258-1264.

Matorina, N. N., and Popov, A. N., 1958, Temperature effect on the ion-exchange equilibrium. I. The principal factors determining the changes of the ion-exchange adsorption with temperature: Zhur. Fiz. Khim., v. 32, p. 2557-2560.

Matsuda, Toshihiko, Okazaki, Minoru, and Hiroe, N., 1961, Study of ternary ion-exchange reactions. Height of exchange zone and ion separation: Kagaku Kogaku, v. 25, p. 104-108.

Mattson, Sante, 1932, The laws of soil colloidal behavior. IX. Amphoteric relations and isoelectric weathering; Soil Sci., v. 34, p. 228-240.

Mattson, Sante, and Wiklander, Lambert, 1940, The laws of soil colloidal behavior. XXI. The amphoteric points, the pH, and the Donnan equilibrium: Soil Sci., v. 49, p. 109-151.

Mayer, S. W., 1950, Cation-exchange equilibria at constant ionic strength: Am. Chem. Soc. Jour., v. 72, p. 2292-2293.

Mazia, Daniel, 1940, The binding of ions by the cell surface: Cold Spring Harbor Symposia Quant. Biol., v. 8, p. 195-203.

McAtee, J. L., Jr., 1962, Cation exchange of organic compounds on montmorillonite in organic media: Clays and Clay Minerals, Proc. 9th Natl. Conf. Mono. no. 11, Earth Science Series: New York, Pergamon Press, p. 444-450.

McAuliffe, C. D., Hall, M. S., Dean, L. A., and Hendricks, S. B., 1947, Exchange reactions between phosphates and soils: Soil Sci. Soc. America Proc., v. 12, p. 119-123.

McCalla, T. M., 1940, Cation adsorption by bacteria: Jour. Bacteria, v. 40, p. 23-32.

McCalla, T. M., and Foltz, V. D., 1941, Uptake of ions by bacteria: Kansas Acad. Sci. Trans., v. 44, p. 46-47.

McKelvey, J. G., Spiegler, K. S., and Wyllie, M. R. J., 1957, Salt filtering by ion-exchange grains and membranes: Jour. Phys. Chemistry, v. 61, p. 174-178.

McLean, E. O., 1950, Reciprocal effects of magnesium and potassium as shown by their activities in a beidellite clay: Soil Sci. Soc. America Proc., v. 14, p. 89-93.

______ 1951, Interrelationships of potassium, sodium and calcium as shown by their activities in a beidellite clay: Soil Sci. Soc. America Proc., v. 15, p. 102-106.

McLean, E. O., and Baker, F. E., 1954, Cationic activities as indices for characterizing S. Arkansas soils occurring in the southern region: Soil Sci. Soc. America Proc., v. 18, p. 143-147.

McLean, E. O., and Marshall, C. E., 1948, Reciprocal effects of calcium and potassium as shown by their cationic activities in montmorillonite: Soil Sci. Soc. America Proc., v. 13, p. 179-182.

McLean, E. O., Barber, S. A., and Marshall, C. E., 1951, Ionization of soils and soil colloids. I. Methods for simultaneous determination of two cationic activities: Soil Sci., v. 72, p. 315-325.

Mehlich, Adolph, 1939, Use of triethanolamineacetate, barium hydroxide buffer for the determination of some base-exchange properties and lime requirement of soils: Soil Sci. Soc. America Proc., v. 3, p. 162-166.

_____1942a, Rapid estimation of base-exchange properties of soils: Soil Sci., v. 53, p. 1-14.

_____1942b, Adsorption of barium and hydroxylions by soils and minerals in relation to pH: Soil Sci., v. 53, p. 115-123.

_____1948, Determination of cation- and anion-exchange properties of soils: Soil Sci., v. 66, p. 429-445.

_____1952, Factors affecting adsorption of cations by plant roots: Soil Sci. Soc. America Proc., v. 17, p. 231-234.

Melkersson, Karl-Axel, 1956, Separation process using permselective membranes: Univ. Micro-films (Ann Arbor, Mich.), Publ. No. 19119, 180 p., Dissert. Abstr. 16, 2117-18.

Menzel, R. G., and Jackson, J. L., 1951, Mechanism of sorption of hydroxy cupric ion by clays: Soil Sci. Soc. America Proc., v. 15, p. 122-124.

Méring, J., and Glaeser, R., 1954, Role of the exchangeable cation valence in montmorillonite: Soc. Francaise Minéralogie et Crystallographie Bull., v. 77, p. 519-530.

Méring, J., Mathieu-Sicaud, A., and Perrin-Bonnet, I., 1950, Electron microscope study of montmorillonite saturated with different cations: 4th Internat. Soil Sci. Congress Trans., v. 3, p. 29-32, 173.

Meyer, K. H., Bernfield P., 1946, Permeability of membranes. X. Ionic permeability of living membranes: Helvetica Chim. Acta., v. 29, p. 52-

Michaelis, L., 1927, Investigation of molecular sieve membranes: Colloid Symposium Mono. 5, p. 135-148.

Miller, R. M., 1962, Isopositional substitution in crystalline substances: Univ. Micro-films, Order No. 62-451, 123 p., Dissert. Abstr. 22, 4321.

Millot, Georges, 1949, Relations entre la constitution et la genese des roches sedimentaires argileuses: Geol. Appliq. et Prosp. Mineral., v. 11, nos. 2-4.

Mirskii, Ya. V., Mitrofanova, M. G., and Bredikhina, T. N., 1962, Ionic exchange of Ca for Na in a synthetic zeolite of the A type. Sintetich Tseolity, Poluchenie, Issled. i Primenie, Akad. Nauk SSSR, Otd. Khim. Nauk 1962, p. 167-168.

Mitchell, W. A., 1955, A review of the mineralogy of Scottish soil clays: Jour. Soil Sci., v. 6, p. 94-98.

Mitra, R. P., 1942, Electrochemical aspects of ion exchange in clays, bentonites, and clay minerals: Indian Soc. Soil Sci., Bull., no. 4, p. 41-61.

Mitra, D. K., and Chatterjee, B., 1953, Measurement of Cu-ion activity: Indian Soc. Soil Sci. Jour., v. 1, p. 12-14.

Mitra, S. P., and Prakash, D., 1957, A comparative study of different methods of determining exchangeable cations from clays and micas: Anal. Chim. Acta, v. 16, p. 431-435.

Mitra, R. P., and Rajogopalan, K. S., 1952, Origin of the base exchange capacity of clays and significance of its upper limiting value: Soil Sci., v. 73, p. 349-360.

Mitra, R. P., and Sawkney, G. L., 1953, Reaction between neutral salts and montmorillonitic clays: Indian Soc. Soil Sci. Jour., v. 1, p. 71-81; 95-104.

Miyake, Shingo, 1958, Cation-exchange reaction of calcium alginate in acid solution: Kogyo Kagaku Zasshi, v. 61, p. 444-447.

Moiseyev, V. V., 1960, The development of ideas about ion exchange on glass. Vestnik Leningrad Univ., v. 15, no. 22. Ser Fiz i Khim. p. 49.

Moiseyev, V. V., and Nikolskii, B. P., 1957, Investigation of ion-exchange properties of electrode glasses by means of radioactive indicators. Vestnik Leningrad Univ., v. 12, no. 16. Ser. Fiz. i Khim., no. 3, p. 69-84.

Moldobaev, S., 1963, Adsorption characteristics of clays of Northern Kirgizia and the effect on these characteristics of cation exchange and thermal treatment. Sb. Materialov Konf., Posvyashch. 100-letiyu so Dnya Rozhdeniya Akademika, N. S. Jurnakova, Akad. Nauk Kirg. SSR 1963, 130-8.

Monet, G. P., 1957, Sorption processes, adsorption dialysis, and ion-exchange--an introduction: Chem. Eng. Progr., v. 53, p. 514-517.

Monge, G. G., 1960, Cation-exchange equilibriums in a carboxylic cation exchanger and in attapulgite clay. J. Agr. Univ. Puerto Rico 44, p. 221-235.

Mookerjee, S., and Mukherjee, S. K., 1953, 1954, Ionic antagonism in exchange reactions on clays. I. Symmetry values of colloidal clay salts with cationic mixtures. II. Competition between two cations: Indian Soc. Soil Sci., Jour., 1 (1953), p. 95-104, 2 (1954), p. 29-36.

Moralli, G. J., 1954, Cationic exchange resins of homogeneous spatial arrangement: J. recherches centre natl. recherche sci., Labs. Bellevue Paris, no. 26, p. 265-276.

Morel, R., 1954, The balance of cations of different dimensions adsorbed on clays: Acad. Sci. Paris Comptes Rendus, 239, p. 1846-1848.

Mortland, M. M., 1955, Adsorption of ammonia by clays and mucks: Soil Sci., v. 80, p. 11-18.

Mortland, M. M., and Mellon, J. L., 1954, Conductometric titration of soils for cation-exchange capacity: Soil Sci. Soc. America Proc., v. 18, p. 363-365.

Mukherjee, J. N., 1921, Origin of the charge of a colloidal particle and its neutralization by electrolytes: Faraday Soc. Trans., v. 16, append. p. 103-115.

Mukherjee, J. N., Mitra, R. O., and Bagchi, S. N., 1951, Electrochemical character of H-clays in relation to their mineralogical compositions: Indian Soc. Soil Sci. Bull., no. 6A, p. 1-18.

M~~j~~ukherjee, S. K., De, R. M., and Rao, Venugopal, 1951, Cation exchange in homoionic clay salts. I. Influence of H ion concentration on symmetry values and the lyotrope series: Indian Soc. Soil Sci. Bull., no. 6A, p. 67-88.

Mukherjee, S. K., and Marshall, C. E., 1951, Electrochemical properties of mineral membranes IX: J. Phys. and Colloid Chem., v. 55, no. 1, p. 61-68.

Muller, J. F., 1933, Some observations on base exchange in organic materials: Soil Sci., v. 35, p. 229-237.

Murray, H. H., and Lyons, S. C., 1960, Further correlations of kaolinite crystallinity with chemical and physical properties: Clays and Clay Minerals, Proc. 8th Natl. Conf. Mono. no. 9, Earth Sci. Series: New York, Pergamon Press, p. 11-17.

Musso, Hans, 1958, Modern separation methods in chemistry. Naturwissenscheften <u>45</u>, p. 97-104.

Myers, G. E., and Boyd, G. E., 1956, A thermodynamic calculation of cation-exchange selectivities: Jour. Phys. Chem. <u>60</u>, p. 521-529.

Nachod, F. C., and Wood, W., 1945, The reaction velocity of ion exchange: Jour. America Chem. Soc. <u>67</u>, p. 629-631.

Nagasawa, M., and Kagawa, I., 1956, Membrane potentials of an ion exchange membrane: Faraday Soc. Discussions <u>1956</u>, no. 21, p. 52-60.

Nagasawa, 1952, Theory of membrane potential: Jour. Phys. Chem. <u>56</u>, p. 1017-1024.

Nagy, B., and Bradley, W. F., 1955, The structural scheme of sepiolite: Am. Mineralogist, v. 40, p. 885-892.

Nakgaki, M., Koga, M., and Noguchi, S., Membrane permeability by the membrane-electrode method. I. Permeabilities of ions with permselective collodion and ion exchanger-collodion membranes. Yakugaku Zasshi <u>82</u>, p. 1124-1130.

Nancollas, G. H., and Paterson, R., 1961, Kinetics of ion exchange on zirconium phosphate and hydrated thoria: Jour. Inorg. Nucl. Chem. 22, p. 259-268.

Nash, V. E., and Marshall, C. E., 1956a, The surface reactions of silicate minerals. I. The reactions of feldspar surfaces with acidic solutions: Univ. Missouri Coll. Agr. Res. Bull. 613, p. 36.

_____ 1956b, The surface reactions of silicate minerals. II. Reactions of feldspar surfaces with salt solutions: Univ. Missouri Coll. Agr. Res. Bull. 614, p. 36.

Neihof, R., and Sollner, K., 1956, Physical chemistry of the differential rates of permeation of ions across porous membranes. Faraday Soc. Discussions 1956, no. 21, p. 94-101.

Nelson, Frederick, Holloway, J. H., Kraus, K. A., 1963, Cation exchange separation of calcium and magnesium at high ionic strength: Jour. Chromatog. 11 (2), p. 258-260.

Nelson, R. A., and Hendricks, S. B., 1943, Specific surface of some clay minerals, soils, and soil colloids: Soil Sci., v. 56, p. 285-296.

Nikolaev, V. M., Bagretsov, V. F., and Kalmykov, Yu. A., 1963, The effect of various treatments on ion-exchange properties of vermiculite. I. Destruction of vermiculite with acid solutions. Inst. Politekhn. Tr. Ural'sk 1963 (121), p. 30-34.

Nikolaev, V. M., Bagretsov, V. F., and Beketov, A. R., 1962, Kinetics of ion-exchange on vermiculites. Zh. Prikl. Khim. 35, p. 2414-2420.

Nikolaev, V. M., Baretsov, V. F., and Lebedev, V. M., 1963, The sorption of microamounts of strontium and cesium on vermiculite. Radiokhimiya 5(1), p. 32-37.

Nikolskii, B. P., 1937, Theory of the glass electrode I. Acta Physico-Chem. URSS 7 , p. 597.

Nikolskii, B. P., and Tolmacheva, T. A., 1937a, Theory of the glass electrode II. Effect of B_2O_3 and Al_2O_3 on the electrode properties of the glass. Zh. Fiz. Khim. 10, p. 504.

_____1937b, Theory of the glass electrode III. Transfer from the hydrogen electrode function to the sodium function. Zh. Fiz. Khim. 10, p. 513.

Nikol'skii, B. P., and Materova, E. A., 1951, Theory of the glass electrode. IV. Experimental confirmation of the exchange nature of the potential of a glass electrode. Zhur. Fig. Khim. 25, p. 1335-1346.

Nikol'skii, B. B., 1953, Theory of the glass electrode. V. Generalized theory of the glass electrode. Zhur. fig. Khim. 27, p. 724-743.

_____1953, The theory of the glass electrode. VI. The valence of anions in the glass phase. Zhur. Fiz. Khim. 27, p. 805-806.

_____1960, Importance of the study of solutions in the development of the ion exchange theory (1960). Vestnik Leningrad. Univ. 15, no. 22, Ser. Fiz. i Khim, no. 4, p. 11-25.

Nikol'skii, B. P., and Bogatova, N. F., 1961a, Ion-exchange theory. I. Curves of absorption of ions by cation exchangers and anion exchangers Vestnik Leningrad. Univ. 16, no. 10, Ser. Fiz. i Khim, no. 2, p. 94-111.

_____1961b, Ion-exchange theory II. Vestnik Leningrad. Univ. 16, no. 16, Ser. Fiz. i Khim. no.3, p. 97-107.

Nikol'skii, B. P., Isakova, N. P., and Shul'ts, M. M., 1962, Electrode and acid properties of boroaluminosilicate glass as affected by chemical composition. Dokl. Akad. Nauk SSSR 142, p. 1331-1334.

Nikol'skii, B. P., and Shul'ts, M. M.1959, Electrode properties of glass. Leningrad 3rd all union Conf. on the glassy state, Nov. 16-20, 1959, p. 256-262. New York's Consultants Bur., 1960.

______1962, Glass electrode theory. Zh. Fiz. Khim. 36, p. 1327-1330.

Nikol'skii, B. P., Shul'ts, M. M., and Peshekhonova, N. V., 1958a, Theory of the Glass Electrode IX. The application of the ion exchange theory to glass electrodes with different metallic functions. Zh. Fiz. Khim. 33, 1920.

______1958b, Theory of Glass Electrodes VIII. The transition of the glass electrode from one metallic function to another. Zhur. Fiz. Khim. 32, p. 262-269.

______1958, Theory of Glass Electrodes VII. Effect of foreign ions on the sodium and potassium functions of the glass electrodes. Zhur. Fiz. Khim. 32, p. 19-26.

Nikol'skiff, B. P., Shul'tz, M. M., Peshekhonova, N. V., and Belyustin, A. A., 1961, Electrode behavior of glasses containing two acidic (glass-forming) oxides. Dokl. Akad. Nauk SSSR 140, p. 641-643.

Nikol'skii, B. P., Bysokoostrovskaya, N. B., and Trofimoy, A. M., 1962, Exchange of the ions of some alkaline earth metals on carboxylic, phosphate, and sulfonated resins. Radiokhimiya 4(4), p. 512-514.

Nikolsky, B. P., and Shultz, M. M., 1963, The new ideas of the ion-exchange theory of the glass electrode I. Vestnik, Leningrad Univ., no. 4 (1), p. 73 (1963.

Nikolsky, B. P., Shultz, M. M., and Beljustin, A. A., 1963, The new ideas of the ion-exchange theory of the Glass Electrode II. Vestnik, Leningrad Univ., no. 4(1), p. 86 (1963).

Nims, L. F., 1962, Tracers, transfer through membranes, and coefficients of transfer. Sci. 137, p. 130-132.

Nutting, P. G., 1935, Technical basis of bleaching-clay industry: Am. Assoc. Petroleum Geologists Bull., v. 19, p. 1043-1052.

_____1937, A study of bleach clay solubility: Jour. Franklin Inst., v. 224, p. 339-362.

Nye, Peter, Craig, Doris, Coleman, N. T., and Ragland, J. L., 1961, Ion-exchange equilibria involving aluminum. Soil Sci. Soc. Am., Proc. 25, p. 14-17.

Oda, Ryokei, 1947, Mechanism of ionic exchange in ion-exchanging synthetic resins. Repts. Chem. Res. Inst. Kyoto Univ. 16, p. 41.

Ogg, C. L., 1942, Base exchange equations applied to Iowa soils: Iowa State Coll. Jour. Sci., v. 17, p. 103-104.

Ohlrogge, A. J., 1958, How roots tap a fertilizer band. Plant Food Rev. 4, no. 2-3, 4-5, p. 33-35.

Okazaki, Minoru, 1963, Ion exchange equilibrium of hydrated halloysite treated with concentrated NaOH solution. Kogyo Kagaku-Zasshi 66(3), p. 322-324.

Oliinik, A. V., and Korshunov, I. A., 1962, The equation of the ion-exchange adsorption kinetics in its initial state. Tr. po Khim. i Khim. Tekhnol. 1962, no. 1, p. 213-215.

_____1962, The kinetics of ion-exchange in its initial stage. Tr. po Khim. i Khim. Tekhnol. 4, p. 430-435.

Orville, P. M., 1963, Alkali ion exchange between vapor and feldspar phases: Am. Jour. Sci. 261, p. 201-237.

Osborn, G. H., 1953, Ion-exchange resins in analytical chemistry. The application of ion-exchange resins to the analysis of insoluble substances. Analyst 78, 220-1 (1953).

Overstreet, Roy, 1957, Absorption of inorganic ions by root cells: Plant Physiol. 32, p. 491-492.

Pachter, A., 1957, Interaction of montmorillonite clays with Soil Sci., v. 83, p. 335-343.

Page, J. B., and Baver, L. D., 1939, Ionic size in relation to fixation of cations by colloidal clay: Soil Sci. Soc. America Proc., v. 4, p. 150-155.

Paliwal, K. V., 1961, A statistical examination of the suitability of some of the ion-exchange equations in respect of some clay minerals and oxides in systems containing calcium, magnesium, and potassium: Jour. Indian Soc. Soil Sci. 9, p. 205-214.

Panasevich, A. A., Ovcharenki, F. D., and Kukovskii, E. G., 1962, The effect of ion exchange on the physical and chemical properties of palygorskite. Dopovidi Akad. Nauk Ukr. RSR 1962, p. 931-935.

Panchenkov, G. M., Tolmachev, and Fedorov, V. A., 1963, Synthetic zeolites as ion exchangers. II. Study of the ion exchange equilibrium. Zhurnal fisicheskoy khimii, v. 37, no. 2, p. 456-459.

Paneth, F. A., 1948, Exchange of ions between crystal surfaces and solutions: Jour. Chem. Physics, v. 45, p. 205-211.

Papuashvili, S. N., and Shishniashvili, M. E., 1960, Exchange adsorption and exchange acidity on clays. Prirodnye Mineral. Sorbenty, Akad. Nauk SSR, Otdel. Khim. Geol. Nauk, Trudy Soveshchaniya, Kiev 1958, p. 108-115.

Parausany, V., Danes, F., Mateescu, C., and Landauer, O., 1963, Adsorption of inorganic ions on ion-exchangers. Bul. Inst. Politeh. Bucuresti 25(1), p. 41-52.

Parfenov, A. I., Shultz, M. M., Nekrasova, T. N., and Polozova, I. P., 1963, The electrode properties and chemical stability of lithiumsilicate glasses containing oxides of yttrium. Vestnik, Leningrad Univ., no. 4(1), p. 126.

Parfenov, A. I., Shultz, M. M., Kochergina, N. N., Ivanov, V. P., Evnina, S. B., Kalmikova, L. P., and Ageeva, E. D., 1963, The electrode properties and chemical stability of a number of polycomponent lithiumsilicate glasses. Vestnik, Leningrad Univ., no. 4(1), p. 162.

Parker, F. W., 1929, Exchangeable hydrogen in soils: Am. Soc. Agronomy Jour., v. 21, p. 1030-1039.

Parsons, J. S., 1958, Permselective membrane electrodes. Analytical application: Anal. Chem. 30, p. 1262-1265.

Pauley, J. L., 1954, Prediction of cation-exchange equilibria: Am. Chem. Soc. Jour. 76, p. 1422-1425.

Pauling, Linus, 1930, The structure of micas and related minerals: Natl. Academy Sci. Proc., v. 16, p. 123-129.

_____1940, The nature of the chemical bond and the structure of molecules and crystals: Ithaca, New York, Cornell Univ. Press, 450 p.

Paver, H., and Marshall, C. E., 1934, The role of aluminum in the reactions of the clays: Soc. Chem. Industry Jour., v. 53, p. 750-760.

Peech, Michael, 1941, Determination of exchangeable bases in soils, rapid micromethod: Indus. Eng. Chemistry Anal. Ed., v. 13, p. 436-441.

_____1945, Determination of exchangeable cations and exchange capacity of soils-rapid micro-methods utilizing centrifuge and spectrophotometer: Soil Sci., v. 59, p. 25-38.

Peech, Michael, Alexander, L. T., Dean, L. A., and Reed, J. F., 1947, Methods of soil analysis for soil-fertility investigations: U.S. Dept. Agriculture Circ. 757.

Perkins, A. T., 1949, Reactions of muscovite, bentonite, and their treated residues: Soil Sci., v. 67, p. 41-46.

Peshekhonova, N. V., Romanova, I. F., and Gorina, M. Yu, 1960, Lithium function of glass electrodes. Vestnik Leningrad. Univ. 15, no. 16, Ser. Fiz. i Khim. no. 3, p. 85-94.

Peterson, M. A., 1960, Exchange diffusion and electrochemical studies of ion-selective membranes. Univ. Microfilms (Ann Arbor, Mich.), L. C. Card No. Mic 6-3863, 154 pp.; Dissertation Abstr. 21, 1392-3.

Petrovskii, G. T., 1959, Electrode properties of sodium barium silicate glasses, Leningrad 3rd all-union Proc. on the glassy state, Nov. 16-20, 1959, p. 263-265. New York Consultants Bureau, 1960.

Pieroni, L. J., and Dranoff, J. S., 1963, Ion-exchange equilibriums in a ternary system: Am. Chem. Inst. Engrs. Jour. 9, p. 42-45.

Piper, C. S., 1947, Soil and plant analysis: New York, Interscience Publishers, Inc., 368 p.

Platek, W. A., and Marinsky, J. A., 1961, Ion-exchange in concentrated electrolyte solutions. I. The system lithium chloride-alkali chloride-Dowex-50: Jour. Chem. Phys. 65, p. 2113-2117.

_____1961, Ion-exchange in concentrated electrolyte solutions. II. The system lithium chloride-alkali chloride-zeolite: Jour. Chem. Phys. 65, p. 2118-2122.

Plumat, E., 1954, Cationic screening and surface reaction phenomena: Silicates Industriels, v. 19, p. 97-107.

Pochhali, L., 1960, Ion-exchange reactions with heteroionic synthetic resins. I. Cation exchange: Indian Chem. Soc. Jour. 37, p. 521-526.

Pommer, A. M., 1963, Relation between dual acidity and structure of H-montmorillonite: U.S. Geol. Surv. Prof. Paper 386-C, 23 p.

Pommer, A. M., and Carroll, D., 1960, Interpretation of potentiomatric titration of H-montmorillonite: Nature 185, no. 4713, p. 595-596.

Pratt, P. F., and Holowaychuck, N. A., 1954, A comparison of ammonium acetate, barium acetate, and buffered barium chloride methods of determining cation-exchange capacity: Soil Sci. Soc. America Proc., v. 18, p. 365-368.

Puustjarvi, Viljo, 1958, On the mechanism of the uptake of cations by Sphagnum: Suo 9, no. 1, p. 13.

_____1956, On the cation exchange capacity of heats and on the factors of influence upon its formation: Acta Agr. Sci, v. 6, p. 410-449.

Rachinskii, V. V., 1961, The theory of the dynamics of ion-exchange sorption and chromatography. II. The nonequilibrium dynamics of the sorption of equivalent ions. Izv. Timiryazevsk. Sel'skorhoz. Akad. 1961, no. 3, p. 177-194.

_____1961a, The theory of the dynamics of ion-exchange sorption and chromatography. II. The nonequilibrium dynamics of the sorption of equivalent ions. Izv. Timiryazevsk. Sel'skokhoz. Akad. 1961, no. 3, p. 177-194.

Rachinskii, V. V., and Rustamov, S. M., 1961b, Theory of the dynamics of ion-exchange adsorption and chromatography. III. Dynamics of the ion-exchange adsorption of ions of different valencies. Izv. Timirynzevsk. Sel'skokhoz. Akad. 1961, no. 6, p. 214-223.

_____1962, Determination of ion-exchange constants by the method of elution radiochromatography. Radiokhimiya 4 (4), p. 434-442.

Radu, I. F., 1940, Über die Basenaustausch-Kapazitat der Boden: Bodenk. u. Pflanzernernähr. Düng., v. 21-22, p. 574-580.

Ray, B. B., and Das, C. C., 1953, Electrochemical properties of H-clays from several Indian soils in relation to their mineralogical makeup: Soil Sci., v. 76, p. 97-105.

Reichenberg, Daniel, 1962, Ion exchange selectivity, Endeavour 22, 123-8.

Reichenberg, Daniel, and Sutcliffe, J. F., 1954, Absorption of ions by plants Nature 174, 1047-8.

Reid, C. E., and Spencer, H. G., 1960, Ultrafiltration of salt solutions by ion-excluding and ion-selective membranes: Jour. Appl. Polymer Sci. 4, p. 354-361.

Reifenberg, A., and Buckwold, S. J., 1954, The release of silica from soils by the ortho-phosphate anion: Jour. Soil Sci., v. 5, p. 106-115.

Reitemeier, R. F., Brown, I. C., and Holmes, R. S., 1951, Release of native and fixed non-exchangeable potassium of soils containing hydrous mica: U.S. Dept. Agriculture Tech. Bull. 1049, 46 p.

Rible, J. M., and Davis, L. E., 1955, Ion-exchange in soil columns: Soil Sci., v. 79, p. 41-48.

Riedel, H. J., 1962, Characterization of the cation exchange properties of suitable inorganic materials. Ber. Kernforsch. Juelich 1962, no. 32, 83 p.

Rios, E. G., 1956, Ion-exchange equilibrium between solid surfaces and aqueous solutions. Trabajos reunion intern. reactividad solidos, 3°, Madris, 1, p. 21-56.

Rios, E. G., and Vasquez, C. del Pino, 1956, Exchange equilibrium between hydrogen ions and alkali cations with resins. Anales. edafol: y fisiol. vegetal (Madrid) 15, p. 725-780.

Ripley-Duggan, B. A., 1952, Retention by wood of Cu and Zn from aqueous solutions of their salts: Jour. Appl. Chem., v. 2, p. 593-600.

Robertson, R. H. S., 1948, Clay minerals as catalysts: Clay Minerals Bull., v. 1, p. 47-54.

Robertson, R. H. S., and Twedily, A. E., 1953, The biogeochemistry of Skye diatomite: Clay Minerals Bull., v. 2, p. 7-16.

Rodriques, G., 1954, Fixed ammonia in tropical soils: Jour. Soil Sci., v. 5, p. 264-274.

Rosenberg, N. W., George, J. H. B., and Potter, W. D., 1957, Electrochemical properties of cation-transfer membrane. J. Electrochem. Soc. 104, p. 111-115.

Ross, C. S., 1943, Clays and soils in relation to geologic processes: Washington Acad. Sci. Jour., v. 33, p. 225-235.

Ross, C. S., and Hendricks, S. B., 1945, Minerals of the montmorillonite group, their origin and relation to soils and clays: U.S. Geol. Survey Prof. Paper 205-B.

Rothstein, Aser, 1957, Transport of bivalent cations into the yeast cell in relation to potassium and phosphate uptake. U.S. AEC., UR-502, 21 p.

Rothstein, A., Hayes, A., Jennings, D., and Hooper, D., 1958, The active transport of Mg++ and Mn++ into the yeast cell. J. Gen. Physiol. 41, p. 585-594.

Russell, E. W., and Cox, G. A., 1950, The direct determination of ionic activity products or ratios in soils: Trans. Intern Congr. Soil Sci. 4th Congr., Amsterdam 1950, I, p. 138-141, IV 82.

Russell, R. S., 1954, The relationship between metabolism and the accumulation of ions by plants. Symposia Soc. Exptl. Biol. 8, Active Transport and Secretion, p. 343-366.

Saeki, H., and Okamoto, M., 1956, The frictions and availabilities of phosphates in soils and montmorillonite series: Jour. Soil Sci., Tokoyo, v. 27, p. 149-154.

Sakai, W., Seijama, T., 1953, Theory of ion-exchange equilibria, II. Faculty Engineering, Kyushu Univ., Mem., 14, p. 85-100.

Salminen, Simo, Ekman, Aarne, Rastas, Jussi, 1963, Transport of Ions across Membranes: Nature 200, p. 1069.

Salmon, J. E., 1952, Complexes involving trivalent iron and orthophosphoric acid. I. Experiments with ion-exchange resins: Jour. Chem. Soc. (London),1952, p. 2316-2323.

_____1953, Complexes involving trivalent iron and orthophosphoric acid. II. Ion-exchange studies of solution containing phosphate and chloride: Jour. Chem. Soc. (London), 1953, p. 2644-2649.

Samodelov, A. P., 1961, The electrode properties of the scandium-membrane electrode. Izvest. Sibir. Otdel. Akad. Nauk SSSR. 1961, no. 4, p. 43-47.

Samsonov, G. V., 1962, Thermodynamic theory for the selectivity of the sorption of ions as established by ion-exchange methods for the purification of pharmaceutical substances. Tr. Leningr. Khim. Farmatsevt. Inst. 1962, no. 15, p. 9-14.

Samsonov, G. V., and Moskvichev, B. V., 1963, Thermodynamics of the selective calcium sorption on carboxylic dation exchangers. Kolloidn. Zh. 25(3), p. 366-368.

Samsonov, G. V., and Pasechnik, V. A., 1962, Change in the thermodynamic potential of ion-exchange resins in the process of ion exchange. Zh. Fiz. Khim. 36, p. 2727-2733.

Saunders, W. M. H., and Blakemore, L. C., 1955, Changes in the base status of soil after treatment with sulphur or sulphuric acid, New Zealand Jour. Sci. Tech., v. B37, p. 276-282.

Scatchard, G., 1953, Ion-exchange electrodes: Am. Chem. Soc. Jour. 75, p. 2883-2887.

Schachtschabel, P., 1940, Untersuchung über die sorption de tonmineralien und Boden. Kolloide und die Bistimmung des Anteils dieser Kolloide und der sorption in boden, Kolloid-Beihefte 51, p. 199-276.

_____1941, Die Bindung der Kationen und die Bistimmung der Sorptionsläger des Bodens: Zeits. Pflantzenernährung, Düngung u. Bodenk., v. 23, p. 1-17.

Scheffer, F., Rathje, W., and Schafmayer, H., 1952, Mechanism of absorption of matter by plant cells. Z. Pflantzenernähr. Düngung u. Bodenk. 56, p. 139-151.

Scheffer, F., and Schulz, H. G., 1955, Preparation and properties of some iron phosphates. A contribution to phosphate fixation in soils: Zeits. Pflantzenernähr. Düngung u. Bodenk., v. 70, p. 141-164.

Schnepfe, M. M., 1960, Cation exchange with vermiculite: U.S. Geol. Survey Prof. Paper 400-B, B161-B163.

Schoen, Ubriche, 1953, Identification of clay by phosphate fixation and cation exchange: Zeitschr. Pflantzenernähr. Düngung u. Bodenk., v. 63, p. 1-17, 97-119.

Schofield, R. K., 1946, Ionic forces in thick films of liquid between charged surfaces: Faraday Soc. Trans. 42B, p. 219-25 (1946).

______1947, A ratio law governing the equilibrium of cations in the soil solution: Internat. Cong., 11th, London, Pure and Applied Chem., Proc., v. 3, p. 257-261.

______1947, Some problems connected with the retention of ions by clay constituents: Clay Minerals Bull., v. 1, p. 18-20.

______1949a, Effect of pH on electric charges carried by clay particles: Jour. Soil Sci., v. 1, p. 1-8.

______1949b, Calculation of surface areas of clays from measurements of negative adsorption: British Ceramic Soc. Trans., v. 48, p. 207-211.

Schofield, R. K., and Samson, H. R., 1954, Floculation of kaolinite due to the attraction of opposites, changed drystal faces: Faraday Soc. Discussions, no. 8, p. 135-145.

Schofield, R. K., and Taylor, A. E., 1955, Measurements of the activities of bases in soils: Jour. Soil Sci., v. 6, p. 137-146.

Schonfeld, T., and Broda, E., 1951, Adsorption of ions on paper and glass surfaces. Mikrochemie ver Mikcrochim. Acta 36-37, p. 537-552.

Schonhorn, Harold, 1961, Preparation and characterization of multilayer membrane electrodes: Univ. Microfilms (Ann Arbor, Mich.), L. C. Card No. Mic 60-6428, 93 p.

Schuffelen, A. C., 1947, Soil factors influencing the cation absorption of plants: Landbouwkund-Tijdschr. 1944, p. 116-124; Biol Abs. 21,

Schuffelen, A. C., Mance, and Vender, H. N., 1955, Potassium fixation, in Soils Potassium Symposium, p. 157-201.

Schuffelen, A. C., and Middelburg, H. A., 1953, Ionic exchange interrelationships in soils

Schuffelen, A. C., and Middelburg, H. A., 1954, A rapid method for the determination of the base exchange capacity of plant roots: 5th Internat. Soil Sci. Congress Trans., v. 2, p. 348-351.

Schuylenborgh, J. van, and Vervelde, G. J., 1952, The use of glass electrodes for the measurement of activities of metal ions. Rec. trav. chin. 71, p. 490-496.

Schwabe, K., and Dahms, H., 1960, Radiotracer investigation of ion exchange on glass electrodes: Isotopen Tech. I, p. 34-39.

_____1960, Untersuchung des Ionenaustauchen an Glaselkroden in alkalischen Lösung mit Radioisotropen: Naturwissenschaften, v. 47, p. 251-252.

_____1961, Comparative investigation of the electromotive properties and chemical behavior of glass electrodes by radioactive indicators. I. Investigations of the alkali error. Z. Elektrochem. 65, p. 518-526.

Scott, R., 1954, Cesium accumulation by marine algae: Radioisotope Conf., 2nd, Oxford, Med. Physiol. Application, Proc., p. 373-380.

Seiler, F. E. E., and Ilchenko, V. lalirin, 1955, Manganese in the series of exchangeable soil cations: Agric. Dept. Minas Geras Bol. Prod. veg., v. 4 (No.5-6), p. 7-21.

Senõ, M., and Yamabe, T., 1960, The ion-exchange behavior of some neutral amino acids: Chem. Soc. Japan Bull., v. 33, No. 11, p. 1532-1549.

Serdobol'skii, I. P., 1957, The chemical theory of cation exchange: Pochvovedenie 1957, No. 6, p. 24-34.

_____1955, The reactions of amino exchange: Pochvovedenie, no. 7, p. 24-34.

Shaw, T. I., 1959, Mechanism of iodine accumulation by the brown sea weed laminciria digitata: The uptake of iodine - 131. Royal Soc. Proc., London B150, p. 356-371.

Shaw, W. M., 1949, Determination of exchangeable hydrogen and lime requirement of soils: Assoc. Official Agr. Chemists Jour., v. 32, p. 437-452.

_____1952, Report on exchangeable hydrogen in soils: Assoc. Official Agr. Chemists Jour., v. 35, p. 597-621.

_____1953, Exchangeable hydrogen in soil. The titration of H with $CaCO_3$ and resulting pH values of certain soils: Assoc. Official Agr. Chemists Jour., v. 36, p. 230-237.

Shih, Chiao-Nai, 1958, Absorption and accumulation of ions (in plants). Chih Wu Sheng Li Nsueh T'ung Hsun 1958, no. 4, p. 1-14.

Shul'ts, M. M., 1954, Investigation of the sodium function of the glass electrode. Uchenye Zapiski Leningrad. Gosudarst. Univ. No. 169, Ser. Khim Nauk No. 13, 80-156, 1953; Referat. Zhur., Khim. 1954, No. 32, p. 160.

_____1960, Theory of glass electrode and a few problems of glass chemistry. Vestnik Leningrad. Univ. 15, no. 22, Ser. Fiz. i Khim no. 4, p. 40-48.

_____1963, The dependence of the electrode properties of glasses upon their structure. Vestnik. Leningrad Univ., no. 4(1), p. 98.

Shul'ts, M. M., and Belyustin, A. A., 1962, Effect of boric anhydride on the electrode properties of the simple sodium silicate glasses: Vestn. Leningr. Univ. 17, no. 4, ser. Fiz. i Khim., no. 1, p. 135-142.

Shul'ts, M. M., and Parfenov, A. I., 1958, Behavior of sodium glass electrodes in alcohol - water solutions of sodium chloride: Vestnik Leningr. Univ. 13, no. 16, ser. Fiz. i. Khim., no. 3, p. 118-125.

Shul'tz, M. M., Bobrov, V. S., and Bukhareva, I. S., 1963, The electrode properties of glasses, containing TiO_2: Vestnik, Leningrad Univ., no. 4 (1), p. 134.

Shul'tz, M. M., Parfenov, A. I., Panfilova, N. P., 1963, The influence of ZrO_2 on electrode properties and chemical stability of alkali silicate glasses: Vestnik, Leningrad Univ., no. 4(1), p. 143.

Shul'tz, M. M., Peshekhonova, N. V., and Lipetz, T. V., 1963, The investigation of electrode properties and chemical stability of lithiumsilicate glasses, containing BaO and La_2O_3: Vestnik, Leningrad Univ., no. 4(1), p. 160.

Shul'tz, M. M., Peshekhonova, N. V., and Shevnina, G. P., 1963, The investigation of the electrode properties of lithium borosilicate and gallosilicate glasses: Vestnik, Leningrad Univ., no. 4(1), p. 120.

Shul'tz, M. M., Parfenov, A. I., Peshekhonova, N. V., and Beljustin, A. A., 1963, The methods of investigations of electrode properties and chemical stability of glasses: Vestnik, Leningrad Univ., no. 4(1), p. 98.

Shul'tz, M. M., Peshekhonova, N. V., Kopuntzova, T. A., and Shandalova, L. P., 1963, The influence of the oxides of alkaliearth metals on electrode properties and chemical stability of natriumsilicate glasses: Vestnik, Leningrad Univ., no. 4(1), p. 114.

Shul'tz, M. M., Parfenov, A. I., De-jui, Chen, Bondarenko, T. G., and Mekhrjushev, J. J., 1963, The electrode properties of glasses of the Li_2O-Cs_2O-La_2O_3-SiO_2 oxide system: Vestnik, Leningrad Univ., no. 4 (1), p. 155.

Shul'tz, M. M., Peshekhonova, N. V., Parfenov, A. J., Ivanova, E. A., and Petrova, V. N., 1963, The investigation of influence of alkaliearth oxides on the electrode properties and chemical stability of lithiumsilicate glasses: Vestnik, Leningrad Univ., no. 4(1), p. 104.

Sieskind, O., and Wey, R., 1960, The variation in cation-exchange capacity of montmorillonite-H as a function of pH: Bull. group franc-argiles <u>9</u>, no. 4, page 1-6.

Skurikhina, G. M., and Uyr'ev, V. I., 1959, Influence of cation concentration on the absorption activity of carboxycellulose: Trudy Lening. Lesolekh. Akad. im. S. M. Kirova <u>1959</u>, no. 87, p. 73-77.

Slabaugh, W. H., 1952, The heat of neutralization of H-bentonite: Am. Chem. Soc. Jour., v. 74, p. 4462-4464.

_____1954, Cation exchange properties of bentonites: Jour. Phys. Chemistry, v. 58, p. 162-165.

_____1955, Heats of immersion of some clay systems in aqueous media: Jour. Phys. Chemistry, v. 59, p. 1022-1024.

Soldatov, V. S., and Starobinets, G. L., 1963, Temperature dependence of the apparent equilibrium constants of ion-exchange processes: Izv. Vysshikh Uchebn. Zavedenii, Khim. i. Khim. Tekhnol. <u>6</u>(1), p. 68-71.

_____1963, The thermodynamic functions of ion exchange: Izv. Vysshikh Uchebn. Zavedenii, Khim. i Khim. Tekhnol. <u>6</u>(3), p. 420-424.

Sollner, K., 1945, The physical chemistry of membranes with particular reference of the electrical behavior of membranes of porous character II. The nature of the "dried" collodion membrane. Some current membrane theories and their limitation: J. Phys. Chemistry <u>49</u>, p. 171-191.

______1945, The phys. chem. of membranes with particular reference to the electrical behavior of membranes of porous character. III. The geometrical and electrical structure of membranes of porous character; some examples of the machine action of membranes: Jour. Phys. Chemistry 49, p. 265-280.

______1949, The origin of bi-ionic potentials across porous membranes of high ionic selectivity. I. The bi-ionic potential and the mechanism of its origin; the various factors that determine the sign and the magnitude of the bi-ionic potential; systems with critical ions of the same size and of different absorbability: J. Phys. Colloid Chemistry 53, p. 1211-1226.

______1950, Addition to the papers "The origin of the bi-ionic potential across porous membranes of high ionic selectivity. I. II: Jour. Phys. Colloid Chemistry 54, p. 743-744.

______1950, Recent advances in the electrochem. of membranes of high ionic selectivity: Jour. Electrochem. Soc. 97, p. 139-151.

Sollner, K., and Carr, C. W., 1942, The structure of the collodion membrane and its electrical behavior. IV. The relative merits of the homogenous phase theory and the micellar-structure theory as applied to the dried collodion membrane: Jour. Gen. Physiol. 26, p. 17-25.

______1943, The structure of the collodion membrane and its electrical behavior. V. The influence of the thickness of dried collodion membranes upon their electromotive behavior. Jour. Gen. Physiol. 26, p. 309-323.

_____1944, The structure of the collodion membrane and its electrical behavior. X. An experimental test of some aspects of the Teorell and Meyer and Siever's theories of electrical membrane behavior: Jour. Gen. Physiol. 28, p. 1-15.

Sollner, K., and Beck, P. W., 1944, The structure of the collodion membrane and its electrical behavior. IX. Water uptake and swelling of collodion membranes in aqueous solutions of organic electrolyte and nonelectrolytes: Jour. Gen. Physiol. 27, p. 451-460.

Sollner, K., and Gregor, H. P., 1945, Membrane equilibria which involve only the ions of strong inorganic electrolytes: Am. Chem. Soc. Jour. 67, p. 346.

_____1950, The electrochemistry of permselective protamine collodion membranes, II: Jour. Phys. Chemistry 54, p. 330-338.

Sollner, K., Carr, C. W., and Gregor, H. P., 1950, Ionic membranes. U.S. 2,510,262, June 6, 1950 (to Regents of the Univ. of Minnesota).

Sollner, K. Dray, S., Grim, E., and Neihof, R. Electrochemical studies with model membranes in Ion Transport Across Membranes. Edited by Hans Clarke Acad. Press.

Spannaay, M. J., 1957, Non-equilibrium diffuse double-layer: Faraday Soc. Trans., v. 53, p. 306-314.

Spiegler, K. S., 1958, Transport processes in ionic membranes: Faraday Soc. Trans. 54. p. 1408-1428.

Starobinets, G. L, and Dubovik, T. L., 1963, The selectivity of anionic exchange on strongly basic anion exchangers: Vestsi Akad. Navuk Belarusk. SSR, Ser. Fix.-Tekhn. Navuk 1963(2), p. 48-52.

Starobinets, G. L., and Soldatov, V. S. (Minsk), 1963, Thermodynamics of the ion exchange on sulfonated styrene - divinyl benzene copolymers: Zhur. fig. khim., v. 37, no. 2, p. 294-300.

_____1962, Thermodynamic characteristics of ion-exchange equilibriums: Vestsi Akad. Navuk Belarusk. SSR, Ser. Fiz.-Tekhn. Navak 1962, no. 3, p. 69-74.

_____1962, Thermodynamics of ionic exchange: Dokl. Akad. Nauk Belorussk, SSR 6, p. 233-236.

Staverman, A. J., 1952, Non-equilibrium thermodynamics of membrane processes: Faraday Soc. Trans. 48, p. 176-185.

Stein, G., and Forgacs, C., 1963, Permselective membranes: Spectroscopic and Conductivity Effects: Science, 142, p. 953.

Stephanova, O, K., Shultz, M. M., Materova, E. A., and Nikolsky, B. P., 1963, The EMF of the galvanic cells involving ion exchange membranes: Vestnik Leningrad Univ. no. 4(1), p. 93.

Stepin, B. D., Tartakovskaya, A. M., and Plyushchev, V. C., 1960, the reversibility of the lyotropic series of alkali metals: Zhur. Neorg. Khim. 5, p. 1612-1617.

Steward, F. C., and Millar, F. K., 1954, Salt accumulation in plants: a reconsideration of the role of growth and metabolism. I. Salt accumulation as a cellular phenomenon: Symposia Soc. for Expt. Biol. 8, Active Transport and Secretion, p. 367-393.

Strelow, F. W. E., 1960, Ion exchange selectivity scale cations based on equilibrium distribution coefficients: Anal. Chemistry 32, p. 1185-1188.

Struthers, P. H., and Sieling , D. H., 1950, Effect of organic anions on phosphate precipitation by iron and alumina as influenced by pH: Soil Sci., v. 69, p. 205-213.

Subrahmanyan, V., and Lakshminarayanaiah, N., 1962, Relation between true and apparent transport numbers of counterions in cation-exchange membranes: Indian Sci. Jour. Res. (India) 21B, p. 229-231.

Sugawan, Kin-ichi, 1957, Base exchange of vermiculite from Ono-machi, Fukashima Prefectue:

Sullivan, E. C., 1905, Base exchange reactions between natural silicates and the bases of numerous silts in solution: Econ. Geology, v. 1, p. 67.

Sutcliffe, J. F., 1956, Selective absorption of alkali cations by storage tissues and intact barley plants: Potassium Symposium Ann. Meeting Board Tech. Ad. Intern. Potash Inst., London, p. 1-11.

_____1959, Salt uptake in plants: Biol. Revs. Cambridge Phil. Soc. 34, p. 159-220.

Sutcliffe, J. F., 1959, Absorption of alkali cations by plant tissue cultures: Nature 183, p. 1513-1514.

Takahaski, Takeo, Ishiwatari, Yoshio, Shirai, Hideko, 1963, Selective ion exchange behavior of Alginate in mixed solution of metal ions: Chem. Soc. Japan Jour. 66, no. 10, p. 1458. (Articles in Japanese)

Tamers, M. A., and Thomas, H. C., 1960, Ion-exchange properties of kaolinite slurries: Jour. Phys. Chemistry 64, p. 29-32.

Tamura, T. 1962, Strontium reactions with minerals: U.S. Atomic Energy Comm. TID-7628, p. 187-195.

Tamura, T., and Jacobs, D. G., Structural implications in cesium sorption: Health Phys. 2, p. 391-398.

Tendeloo, H. J. C., 1947, Potential of ion exchanging substances: Faraday Discussion Soc., p. 293-302.

Tendeloo, H. J. C., Voorspuy, A. J., 1942, Absorption electrodes. IV. Glass electrodes: Rec. Trav. Chim. 61, p. 531-538; Chem. Zentr. 1942, II, p. 1549.

_____1943, Absorption electrodes. V. Glass electrode, ion exchange, and electrode properties: Rec. Trav. Chim. 62, p. 784-792 (in English).

Tendeloo, H. J. C., and Voort, F. H. Van der, 1960, Electrochemical researches on paraffin membranes. VI: Rec. Trav. Chim. 79, p. 639-642 (in English).

Teorell, Torsten, 1951, Quantitative treatment of membrane permeability: Z. Elektrochem. 55, p. 460-469.

Thomas, H. C., 1954, The thermodynamics of ion exchange on clay minerals. A preliminary report on the system montmorillonite cesium-strontium: Clays and Clay Minerals, Proc. and Natl. Conf., 1953, Natl. Acad. Sci.-Natl. Res. Council Publ. No. 327, p. 398-403.

Thomas, H. C., and Frysinger, G. R., 1956, Ion exchange: Rev. Ann. Chem. Phys., v. 7, p. 151-152.

Thomas, T. L., Jr., 1962, Cation separation by using zeolitic materials: U.S. 3,033,641, May 8, 1962, Appl. Mar. 21, 1956, 5 pp.

Thompson, H. S., 1850, On the absorbent power of soils: Royal Agr. Soc. England Jour., v. 11, p. 68-74.

Thompson, J. G., 1953, Preliminary note on a suggested new method for exchangeable bases in calcareous soils: Soil Sci. Jour., v. 4, p. 238-240.

Tibikh, A. A., Parshad, I., and Overstreet, R., 1960, Cation-exchange hysteresis in clay minerals: Soil Sci. 90, p. 219-226.

Tikhomirova, M. M., and Tageeva, N. V., 1958, Experimental geochemical studies of the formation of underground water types: Trudy Lab. Gigrogeol. Problem im. F. O. Savarenskogo, Akad. Nauk SSSR 16, p. 261-284.

Titov, V. S., 1959, Effect of the characteristics of an ion-exchange resin on the properties of a membrane: Khim. Nauka i Prom. 4, p. 137-138.

Tolmachev, A. M., Gorshkov, V. I., and Panchenkov, G. M., 1963, Dynamics for the exchange of ions of different valence: Zh. Fiz. Khim. 37 (7), p. 1635-1636.

Miroslav, Toman, 1953, Theory of anomalous osmosis: Chem. Zvesti 7, p. 7-18.

Toth, S. J., and Price, A. L., 1949, Estimation of cation exchange capacity and exchangeable Ca, K, and Na contents of soils by flame photometer: Soil Sci., v. 67, p. 439-445.

Trofimov, A. M., and Stepanova, L. M., 1960, Radiochemical studies of ion-exchange on swellong ion-exchange resins: Zhur. Fix. Khim. 34, p. 1837-1842.

Trostyanskaya, E. B., and Tevlina, A. S., 1960, Properties of ion-exchange membranes: Zhur. Anal. Khim. 15, p. 681-685.

Truesdell, A. H., 1963, Theory of divalent-cation exchange selectivity, [abs.]: Geol. Soc. America Spec. Paper 76, p. 170.

_____1966, Ion-exchange constants of natural glasses by the electrode method: Am. Mineralogist, v. 51, p. 110-122.

Truesdell, A. H., and Pommer, A. M., 1963, Phosphate glass electrode with good selectivity for alkaline-earth cations: Science 142, no. 3597, p. 1292-1294.

Tsubota, Hiroyuki, 1963, Ion-exchange equilibrium between cesium and phenol-sulfonic-acid-type cation exchange resin: Bull. Soc. Chem., Japan 36(8), p. 1038-1043.

Tsuchihaski, Shoji, and Sekido, Eiichi, 1959, Solution of Na$_2$O, Cao-Sio$_2$ glass in acid and in water: Bull. Soc. Chem., Japan 32, p. 868-872.

Tsyurupa, I. G., 1950, Desorption of cations from soils and clays: Trudy Pochv. Inst. V. V. Dokuchaeva Akad. Nauk. U.S.S.R., v. 31, p. 5-72.

Tye, F. L., 1961, Absorption of electrolytes by ion-exchange materials: Chem. Soc. Jour., 1961, p. 4784-4789.

Tyntyunov, I. A., 1960, Reaction of the mineral part of the soil with water: Soviet Soil Sci., v. 2, p. 162-169 (English Foundation).

Ukai, Yasuo, Nishimura, Shin'ichi, and Yokoi, Toshio, 1958, On the uranium exchange of clay minerals: Coll. Sci. Univ. Kyoto Mem., ser. B, v. 24, p. 353-357.

U.S. Salinitz Laboratory staff, 1954, Diagnosis and improvement of saline and alkali soils: U.S. Dept. Agr. Handbook, no. 60, p. 160.

Vageler, P. W. E., 1928, Eenenander over de mathematische analyse van verdringingsverschijnselen in groden en hare beteekenis voor de praktijk: Landbouw (Buitenzorg, Java), v. 3, p. 244-259.

Vageler, P. W. E., and Woltersdorf, J., 1930, Beitrage zur Frage des Basenaustausches und der Aziditaten: Zeitschr. Pflanzenernahr. Dung. u. Bodenkl, <u>15</u>, p. 329-342.

Vanselow, A. P., 1932, Equilibria of the base-exchange reactions of bentonites, permutite, soil colloids, and zeolites: Soil Sci., <u>33</u>, p. 95-113.

Vasishth, R. C., 1961, Studies of the cation-exchange system $Fe^{+++}-H^{+}$: Univ. Microfilms, L. C. Card No. Mic 60-5980, p. 134. Dissertation Abs. 21, 3033-3034.

Vendel, I. M., 1955, Ion and atom substitution from geochemical viewpoints: Acta Geol. Acad. Sci. Hung. <u>3</u>, p. 245-300 (in German).

_____1958, Geochemical aspects of ion and atom exchange (in rocks). II. A method for the approximate det. of diadochial tendency: Magyar Tudomanyos Akad. Muszaki Tudomanyok Oszatalyanak Kozlemenyei <u>23</u>, p. 153-193.

Vendelshtein, B. Yu, 1958, Relation between the parameters of the electrical double layer on the surface of mineral particles and the diffusion adsorption electromotive force: Trudy Moskov. Neft. Inst. im. I. M. Gubkina <u>1958</u>, no. 22, p. 115-125.

Verwey, E. J. W., and Overbeek, J. T. L., 1948, Theory of the stability of lyophobic colloids: New York, Elsevier Publ. Co., p. 205.

Virasoro, E., 1959, Exchange equilibrium in a weakly acidic cationic resin: Rev. fac. ing. quim. 28, p. 75-80.

Von Rosenberg, D. U., 1958, A numerical solution to the miscible displacement equation: Symposium Digital Computing in Chem. and Petrochem. Inds., New York, N. Y., p. 1-15.

Wada, Koji, and Ataka, Haruo, 1958, Ion uptake mechanism of allophane: Soil and Plant Food 4, p. 12-18.

Walker, G. F., 1951, Vermiculites and some related mixed-layer minerals, *in* Brindley, G. W., *Editor*, X-ray identification and crystal structures of the clay minerals: Mineralog. Soc., London, p. 199-223.

Walker, G. F., and Milne, A., 1950, Hydration of vermiculite saturated with various cations: 4th Internat. Soil Sci. Cong. Trans., v. 2, p. 62-67.

Walton, H. F., 1949, Ion exchange equilibra, *in* Ion Exchange, F. C. Nachod, *Editor*: Acad. Press, Inc., New York, p. 3-28.

Walton, H. F., Jordan, D. E., Samedy, S. R., and McKay, W. N., 1961, Cation exchange equilibriums with bivalent ions: Jour. Phys. Chemistry 65, p. 1477-1484.

Way, J. T., 1850, On the power of soils to absorb manure: Jour. Royal Soc. Agr., England, v. 11, p. 313-379.

_____1852, On the power of soils to adsorb manure: Jour. Royal Soc. Agr., England, v. 13, p. 123-143.

Wear, J. I., and White, J. L., 1951, Potassium fixation in clay minerals as related to crystal structure: Soil Sci., v. 71, p. 1-14.

Wegmann, Dorothee, Lyssy, G. H., and Simon, W., 1961, Electromotive behavior of electrode glasses. II. Measurements on electrode glasses in aqueous systems: Helv. Chim. Acta 44, p. 25-30.

Weiss, Armin, 1959, Cation-exchange ability of clay minerals. III. Cation exchange in kaolinite: Z. anog. u. allgem. Chem. 299, p. 92-120.

Weiss, Armin, and Amstutz, G. C., 1966, Ion-exchange reactions in clay minerals and cation selective membrane properties as possible mechanisms of economic metal concentration: Mineralization Depositor, v. 1, p. 60-66.

Weiss, Armin, Michel, Eugen, and Fodnes, Trygve, 1962, Cation exchange and intercrystalline swelling of linear polyvanadates: Naturwissenschaften 49, p. 11-12.

Weiss, Armin, and Thamerus, Gerhard, 1962, The introduction of Al^{+++} and Si^{4+} into mica-like layer silicates in place of exchangeable cations: Z. Anorg. Allgem. Chem. 317, p. 142-148.

Wey, Raymond, 1953, Sur l'absorption de l'anion phosphorique par la montmorillonite: Acad. sci. [Paris] Comptes rendus, v. 236, p. 1298-1300.

_____ 1954, Sur l'adsorption de l'acide phosphorique pour la montmorillonite, role des cations Al: Acad. sci. [Paris] Comptes rendus, v. 238, p. 389-391.

White, W. A., 1953, Allophanes from Lawrence County, Indiana: Am. Mineralogist, v. 38, p. 634-642.

Whitney, D. C., and Diamond, R. M., 1963, Ion exchange studies in concentrated solutions. I. The alkali cations with a fulfonic and a carboylic acid resin: Inorganic Chemistry 2(6), p. 1284-1295.

Wiegner, G., and Hans, J., 1927, Uber Basenaustausch an Permutiten: Kolloid-Zeitschr., v. 43, p. 268-272.

Wiklander, Lambert, 1946, Studies of ion-exchange with special reference to condition in soils: Annales Royal Agr. College of Sweden, v. 14, p. 125.

_____1950, Fixation of potassium by clays saturated with different cations: Soil Sci. 69, p. 261-268.

_____1955, Cation and anion exchange phenomena. Chap. 4 in Bear, F. E., Editor, Chemistry of the Soil: Am. Chem. Soc. Mon. 126, New York, Reinhold Pub. Corp., 373 pp.

Williams, D. E., and Coleman, N. T., 1950, Cation Exchange properties of plant root surfaces: Pland and Soil, v. 2, p. 243.

Williams, R. J. P., 1954, The stability of complex ions with special reference to hydration: Jour. Phys. Chemistry, v. 58, p. 121-126.

Williams, F. J., Neznayko, M., and Weintritt, D. J., 1953, Effects of exchangeable bases on the colloidal properties of bentonite: Jour. Phys. Chemistry, v. 57, p. 6-10.

Wills, G. B., 1962, Membrane selectivity. Dissertation Abs. 22, 3963-4. (Univ. of Wisconsin, Madison). Univ. Microfilms (Ann Arbor, Mich.) Order No. 62-2266, 144 pp.

Winger, A. G., 1957, Membrane processes - ion exchange: Chem. Eng. Prog. 53, p. 606-612.

Winkler, R., 1960, Adsorption of uranium fission products on humic acid: Kernenergie 3, p. 992-998. (in German)

Winterkorn, H. F., 1952a, Job experience with exchange phenomena involving inorganic and organic ions: Am. Soc. Testing Mater. Spec. Tech. Publ. no. 142, p. 29-42.

_____1952b, Surface chemical properties of clay minerals and soils from theoretical and experimental developments in electroosmosis: Am. Soc. Testing Mater. Spec. Tech. Publ., no. 142, p. 44-52.

Woodruff, C. M., 1953, The relative activities of cations in Putnam clay: Univ. Microfilms (Ann Arbor, Michigan), Publ. 6102, 159 p.

_____1955a, Ionic equilibria between clay and dilute salt solutions: Soil Sci. Soc. America Proc., v. 19, p. 36-39.

_____1955b, Cation activities in the soil solution and energies of cationic exchange: Soil Sci. Soc. America Proc., v. 19, p. 98-99.

Wovermann, D., Bonhoeffer, K. F., and Helfferich, F., 1956, Cation exchanger selective for potassium ions: Z. Physik Chem. 8, p. 265-283.

Wyllie, M. R. J., 1954, Ion-exchange membranes. I. Equations for the multi-ionic potential: Jour. Phys. Chemistry 58, p. 67-73.

Wyllie, M. R. J., and Kanaan, S. L., 1954, Ion exchange membranes. I. Equation for the multionic potential - bi-ionic potentials in monovalent ionic systems: Jour. Phys. Chemistry 58, p. 67-80

_____1954, Ion-exchange membranes. II. Membrane properties in relation to bi-ionic potentials in univalent-ion systems: Jour. Phys. Chemistry 58, p. 73-80.

Wyllie, M. R. J., AND Patnode, H. W., 1950, The development of membranes prepared from artificial cation-exchange material with particular reference to the determination of sodium-ion activities: Jour. Phys. Colloid Chem. 54, p. 204-227.

Yamabe, Takeo, 1955, Empirical formula of the ion-exchange equilibria bared on the mass action law: Japan Chem. Soc. Jour., Ind. Chem. Sec. 58, p. 188-191.

_____1955, Application of Donnan equilibrium to ion exchange: Japan Chem. Soc. Jour., Ind. Chem. Sec. 58, p. 191-193.

_____1955, Equilibrium value of ion exchange calculated on the basis of the Donnan equilibrium: Japan Chem. Soc. Jour., Ind. Chem. Sec. 58, p. 915-917.

Yamabe, Takeo, and Furuichi, Toshio, 1956, Equilibriums of ion exchange in the calcium cycle: Kogyo Kayaku Zasshi 59, p. 144-146.

Yamabe, Takeo, and Saito, Tazuko, 1960, Exchange equilibriums on ion-exchange membranes: Kogho Kagaku Zasshi 63, p. 1848.

Yamabe, Takeo, Seno, Manabu, Tanaka, Tatsuo, and Kamii, Ichiro, 1960, Transport behavior of some inorganic cations across ion-exchange membranes: preferential impermeability of Ba ions across sulfonic acid membrane: Chem. Soc. Bull, Japan 33, p. 1740.

Yermolenko, N. F., and Shirinskaya, L. P., 1962, Selectivity of exchange on an NaA-type molecular sieve: Zhurnal fizicheskoy khimii, v. 36, no. 11, p. 2432-2435.

Yoder, H. S., and Eugster, H. P., 1955, Synthetic and natural muscovites: Geochim. et Cosmochim. Acta, v. 8, no. 5/6, p. 225-280.

Yoshida, Minoru, 1959, Studies on the adsorptive capacity of the soil. IV. The kind of negative charge and the exchange acidity: Tokyo Soil Sci., v. 30, p. 349-352 (in Japanese).

_____1960, Studies on the adsorptive ability of soil. V. Adsorption of potassium and ammonium: Nippon Dojo-Hiryogaku Zasshi 31, p. 415-418 (in Japanese).

Yoshito, Matsusaka, and Sherman, G. D., 1950, Titration curves and buffering capacities of Hawaiian soils: Univ. Hawaii Agric. Exper. Sta., Tech. Bull. No. 11, 36 p.

Zaitser, B. D., 1959, Experiment on the establishment of a correlation between content of exchangeable Ca and K, available P_1 and total N in humic-podzolic horizons of forest soils: Pochvovedenie, no. 3, p. 72-76.

Zakirov, K. Z., Rish, M. A., and Ezdakov, V. I., 1959, Accumulation of microelements in plants growing in regions of ore deposits: Uzbek, Biol. Zhur., Akad. Nauk Uzbek SSSR, no. 1, p. 15-20.

Zhabrova, G. M., and Egorov, E. V., 1961, Rules of sorption and ion exchange on amphoteric oxides and hydroxides: Uspekhi Khim. 30, p. 764-776.

Zhukov, A. I., Baranov, G. P., and Plyasunov, P. V., 1962, Sorption of hydrolyzed ions of Group I and II elements by cation-exchange resins: Zh. Neorgan. Khim. 7, p. 1452-1457.

Symposia and other special reports

Ion Exchange and its applications, 1955. Papers read at the conference in the William Beveridge Hall, London Univ., 5th-7th April, 1954, with the discussions that followed: Chem. Soc. Ind., London, S.W. 1.

Ion-exchange phenomena, 1952, A.S.T.M. Spec. Publ. No. 142.

Anion-exchange of several metal ions in HCl, HNO_3, and H_2SO_4 solutions with Dowex-2: U.S. Radiological Defense Lab Rept. No. 228.

Anion-exchange studies in phosphoric acid solutions: U.S. Radiological Defense Lab Rept. No. 231.

Synthesis of ion-exchange resins: Ann. New York Acad. Sci., v. 57, 1953. (a symposium with many useful articles)

Projet de specifications pour echangeurs de cations: Centre belge d'etude et de documentation des eaux (CEBEDEAU) No. 106, 1959.

Membrane phenomena: Faraday Soc. Discussions, v. 21, 1956.