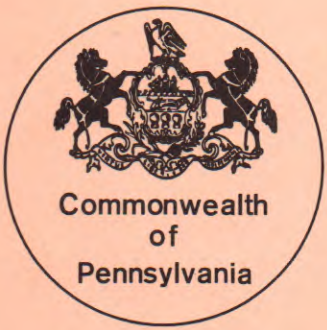
MINE DRAINAGE ABSTRACTS

A BIBLIOGRAPHY



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A BIBLIOGRAPHY

Prepared by

Bituminous Coal Research, Inc.

for the

Coal Research Board

Commonwealth of Pennsylvania

William W. Scranton, Governor

Department of Mines and Mineral Industries

H. B. Charmbury, Secretary

FOREWORD

Interest in improving water quality in our streams has led many people to seek information on all phases of the subject. People associated with the coal industry are particularly interested in published material relating to acid mine drainage. To facilitate the search for information on this subject, the Pennsylvania Coal Research Board has underwritten a project at Bituminous Coal Research, Inc., to publish this annotated bibliography on Acid Mine Drainage.

Governor William W. Scranton appointed the following members to the Coal Research Board: Dr. H. B. Charmbury, Chairman, Mr. Robert Rissinger, Mr. John Todhunter, Dr. G. L. Barthauer, Mr. Joseph Kershetsky, Mr. John Seddon, and Mr. Charles G. Zink. The Secretary of the Board and Director of Research and Development is Dr. David R. Maneval.

In January 1961, under the sponsorship of the Coal Industry Advisory Committee to ORSANCO, a special library on Acid Mine Drainage was established at Bituminous Coal Research, Inc. With their continuing support, the collection of abstracted references has now reached 500 for the period from 1910 through 1963. It is this collection of abstracts which is the source of this bibliography, as prepared by Williamina T. Beery, BCR Project Scientist.

It is anticipated that annual supplements following the same format will be prepared and will be available for insertion in this publication. It is recognized that many articles published during the years covered by this issue have not yet been abstracted; however, as they are completed, they will be included in these annual supplements. Readers are invited to submit pertinent references to the library of Bituminous Coal Research, Inc., 350 Hochberg Road, Monroeville, Pennsylvania, for inclusion in the future.

October, 1964

10-1 THE ACID WATERS OF WESTERN PENNSYLVANIA

Trax, E. C., Eng. Record, 62, 371-2, (1910). Also appeared in Eng. News, 64, 362-3, (1910). This general discussion describes the effect of acidity from mines on Pennsylvania rivers. Changes in color and in useful bacteria count, the effect on pipes and plumbing fixtures are all significant results of acidity discussed. The Youghiogheny is the most acid, the Allegheny the least acid of the rivers.

10-2 OXIDATION OF SULFIDES

Buehler, H. A., and Gottschalk, V. H., Econ. Geol., 5, 28-35, (1910). The experiments described in this article purport to show that natural sulfides are perceptibly oxidized by atmospheric air in the presence of water; that pyrite and marcasite in contact with other natural sulfides greatly increase the rate of oxidation of the other sulfides; that fine grinding affects the rate of oxidation; that analyses of mine waters from the southwest Missouri lead and zinc district indicate the similarity of natural oxidation processes to those obtained in the laboratory.

10-3 THE EXACT DETERMINATION OF SULFUR IN PYRITE AND MARCASITE

Allen, E. T., and Johnston, J., Ind. Eng. Chem., 2, 196-203, (1910). A method of analysis for sulfur in pyrite and marcasite is presented and discussed. Comparison of results is made with two other methods.

10-4 MINERAL SULFIDES OF IRON WITH CRYSTALLOGRAPHIC STUDY

Allen, E. T., Crenshaw, J. L., Johnston, J., and Larsen, E. S., Am. J. Sci., 183, 169-236, (1912). This is a thorough chemical and crystallographic study of the mineral sulfides of iron (including pyrite).

10-5 OXIDATION OF SULFIDES PART II

Gottschalk, V. H., and Buehler, H. A., Econ. Geol., 7, 12-34, (1912). The authors report the results of laboratory work which demonstrate that the presence of iron sulfide increases the solubility of other metallic sulfides. A list of natural minerals arranged according to electromotive force is presented.

10-6 ACTION OF ACID MINE WATER ON THE INSULATION OF ELECTRIC CONDUCTORS

Clark, H. H., and Ilsley, L. C., U. S. Bureau of Mines, Tech. Paper No. 58, (1913). A method for testing the action of acid water on the insulation of electrical conductors is described and test results are given.

10-7 EFFECT OF TEMPERATURE AND ACIDITY IN THE FORMATION OF MARCASITE (FeS_2) AND WURTZITE (ZnS); A CONTRIBUTION TO THE GENESIS OF UNSTABLE FORMS. ALSO MICROSCOPIC STUDY

Allen, E. T., Crenshaw, J. L., and Merwin, H. E., Am. J. Sci., 188, 393-431, (1914). The chemistry of formation of iron sulfides is discussed. The effect of acidity and temperature on the crystalline form is investigated.

10-8 THE STOKES METHOD FOR THE DETERMINATION OF PYRITE AND MARCASITE

Allen, E. T., and Crenshaw, J. L., Am. J. Sci., 188, 371-92, (1914). The Stokes method for estimating pyrite in the presence of marcasite is based on the difference in behaviour of the two minerals when boiled with a standard solution of ferric sulfate. This article describes the method, gives some results and discusses the problem.

10-9 A NEW RAW WATER SUPPLY FOR THE CITY OF MCKEESPORT, PENNSYLVANIA

Trax, E. C., J. Am. Water Works Assoc., 947-58, (1916). The background for changing from the Youghiogheny to the Monongahela River for a source of raw water supply for McKeesport is presented. The effect of acid from mine-drainage was an important factor.

10-10 THE INFLUENCE OF IRON PYRITES ON THE OXIDATION OF COAL

Drakely, T. J., J. Chem. Soc., 109, 723-33, (1916). The author reviews the literature on the effect of iron pyrites on the oxidation of coal. He presents some experimental data to support his contention that although it plays a subsidiary role, it is not entirely negligible.

10-11 CHEMISTRY IN COAL MINING

Blakeley, A. G., Coal Age, 10 (8), 296-302, (1916). This discussion of the function of the chemist in coal mining includes the analysis of several mine waters.

10-12 THE CHEMISTRY OF MINE WATER

Young, C. M., Coal Age, 10, 704-7, (1916). Analyses of several samples of mine water are used to illustrate the wide variation in composition. Lime and soda ash are discussed as neutralizing agents. The possibility of recovering by-products of the neutralization for commercial use is considered.

10-13 USE OF MINE WATER AS BOILER FEED

Chance, Edwin M., Coal Age, 11, 600-1, (1917). Under normal circumstances, the softening of mine water for use as a boiler feed is not recommended. Neutralization with lime allayed corrosion but caused increased incrustation. A double neutralization, first with lime then with soda ash, stopped both corrosion and scaling but caused the boilers to foam badly.

10-14 THE POLLUTION OF STREAMS

Sherlock, C. C., Eng. Mining J., 106, 861, (1918). The rights and responsibilities of the mine owner with respect to use of water are discussed and illustrated by quotations from five court decisions.

10-15 PYRITE DEPOSITS IN OHIO COAL

Tucker, W. M., Econ. Geol., 14, 198-219, (1919). The location and characterization of recoverable pyrite in various coal seams in Ohio is presented tabularly and discussed. The total possible production is estimated at 250,000 tons/yr.

20-1 GEOGRAPHIC DISTRIBUTION OF SULFUR IN WEST VIRGINIA COAL BEDS

White, I. C., Trans. AIME, 63, 932-44, (1920). Outline maps are used to show the distribution of sulfur in West Virginia coal beds of various groups.

20-2 SULFUR IN COAL: GEOLOGICAL ASPECTS

Ashley, G. H., Trans. AIME, 63, 732-8, (1920). The mode of occurrence of pyrites in coal and the possible sources are discussed.

20-3 SOME CHEMICAL DATA ON COAL PYRITE

Yancey, H. F., Chem. Met. Eng., 22, 105-9, (1920). The summary of the results of a study of coal pyrite for the manufacture of sulfuric acid is presented. Sulfur, carbon, arsenic, and phosphorus content of coal pyrite were determined.

20-4 MINE-WATER NEUTRALIZING PLANT AT CALUMET MINE

Tracy, L. D., Trans. AIME, 66, 609-23, (1921). The objective of this plant is to develop a process of treating the water pumped from the mines so that it may be rendered suitable for use at the power plants of the mines and also at the coke ovens, at the same time producing a by-product which will have enough commercial value to place the plant on a self-sustaining basis. Addition of limestone to the acid mine water produces $Fe_2(SO_4)_3$. The plant is experimental (1920) and the treated water is not suitable for use in steam boilers without further treatment.

20-5 RUN-OFF AND MINE DRAINAGE

Eavenson, H. N., Trans. AIME (Coal Division), 66, 624-35, (1921). This is a detailed report of the volume of run-off from eleven mines of the United States Coal & Coke Company in the Pocahontas coal field. There is a brief discussion of character of acid mine drainage by J. R. Campbell and H. B. Wright. Discussion of run-off problems is presented by A. B. Crichton, J. B. Warrimer, R. V. Norris, and H. G. Moulton.

20-6 ACID PRODUCTION BY A NEW SULFUR-OXIDIZING BACTERIUM

Waksman, S. A. and Joffe, J. S., Sci., 53, 216, (1921). This is a brief report of the characteristics of thiobacillus thiooxidans.

20-7 THE OXIDATION OF SULFUR BY SOIL MICROORGANISMS: I.

Lipman, J. G., Waksman, S. A., and Joffe, J. S., Soil Sci., 12, 475-89, (1921). The growth, activity, and description of the thiobacillus thiooxidans organism is given in the reference frame of soil science.

20-8 POLLUTION OF RIVER WATER IN THE PITTSBURGH DISTRICT

Young, C. M., J. Am. Water Works Assn., 8, 201-17, (1921). Mines, waste dumps at coal washeries, and other industries all contribute to the acidity of river water in the Pittsburgh district. Sewage discharged into the rivers serves as a neutralizing agent and is precipitated, resulting in a lower putrefaction rate. The acid in the river water causes damage to boilers, to piping, to clothes, and treatment is expensive and inadequate at best.

20-9 NATURE OF ACID WATER FROM COAL MINES AND THE DETERMINATION OF ACIDITY

Selvig, W. A., and Ratliff, W. C., Ind. Eng. Chem., 14 (2), 125-7, (1922). The composition of mine water and its natural precipitate, "sulfur mud," is presented. Methods for determining free acidity and total acidity are outlined. Direct titration of acid mine water for sulfuric acid with alkali solutions in the presence of methyl orange gives too high results on account of the hydrolysis of ferric and aluminum sulfates. Reduction of sulfates previous to titration gives more nearly correct free acid values.

20-10 MICROORGANISMS CONCERNED IN THE OXIDATION OF SULFUR IN THE SOIL V. BACTERIA OXIDIZING SULFUR UNDER ACID AND ALKALINE CONDITIONS

Waksman, S. A., J. Bact., 7, 609-16, (1922). The effect of pH on the activity of thiobacillus thiooxidans is reported.

20-11 MICROORGANISMS CONCERNED IN THE OXIDATION OF SULFUR IN THE SOIL IV. A SOLID MEDIUM FOR THE ISOLATION AND CULTIVATION OF THIOBACILLUS THIOOXIDANS

Waksman, S. A., J. Bact., 7, 605-8, (1922). This is one of a series of articles on thiobacillus thiooxidans.

20-12 MICROORGANISMS CONCERNED IN THE OXIDATION OF SULFUR IN THE SOIL II. THIOBACILLUS THIOOXIDANS, A NEW SULFUR-OXIDIZING ORGANISM ISOLATED FROM THE SOIL

Waksman, S. A., and Joffe, J. S., J. Bact., 7, 239-56, (1922). The isolation of thiobacillus thiooxidans, its cultural characteristics, physiology, and activity are thoroughly discussed.

20-13 MICROORGANISMS CONCERNED IN THE OXIDATION OF SULFUR IN THE SOIL III. MEDIA USED FOR THE ISOLATION OF SULFUR BACTERIA FROM THE SOIL

Waksman, S. A., Soil Sci., 13, 329-36, (1922). A comparative review is presented of the various microorganisms concerned in the oxidation of sulfur and of those organisms which are or may become active.

20-14 ACID-RESISTING ALLOYS FOR USE IN MINE WATER

Enos, G. M., Coal Age, 23 (17), 665-8, (1963). A number of materials were subjected to tests in acid mine water and rated for their resistance to corrosion.

20-15 THE OXIDATION OF FERROUS SULFATE TO FERRIC SULFATE BY MEANS OF AIR

Reedy, J. H., and Machin, J. S., J. Ind. Eng. Chem., 15, 1271-2, (1923). The effect of concentration, temperature, and catalytic action on the rate of the oxidation of ferrous sulfate to ferric sulfate is discussed. The reaction is of interest in connection with extraction of copper from poor pyritic ores.

20-16 POLLUTION OF WATER SUPPLIES BY COAL MINE DRAINAGE

Collins, C. P., Eng. News-Record, 91 (16), 638, (1923). The serious character of acid mine drainage is reviewed. The relationship between coal mine drainage and rainfall is presented graphically. A sketch of a suggested plant for treating mine drainage with slaked lime is included.

20-17 WHAT SHALL BE DONE ABOUT THE GROWING EVIL OF THE POLLUTION OF STREAMS BY MINE DRAINAGE?

Crichton, A. B., Coal Age, 23, 447-51, (1923). A review of the proposed laws to protect water supplies is presented. Neutralization of waters discharged into the Ohio River and its tributaries would require a million tons of lime yearly and the quantity is increasing. The prediction of an impending crisis in pollution is made. In an editorial on p. 436 of the same issue of Coal Age, the editor decries Mr. Crichton's gloomy prognostication and strongly recommends the investigation of the problem.

20-18 RELATION OF DRAINAGE FROM MINES TO STREAM POLLUTION

Crichton, A. B., Mining Congr. J., 12, 418-20, (1926). There is no known satisfactory solution to the acid mine drainage problem. The cost of neutralization would be from 34 to 57 cents a ton, the cost of softening would be from 70 cents to one dollar per ton and even then the water would not be suitable for all uses. There is a real need for a careful investigation of the whole problem before the passage of legislation which would hurt mining or industry.

20-19 RESTRICTION OF STREAM POLLUTION

Stevenson, W. L., Mining Congr. J., 12, 423-5, 469, (1926). The work of the Sanitary Water Board as a cooperative agency is exemplified by the resolution providing for the classification of streams which is presented.

20-20 MINE-WATER PURIFICATION

Handy, J. O., Mining Congr. J., 12, 421-3, (1926). The characteristics of acid mine drainage are discussed. The cost of hydrated lime treatment with a mechanical lime proportioning and feeding device to make the waters usable would be 0.15 per 1000 gallons. Prof. James Withrow of the Dept. of Chemical Engineering at Ohio State University discusses the paper.

20-21 THE RELATIVE EFFECTIVENESS OF BACTERIA AS AGENTS OF CHEMICAL DENUDATION

Thiel, G. A., J. Geol., 35 (7), 647-52,(1927). The effect of the presence of bacteria in the experimental leaching of certain rocks is discussed. The author says that the activity of micro-organisms that decompose sulfates with the production of sulfides create a sulfate-sulfide-sulfate cycle which is an important factor in the formation of sulfate waters.

20-22 RIVER POLLUTION AND THE ACIDITY OF NATURAL WATERS

Menzies, W. J. M., Nature, 119, 638-9, (1927). A letter commenting on H. W. Harvey's article in Nature 119, 463-4, (1927), points out that flora and fauna may become acclimatized to variations in acid content of water.

20-23 FUNDAMENTAL PROBLEMS RELATING TO RIVER POLLUTION

Harvey, H. W., Nature, 119, 463-4, (1927). There is a need for thorough investigation of the role of the inorganic and organic pollutant on the biology of river water.

20-24 DISPOSAL OF DRAINAGE FROM COAL MINES

Crichton, A. B., Proc. Am. Soc. Civil Engrs., 53, 1656-66, (1927). This review of acid mine drainage covers many phases of the problem in a general way.

20-25 OBSERVATIONS OF ACID MINE DRAINAGE IN WESTERN PENNSYLVANIA

Leitch, R. D., Mining Congr. J., 14, 835-9, 848, (1928). Types of mines and coal formations are discussed in relation to coal districts. The quality of water from working and abandoned mines and gob piles and the effect of acid on streams are discussed. The potentialities of neutralization as a control measure is outlined.

20-26 NOTES ON PRACTICAL WATER ANALYSIS

Collins, W. D., U. S. Geological Survey Water-Supply Paper 5964, Washington, D. C., (1928). This paper contains suggestions for analytical procedures to be used on water samples. This is a reprint from the publication, "Contributions to the Hydrology of the United States, 1927," pp 235-61.

20-27 THE BLENDING OF PIT WASTES

Ridley, C. N., Colliery Eng., 6 (62), 128, 147, (1929). The treatment of mine waters to make them suitable for boiler use can sometimes be accomplished by analysis and blending of various types (hard, alkaline, acid). Some typical analyses are presented.

20-28 A COMPARISON OF THE ACIDITY OF WATERS FROM SOME ACTIVE AND ABANDONED MINES

Leitch, R. D. and Yant, W. P., U. S. Bur. Mines Rept. Invest. 2895. In order to determine whether acidity of drainage water from abandoned mines was lower than from active mines, a study of mines was made. The acidity and dissolved oxygen were found to be lower, the amount of ferrous sulfate was correspondingly higher. It seems likely that the sealing of abandoned mines would result in decreasing acidity from them sooner than if they were allowed to remain open.

30-1 WANTED: MORE RESEARCH ON ACID MINE DRAINAGE

Carpenter, L. V., Coal Age, 35, 406-8, (1930). This historical review of the acid mine-water pollution situation expounds the need for further study and field treatment work.

30-2 DEVELOPMENTS IN THE TREATMENT OF ACID MINE DRAINAGE

Carpenter, L. V. and Davidson, A. H., Proc. West Va. Acad. Sci., 4, 93-9, (1930). The formation of acid in mine waste water is a subject on which research is needed. Neutralization of acid water is discussed. The quantity of water is dependent on many characteristics of the mined area. In West Virginia the average quantity of water is about 1000 gal. per day per acre of mined coal. Sealing of abandoned mines has proven to be a method for controlling acid waste.

30-3 STREAM POLLUTION INVESTIGATION IN WEST VIRGINIA

Herndon, L. K., West Virginia Univ. Eng. Expt. Sta. Tech. Bull. No. 3, 68-74, (1930). The condition of the Cheat River Basin is reported on briefly. Among the sources of industrial pollution are some 98 coal mines pouring substantial amounts of acid into the basin. Improvement is the responsibility of the industry.

30-4 SEALING OLD WORKINGS PREVENTS ACID FORMATION AND SAVES PIPES AND STREAMS

Leitch, R. D., and Yant, W. P., Coal Age, 35, 78-80, (1930). A description of the results of sealing eight mines in southwest Indiana includes a description of the seals. The chemistry of formation of acid in mines is postulated and three pictures of equipment used for studying the chemistry of acid mine-water are included.

30-5 EFFECT OF SEALING ON ACIDITY OF MINE DRAINAGE

Leitch, R. D., Yant, W. P. and Sayers, R. R., U. S. Bureau of Mines Report Invest. 2994, (1930). Samples of water were taken from both open and closed sections of eight mines in southern Indiana. The evidence seems conclusive that sealing of worked-out or abandoned sections of mines results in inhibiting acid formation. "Sealing" must mean making air-tight.

30-6 THE OXIDATION OF PYRITE AND SULFUR AS INFLUENCED BY LIME AND MAGNESIA - A TWELVE-YEAR LYSIMETER STUDY

MacIntire, W. H., Shaw, W. M. and Young, J. B., Soil Sci., 30, 443-57, (1930). This paper gives the results obtained in a 12-year lysimeter study of the oxidation of pyrite and elemental sulfur with ferrous sulfate control as influenced by lime and magnesia.

30-7 X-RAY ANALYSIS OF SLATE

Anderson, H. V. and Chesley, K. G., Amer. J. Science, Series 5, 22, 103-112, (1931). This article is of interest to the Acid Mine Drainage Library because of the report of x-ray diffraction spectra lines related to pyrite, magnetite, etc.

30-8 THE DISPOSAL OF COAL MINE LIQUID WASTES

Bach, H. Z., Proc. Third Inter. Bituminous Coal Conf., 2, 924-59, (1931). Coal mining of today produces three chief classes of liquid wastes: (1) the pit water raised above ground from the water-bearing strata; (2) the coal washings comprising also the coke-quenching waste water; (3) the wastes from manufacturing gas and from by-product recovery. The effluents of dumps (dry refuse deposits) containing noxious matters washed out from the dumped materials by atmospheric precipitations are considered as a special class of secondary wastes. Pit water may require clarification by sedimentation if the suspended matter is present in quantity. In brown coal mining lignite present in the colloidal state requires chemical precipitation with alum and lime. A purification plant installation is described. The presence of dissolved salts-chlorides of sodium, magnesium and lime must be treated by dilution since no method for removal is known. The presence of ferrous sulfate creates the greatest difficulty in pollution. The first step in reducing pollution from ferrous sulfate would be to try to isolate the water containing it underground and pump it to a separate installation for treatment (Possible recovery of copperas). Neutralization with quicklime or soda ash is possible. Damming of the water to provide a sufficiently long detention period for separation and sedimentation of ochre is a third approach. Discussion of the paper is also presented.

30-9 THE CRYSTAL STRUCTURE OF MARCASITE

Buerger, M. J., Am. Miner., 16, 361-95, (1931). In this paper, the details of a complete x-ray determination of the structure of marcasite are given. The literature relating to the subject is thoroughly reported.

30-10 WATER PURIFICATION PROBLEMS IN MINING AND MANUFACTURING DISTRICTS

Drake, C. F., J. Am. Water Works Assoc., 23, 1261-71, (1931). Variability of water quality in streams of Western Pa. and the resultant problems for water purification plants are outlined. The paper (pp. 1261-5) is then discussed by Mr. E. C. Trax (pp. 1266-8) and Mr. H. E. Moses (pp. 1268-71).

30-11 EFFECT OF ACID MINE DRAINAGE ON RIVER WATER SUPPLY

Drake, C. F., J. Amer. Water Works Assoc., 23, 1470-97, (1931). This review of the acid mine-drainage problem is presented from the point of view of active mines, abandoned mines, and gob piles. State support in the sealing of abandoned mines is recommended with provision that operators be required to seal mines abandoned in the future.

30-12 SURVEY OF THE MINE DRAINAGE IN THE WEST FORK RIVER BASIN

Herndon, L. K., W. Va. Univ. Exp. Sta. Tech. Bull. No. 4, 115-52, (1931). A study of the West Fork watershed disclosed a total of 208 mines in the region. The effect of acid drainage from these mines on the water supply was determined from volume and pH data obtained. The economic impact of this pollution is discussed.

30-13 THE ELECTROMOTIVE ACTIVATION OF OXYGEN

Lamb, A. P. and Elder, L. W., J. Am. Chem. Soc., 53, 137-63, (1931). This is the report of a study of the velocity of oxidation of ferrous sulfate solutions by gaseous oxygen.

30-14 THE ACIDITY OF BENNETT BRANCH OF SINNEMAHONING CREEK, PA., DURING LOW WATER - 1930

Leitch, R. D., U. S. Bur. Mines Rept. Invest. 3097, (1931). At a period of extreme low water, the acidity of Bennett Branch shows no definite indications of being much higher than during normal conditions. Methods of measuring stream volume are described.

30-15 THE ACIDITY OF BLACK LICK, TWO LICK AND YELLOW CREEKS, PENNSYLVANIA, DURING LOW WATER IN 1930

Leitch, R. D., U. S. Bur. Mines Rept. Invest. 3102, (1931). The acidity of Black Lick, Two Lick and Yellow Creeks was determined at various points and related to volume. An equilibrium between total and free acidity in streams polluted by mine drainage seems to exist under certain conditions. Ratio appears to be between 2.0 and 2.3 to 1.

30-16 THE ACIDITY OF SEVERAL PENNSYLVANIA STREAMS DURING LOW WATER

Leitch, R. D., U. S. Bur. Mines Rept. Invest. 3119, (1931). Analyses of samples taken from five streams containing mine drainage during normal low water and extreme low water are discussed. Two showed no change in acidity, two showed an increase in acidity, and one a decrease in acidity.

30-17 ACIDITY AND HARDNESS DIFFICULTIES AT MONONGAHELA RIVER PLANTS

Morgan, L. S., Eng. News-Record, 106, 850, (1931). The increase in mining activity along the Monongahela River poses increasing problems for the public water works located on the river. Some of the problems facing water-treatment plants are: (1) Inadequate capacity of chemical-feed equipment, (2) Production of abnormal quantities of sludge, (3) Inadequate facilities for sludge removal, (4) Shortened filter runs, (5) Increased cost of treatment, (6) Failure to obtain satisfactory reduction in hardness.

30-18 SALTS IN TRI-STATE MILL WATERS: THEIR ILL-EFFECT ON THE FLOTATION OF BLENDE AND THEIR REMOVAL

Campbell, A. B., Howes, W., and Ode, W. H., U. S. Bur. Mines Rept. Invest. 3149, (1932). Presence of free acid and ferric sulfate cause corrosion of mill equipment and ferrous sulfate causes difficulties in flotation operations in the Missouri, Kansas, Oklahoma tri-state district. Most satisfactory treatment would be selective removal of ferrous and ferric iron and free acid by alternate periods of aeration and neutralization.

30-19 ACIDITY OF DRAINAGE FROM HIGH PYRITIC COAL AREAS IN PENNSYLVANIA

Leitch, R. D., U. S. Bureau of Mines Rept. Invest. 3146, (1932). Drainage from 39 coal mines said to be in high pyritic areas was sampled. Where possible, samples of water, coal, top and bottom strata and gob material were taken from inside the mines and forms of sulfur in the solid material were determined. In general, drainage from mines in high pyritic areas is more highly acid than has been observed in coal beds of average or low sulfur coals.

30-20 CHARACTER OF DRAINAGE FROM MINES IN THE THICK FREEPORT COAL BED, PENNSYLVANIA

Leitch, R. D., Yant, W. P. and Sayers, R. R., U. S. Bur. Mines Rept. Invest. 3193, (1932). A survey of the composition of the waters from various sections of 15 mines and the total outflow of 18 mines, shows that at the time of this study the general underground drainage was predominantly alkaline. The total outflow of 3 mines that could not be entered was found to be acid. Detailed discussion of the findings on samples from these sources.

30-21 X-RAY STUDY OF THE TRANSFORMATION OF MARCASITE INTO PYRITE

Anderson, H. V. and Chesley, K. G., Amer. J. Science Series 5, 25, 315-324, (1933). The crystalline relationships of marcasite and pyrite are discussed. The mechanism of transformation of marcasite to pyrite is explained.

30-22 ACID MINE DRAINAGE FROM BITUMINOUS COAL MINES

Carpenter, L. V. and Herndon, L. K., West Virginia Univ. Eng. Expt. Sta. Res. Bull. 10, (1933). The quantity of acid mine drainage is correlated with the coal vein, acreage exhausted, and rainfall. Experiments on buffering action are cited. The effect of sterilization on the solubility of sulfur is discussed. A series of tests on the effect of acidity on bacteria and B.O.D. are recorded. Experimental data are correlated with operating data from several water works.

30-23 OXIDATION OF PYRITIC SULFUR IN BITUMINOUS COAL

Nelson, H. W., Snow, R. D., and Keyes, D. B., Ind. Eng. Chem., 25, 1355-58, (1933). In experiments here described, an increase in temperature increases the rate of the oxidation of pyritic sulfur to soluble sulfate. By screening a sample of the pulverized coal to several sized fractions and running a series of oxidation experiments on each fraction, the pyritic sulfur in the finer sizes is oxidized at a faster rate than the larger sizes. Experiments made with ferric sulfate added to the coal-water mixture show that this compound assists materially in the oxidation of the pyritic sulfur in the suspended coal. The effect is enhanced by a rise in temperature. A large amount of the pyritic sulfur is removed from the coal during experiments in which a small amount of chlorine gas is added to the air stream passing through the apparatus. The organic sulfur is unaffected by any of the processes mentioned.

30-24 A QUARTER CENTURY OF PROGRESS IN THE PURIFICATION OF ACID WATERS

Trax, Edward C., West Va. Univ. Exp. Sta. Tech. Bull. No. 6, 5-19, (1933). In this report on acid mine-drainage many facets of the problem are reviewed. Some of the possible approaches to treatment are discussed.

30-25 THE PYRITE-MARCASITE RELATIONSHIP

Buerger, M. J., Am. Miner., 19, 37-61, (1934). A critical study of all available analyses indicates that pyrite corresponds very closely to ideal FeS_2, while marcasite is definitely low in sulfur.

30-26 A STUDY ON MORGANTOWN WATER SUPPLIES, ESPECIALLY THEIR VARIATION IN MINERAL CONTENT

Hodge, W. W. and Newton, R., West Va. Univ. Eng. Exp. Sta. Tech. Bull. 7, 52-69, (1934). Included with the data showing variations in the quality and quantity of water supplies in the Morgantown area are descriptions of the analytical methods used.

30-27 PURIFICATION PROBLEMS RESULTING FROM POLLUTION BY MINE WATER

Trax, E. C., Water Works Eng. 87 (14), 774-775, (1934). This is a discussion of various aspects of the acid-mine drainage problem such as the effectiveness of sealing abandoned mines, progress in the application of basic methods, neutralization, disposal of sludge, germicidal action of mine water, and recognition of the point beyond which water cannot be purified.

30-28 PYRITE OXIDATION

Bain, G. W., Econ. Geol., 30, 166-9, (1935). A study of pyrite in building stone showed that oxidation is accelerated by the presence of sodium and potassium salts. The initial reaction is to ferrous sulfate and can be halted at this stage by treatment with barium chloride. Barium chloride reacts with the ferrous sulfate and forms an insoluble barite precipitate about the pyrite.

30-29 WEST VIRGINIA COAL SEAMS AND THEIR DRAINAGE

Herndon, L. K. and Hodge, W. W., West Va. Univ. Eng. Sta. Res. Bull. No. 14, (1936). Acid mine-drainage in the watersheds of West Virginia is a problem of major importance. A program which takes into account the expected increase from future operations is proposed as a part of the general plan of conservation for the state.

30-30 ISOLATION OF SOME BACTERIA WHICH OXIDIZE THIOSULFATE

Starkey, R. L., Soil Sci., 39, 197-219, (1935). The results of experiments on some cultures which oxidize thiosulfate are presented together with a good review of the related literature.

30-31 EFFECT OF COAL MINE DRAINAGE ON WEST VIRGINIA RIVERS AND WATER SUPPLIES

Hodge, W. W., West Va. Univ. Eng. Exp. Sta. Tech. Bull. No. 9, 32-58, (1937). With the amount of acid draining into the rivers of West Virginia estimated at 600,000 tons per year and the cost for extra treatment placed at over $1,000,000 annually, a means of treatment is needed. Air-sealing of abandoned mines and diversion of surface water have been found to be the cheapest and best methods for prevention of pollution.

30-32 SPRINGS OF WEST VIRGINIA

Price, P. A., McCue, J. B., and Haskins, H. A., W. Va. Geo. Sur. Bull., (1936). Descriptive material and chemical analyses of many major therapeutic springs in West Virginia are included in this volume.

30-33 MINE SEALING REDUCES ACID POLLUTION OF STREAMS IN THE OHIO BASIN

Anon., Coal Mining, 14 (2), 6-7, (1937). This is a report on mine sealing in Ohio, Pennsylvania, Kentucky, and West Virginia under the WPA, USPHS, U. S. Army Corps of Eng., and U. S. Bureau of Mines.

30-34 THE "TANK FILTER" FOR THE PURIFICATION OF SEWAGE AND TRADE WASTES

Bach, H. Z., Water Works and Sewerage, 84, 389-93, 446-9, (1937). A two-part discussion of installations and uses for the "Tank Filter."

30-35 PURIFICATION OF WASTE WATERS OF COAL MINES

Berthelot, C., Usine, 46, 37, (1937). This article (in French) discusses the removal of phenol from waste waters and clarification using mechanical means and a combination of mechanical and chemical flocculation.

30-36 POLLUTION OF STREAMS BY COAL-MINE DRAINAGE - BENEFICIAL EFFECTS OF SEALING ABANDONED MINES

Hodge, W. W., Ind. Eng. Chem., 29, 1048-55, (1937). In 1932 the acid pollution of the Ohio River was equivalent to more than 3,000,000 tons of concentrated sulfuric acid. A regional program for air sealing abandoned mines was begun in December, 1933, under the supervision of the USPHS in cooperation with the states in the Ohio Basin. Within three years, over 47,000 openings in 13,500 abandoned coal mines have been sealed; reductions in acid produced have been from 25 to over 80 percent.

30-37 A SURVEY OF RECENT DEVELOPMENTS IN THE TREATMENT OF INDUSTRIAL WASTES

Rudolfs, W., Sewage Works J., 9, 998-1014, (1937). The subject of trade wastes is reviewed. Problems of taste and odor are mentioned in connection with the treatment of acid mine-water.

30-38 SUBSTANTIAL PROGRESS REPORTED IN MINE SEAL PROGRAM

Anon, Coal Mining, 15 (2), 8-10, (1938). Work done on mine sealing by the WPA from October 1, 1935 to September 1, 1937, are discussed and tabulated particularly for the Ohio watershed. A total additional expenditure of $8 - 10 million would be needed for stabilization. Benefits are dependent upon regional completion and adequate inspection and maintenance. Partial control will be no more satisfactory than a leaky roof.

30-39 OXIDATION OF PYRITIC SULFUR IN COAL MINES

Burke, S. P. and Downs, R., Trans. AIME, 130, 425-44, (1938). This article was first issued as AIME Tech. Pub. 769 (1937). This is an investigation of the reaction mechanism of the oxidation of pyritic sulfur. The experimental procedures are discussed and extensive data on reaction rates are presented. The effect of acid formation on drainage, on the weathering of coal and gob piles, and as an agent contributing to roof falls is discussed. A discussion of the paper is included.

30-40 PROGRESS IN MINE SEALING

Chapman, C. L., West Va. Univ. Eng. Exp. Sta. Tech. Bull. No. 11, 79-85, (1938). The mine sealing program in the Tygart River Basin of West Virginia is discussed in detail. The economics and results of surface sealing of a mine in Preston County are also presented.

30-41 MINE SEALING IN MARYLAND

Hall, G. L., Eng. News-Record, 120, 713-15, (1938). The extent of the acid mine-drainage problem in Maryland and the results of the sealing program are discussed.

30-42 MITIGATION OF TRADE WASTE POLLUTION IN WEST VIRGINIA

Herndon, L. K. and Withrow, J. R., Trans. AIChE, 34, 327-352, (1938). The condition of various river basins in West Virginia is discussed. The harmful effects of acid coal mine-drainage on water for industrial and municipal use and the need for cooperation between the state and industry are presented.

30-43 EFFECT OF COAL MINE DRAINAGE ON WEST VIRGINIA RIVERS AND WATER SUPPLIES

Hodge, W. W., West Virginia Univ. Res. Bull. No. 18, 38, (1938). (Eng. Expt. Station) Data are presented and literature cited which lead the author to conclude that the air-sealing of abandoned mines and entries, diversion of water from mines and the construction of large flood control dams offer the best methods for assuring the maintenance of satisfactory stream conditions for public water supplies, industrial uses, and the recreational activities and good health of all the people.

30-44 THE FLORA AND FAUNA OF SURFACE WATERS POLLUTED BY ACID MINE DRAINAGE

Lackey, J. B., Pub. Health Repts., 53, 1499-1507, (1938). Biological surveys based on the relative abundance of a limited number of easily recognizable species can be used effectively to determine the condition of acid waters.

30-45 SOME TESTS OF ACID RESISTANT PIPE

Leitch, R. D., U. S. Bur. Mines Rept. Invest. 3426, (1938). A number of kinds of pipe were tested in low, moderate and high acidity mine-drainage areas. The results are tabulated and illustrated. Several lined pipes proved satisfactory after two years service, even at 10,000 ppm total acidity.

30-46 STREAM POLLUTION AND THE MINING INDUSTRY

Searls, R. M., Min. Congr. J., 24, 43-6,61, (1938). The drastic regulations proposed in the Barkley-Lonergan Bill are decried. A program to let the public know of activities in the field and to keep the control at the local level is recommended.

30-47 THE TREATMENT AND DISPOSAL OF INDUSTRIAL WASTES

Stevenson, W. L., Trans. World Power Conf., 3rd Conf., Paper No. F7, 3, 324-47, (1938). Pollution of streams by industrial waste is particularly critical in periods of low flow. Studies have led to processes for treatment of industrial wastes such as wastes from abandoned bituminous coal mines.

30-48 ACID DRAINAGE FROM ABANDONED COAL MINES

Tisdale, E. S., Trans. World Power Conf., 3rd Conf., 3, 335-6, (1938). Acid mine-water is formed when water comes in contact with sulfur compounds in the mine in the presence of oxygen. Air-sealing abandoned mines and diverting surface drainage from the mines prevent acid formation. Sealing of 345 mines in West Virginia reduced acid production 77.2 percent.

30-49 FISH CATASTROPHES DURING DROUGHTS

Schaut, G. G., J. Am. Water Works Assn., 31, 771-822, (1939). An investigation of causes of fish kills in drought in the Schuylkill River is reported. Many toxic materials were tested. Acid mine water is not mentioned as a potential cause.

40-1 TESTS ON THE EFFECT OF ACID MINE WATERS ON VARIOUS CEMENTS

Leitch, R. D. and Calverley, J. G., U. S. Bur. Mines Rept. Invest. 3487, (1940). A study was made of tensile strength characteristics of various cements when made with acid mine water of two concentrations. Increase in acidity of mixing water increased tensile strength in aging tests in the laboratory. However, exposure to acid mine water in the field showed a more rapid deterioration of slabs made with high acid mine waters. The authors recommend that further studies be conducted.

40-2 RELATION OF WASTE DISPOSAL TO WESTERN PENNSYLVANIA WATER SUPPLIES

Young, C. H., J. Am. Water Works Assoc., 32, 1867-82, (1940). The effect of such major industries as the steel and bituminous coal industries on the water supply of Western Pennsylvania is discussed. Reducing the amounts of mine drainage and industrial wastes discharged to the streams would have a beneficial effect on the costs of purification and on operating problems of the water works.

40-3 AN INQUIRY INTO STANDARDS PROPOSED FOR STREAM CLEANLINESS

Wolman, A., Sewage and Ind. Wastes, 12 (6), 1116, (1940). The practical and economic factors should be taken into consideration when legislation for stream cleanliness is discussed. The limits should not be more rigid than are necessary.

40-4 GOVERNMENT AID TO DRIVE TUNNELS FOR DRAINAGE ADVOCATED IN ANTHRACITE REGION

Ash, S. H., Coal Age, 45 (12), 110-111, (1940). Federal help is needed to protect present mining areas from inundation from water overflowing from abandoned mines.

40-5 PYRITE RECOVERY FROM COAL MINE REFUSE

Spencer, K. A., Coal Mine Modernization Yearbook, The American Mining Congress, Washington, D. C., 1940, pp 97-104. Where there is a concentration of high sulfur coal mine refuse which presents a difficult disposal problem, pyrite recovery is practical. A flow sheet for a pyrite recovery plant is included.

40-6 THE CONTROL OF STREAM POLLUTION

Graves, H. S., Am. Forests, 46, 113-4, 141, (1940). The Directors of the American Forestry Association have gone on record in support of enforcement of water pollution regulations at the state level rather than by the Federal government. The federal contribution should be in the area of planning.

40-7 POLLUTION CONTROL BILL PASSES HOUSE

Anon, Am. Forests, 46, 187, (1940). No new sources of pollution, either by sewage or industrial wastes, may be discharged into the navigable waters of the United States or their tributary streams without approval of a Division of Water Pollution in the United States Public Health Service if the amended Barkley bill S.685, as passed by the House on March 1, is approved by the Senate.

40-8 CONTROL OF IRON AND SULFUR ORGANISMS BY SUPERCHLORINATION AND DECHLORINATION

Alexander, L. J., J. Am. Water Works Assoc., 32, 1137, (1940). Superchlorination followed by dechlorination with various materials is used to control sulfur and iron organisms, with their related odor and taste.

40-9 WATER PROBLEM IN THE PENNSYLVANIA ANTHRACITE MINING REGION

Ash, S. H., U. S. Bur. Mines Inform. Circ. 7175, (1941). This paper is a general statement of the water problem in the Pennsylvania anthracite mining region. The direction in which mine owners are moving to solve the problem, and the responsibilities of the state and federal governments are discussed.

40-10 WATER - CHIEF PROBLEM IN ANTHRACITE MINING

Ash, S. H., Min. and Met., 22 (411), 167-71, (1941). The problem of flooding in the anthracite mines is one of major consequence.

40-11 OHIO RIVER POLLUTION SURVEY - FINAL REPORT TO THE OHIO RIVER COMMITTEE - SUPPLEMENT "C" - ACID MINE DRAINAGE STUDIES

Anon, Office of Stream Sanitation, U. S. Public Health Serv.,(1942). This survey has been conducted to study the basic theories of acid formation in coal mines and the possibilities and experience with remedial measures. Studies by the U. S. Bureau of Mines have shown that mine sealing can control acid at the mine at reasonable cost. Flood control reservoirs can be used to control acidity in some streams by storage of alkaline water and release as needed. Chemical neutralization has proven impractical due to economic factors. Quality of Allegheny and Monongahela Rivers are shown graphically and discussed.

40-12 STUDIES ON THE REMOVAL OF IRON AND MANGANESE FROM WATER

Moore, E. W. and Snow, E. A., J. New Engl. Water Works Assoc., 56, 320, (1942). This is a study of removal of iron from normal water supplies and is not specifically related to acid mine-drainage.

40-13 INVESTIGATION ON TREATMENT AND DISPOSAL OF ACID INDUSTRIAL WASTES

Morgan, L. S., Sewage Works J., 14, 404-9, (1942). The acid mine-drainage problem in Pennsylvania and the effect of the mine-sealing program of 1936 are discussed. Analytical data and some suggestions for attacking the acid problem are included.

40-14 PENNSYLVANIANS HOLD JOINT MEETING - PITTSBURGH CONFERENCE

Anon, Water Works and Sewerage, 90, 396, (1943). At a joint meeting of Western Penna. AWWA section and Western Div. of the Pennsylvania Water Operators Association, M. Le Bosquet, Jr., Senior engineer USPHS, Cincinnati, Ohio and E. W. Lyons, Senior engineer U. S. Bur. Mines, presented a paper on "Acid mine drainage studies in the Ohio River Pollution Survey." Estimated total annual damage from iron-acid mine drainage in the Ohio Valley is more than $2,000,000. Mine sealing has cut this figure in half. Sealing cost has reached $2,500,000 with annual charges for interest, maintenance, etc. of $870,000. It is estimated that expenditure of $3,500,000 in mine sealing with $450,000 annual charges can be justified since savings amount to 125 percent of total spent. A discussion by C. A. Finley, C. H. Young, L. H. Enslow, and C. W. Rice followed.

40-15 NOTES ON MINE DRAINAGE STREAM POLLUTION

McElroy, D. L., Presented to Somerset County (Pa.) Coal Operators Assoc. November 3, 1943. The problem of acid mine drainage is presented, followed by discussion of the means of eliminating it which have been suggested.

40-16 PRECIPITATION OF COPPER FROM AN ACID MINE WATER

Wartman, S. F. and Roberson, A. H., U. S. Bur. Mines Rept. Invest. 3746, (1944). A discussion of the chemical reactions and rates of percipitation of copper from acid mine water (copper mine). The consumption of metallic iron, which is used for precipitation, is high when ratio of trivalent iron to copper is high.

40-17 CONTROL OF IRON AND SULFUR ORGANISMS BY SUPER-CHLORINATION AND DE-CHLORINATION. EXPERIENCES AND CONCLUSIONS SINCE 1940

Alexander, L. J., J. Am. Water Works Assoc., 36, 1349-55, (1944). This is a general discussion of the effects of super-chlorination in water works.

40-18 MINE DRAINAGE PRACTICE IN THE ANTHRACITE REGION OF PENNSYLVANIA

Griffith, E., Coal Div., AIME, Tech. Paper 1907 (1945). This is a discussion of the drainage practices of the anthracite region. Despite efficient pumping layouts, tunnels for draining active mines and large-scale surface-drainage facilities for keeping water out of mines, the anthracite industry is threatened with curtailment of a major degree and premature extinction because of encroachment of water.

40-19 A RATIONAL EXAMINATION OF STREAM POLLUTION ABATEMENT

Hoak, R. D., Science, 101 (2630), 532-8, (1945). In this article the subject of water pollution is discussed in the language of the layman.

40-20 THE TRUTH ABOUT STREAM POLLUTION

Rice, C. W., Copyright Cyrus William Rice, Pittsburgh, Pa., (1945). This article suggests that the installation of reservoirs in the higher elevations would be a cure-all for the many problems which are associated with water.

40-21 FLOOD-PREVENTION PROJECTS AT PENNSYLVANIA ANTHRACITE MINES - A PRELIMINARY STUDY

Ash, S. H. and Westfield, J., U. S. Bur. Mines Rept. Invest. 3868, (1946). This report covers work conducted during an investigation of the anthracite mine-flood problem. It describes construction work on four mine flood-prevention projects that offered a field for scientific and technologic studies of the problem.

40-22 TREATMENT OF ACID MINE WATER FOR BREAKER USE IN THE ANTHRACITE REGION OF PENNSYLVANIA

Johnson, L. H., U. S. Bur. Mines Inform. Circ. 7382, (1946). Mine water with low acid content is used without treatment for breaker use, but in many instances the mine water is highly acid and is treated to protect metals from corroding. A study of lime treatment systems in use was conducted to correlate the methods of treating mine water, determine the range and effect of treatment, determine the types of lime in use, correlate the testing procedures, and obtain available cost data that would aid interested persons in the anthracite industry and in other industries.

40-23 BACKFILLING PROBLEM IN THE ANTHRACITE REGION AS IT RELATES TO CONSERVATION OF ANTHRACITE AND PREVENTION OF SUBSIDENCE

Ash, S. H., and Westfield, J., U. S. Bur. Mines Inform. Circ. 7342 (1946). The risk of inundation of mines in sections of the anthracite region is increased by subsidence of strata overlying mine workings filled with loosely consolidated water bearing materials. This paper discusses backfilling as a possible solution to the subsidence problem.

40-24 STREAM POLLUTION: EFFECT OF ACID WASTES ON NATURAL PURIFICATION OF THE SCHUYLKILL RIVER

Chubb, R. S., and Merkel, P. P., Sewage Works J., 18 (4), 692-4, (1946). An acid stream interferes with biochemical decay making it even more important that treatment of organic wastes take place before dumping into the stream. Natural stream purification can operate only when an environment favorable to decay organisms is provided.

40-25 MINE ACID STREAM POLLUTION

Lyons, E. W., Unpublished, March 22, 1946. This is the statement of a proposal for a research program on mine acid stream pollution.

40-26 FLOOD PREVENTION AND CONTROL IN THE ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., Mining Congr. J., 32 (3), 32-34, 46, (1946). This is a statement of the water problem in the anthracite mines of Pennsylvania.

40-27 ACID MINE WATER IN THE ANTHRACITE REGION OF PENNSYLVANIA

Felegy, E. W., Johnson, L. H., and Westfield, J., U. S. Bur. Mines Tech. Paper 710, (1947). A discussion of the laboratory equipment and procedures used for testing acid mine waters discharged into streams in the anthracite region of Pennsylvania. Main Streams that flow through are nearly always alkaline. Under present conditions acid mine drainage appears to be beneficial to the municipalities along the banks of the Lehigh, Schuylkill and Susquehanna Rivers because of its neutralizing action on the highly alkaline sewage and industrial wastes.

40-28 FLOOD-PREVENTION PROJECTS AT PENNSYLVANIA ANTHRACITE MINES - PROGRESS REPORT FOR 1945

Ash, S. H., Cassap, W. E., Westfield, J., Eaton, W. L., Romischer, W. M., Podgorski, E. J., and Johnson, L. H., U. S. Bur. Mines Rept. Invest. 4109, (1947). The following subjects are covered in this report:

1. Anthracite reserves of Pennsylvania - W. E. Cassap
2. Underground Water Pools - J. Westfield and W. L. Eaton
   Maps and cross sections of underground water pools and an estimate of quantities of water impounded are given
3. Barrier Pillars - W. L. Eaton
4. The "Buried Valley" of the Susquehanna River - W. M. Romischer and E. J. Podgorski
   A description of the structure of the "Buried Valley" and a discussion of its relation to mine water problems
5. Mining subsidence and backfilling - James Westfield
6. Protective methods utilized to prevent corrosion of equipment by acid mine water - L. H. Johnson
   A resume of materials used and their durability in handling acid mine water. Some cost data are given

40-29 THE ROLE OF MICROORGANISMS IN ACID MINE DRAINAGE. A PRELIMINARY REPORT

Colmer, A. R. and Hinkle, M. E., Science, 106, 253-6, (1947). In this work, a bacterium, unidentified as yet, has been found in acid mine drainage which is involved in the oxidation of ferrous to ferric sulfate. A second bacterium similar, if not identical, in its morphological, cultural, and physiological characteristics to Th. thiooxidans has been isolated repeatedly from the acid mine drainage of some bituminous coal mines. It is postulated that this latter or an unknown similar organism is involved in the oxidation of the sulfur and the sulfur compounds to sulfuric acid. It is felt that the mine sealing program has not given a complete solution to the acid mine drainage and it is suggested that the study of the relation of certain microorganisms to the formation of the sulfuric acid in the mine might be a most profitable one.

40-30 WATER TREATMENT GUIDE

Roetman, E. T., Watson, K. S., and Cotton, E. R., Interstate Commission on the Potomac River Basin, (1947). An outline of the problem of mine wastes covering origin and type, effect on river, volume, characteristics, population, equivalent and disposal or treatment is given on pp. 26-27. The pamphlet covers a variety of industrial wastes.

40-31 MINE WATER

Saul, H., Trans. Inst. Mining Engr. (London), 107, 294-310, (1947-48). The quality of mine water from the point of view of pollution and legal responsibility is considered. The corrosive effect upon the plant and material used for dealing with it and the consequences of discharging it into sources of colliery or public water supply, or surface streams are reviewed.

40-32 STREAM POLLUTION CONTROL - HEARINGS BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON PUBLIC WORKS

United States Government Printing Office, Washington, 1947. Appearing before the Committee on behalf of the National Coal Association, Mr. Andrew B. Crichton (241-55), Dr. Harold J. Rose (255-67), and Mr. Harry Gandy, Jr. (267-73) all voiced objections to the bill because of its possible harmful effect on the coal industry. Mr. A. C. Fieldner (278-86), representing the Bureau of Mines, spoke for the bill.

40-33 WASTE PICKLE LIQUOR

Hoak, R. D., Ind. Eng. Chem., 39, 614-8, (1947). The most important processes for pickle liquor treatment are outlined here. Brief descriptions of the processes developed on a laboratory scale by the fellowship sustained at Mellon Institute by the American Iron and Steel Institute are given. Although certain of these developments show considerable promise, final judgment cannot be made until economic evaluations have been made on a semi-commercial scale.

40-34 INDUSTRIAL UTILITY OF WATER IN PENNSYLVANIA - CHEMICAL CHARACTER OF SURFACE WATER - 1944 TO 1946

Anon, Penna. Dept. of Commerce, State Planning Board, 1947. Prepared in cooperation with the Pennsylvania Department of Forests and Waters, the Pennsylvania Post-War Planning Commission, and the United States Geological Survey, the booklet is a summary of the first results of a comprehensive ground water survey. The industrial use of water in Pennsylvania is tabulated on the basis of the quantity of water required in production of a unit of product. The limits of tolerance of chemical quality for various industrial uses are also presented. Factors affecting the chemical quality and the significance of chemical and physical characteristics as well as a discussion of the analytical data are included.

40-35 DISCUSSION OF PAPER "EFFECT OF STRIP MINING ON WATER SUPPLY"

Beck, J. A., J. Am. Water Works Assoc., 39, 756-60, (1947). This is a discussion of the legal aspects of the effects on stream pollution by acid waters formed from coal strip mining operations.

40-36 EFFECTS OF COAL STRIP MINING UPON WATER SUPPLIES

Snyder, R. H., J. Am. Water Works Assoc., 39, 751-69, (1947). A review of the mechanics of strip mining operations, the chemistry of acid formation from pyrite together with some of the side reactions and the effect of the acid on fresh-water streams. Included is an account of a legal proceeding against coal operators for pollution of water sources because of acidity from strip mines. A discussion of the problem by others points out the inadequacy of present laws, survey methods which may be used, flow computations, and chemical analyses showing the effect of acid pollution is presented.

40-37 BIOLOGICAL ASPECTS OF STREAM POLLUTION

Bartsch, A. F., Sewage Works, 20, 292-302, (1948). This discussion is of a general nature and refers primarily to stream pollution resulting from the introduction of raw or partially treated sewage.

40-38 LIME FOR INDUSTRIAL WASTE TREATMENT

Besselievre, E. B., Sewage Works Eng. and Munic. Sanit., 19, 19-20, (1948). Lime is a relatively cheap chemical to use for treating many kinds of industrial waste. In spite of higher installation costs, the cost of operating the treating facility on an annual basis is lower than for other installations.

40-39 PUBLIC LAW 845 - 80TH CONGRESS CHAPTER 758 - 2ND SESSION (S.418)

This is a statement of Public Law 845, an act to provide for water pollution control activities in the Public Health Service of the Federal Security Agency and in the Federal Works Agency, and for other purposes.

40-40 PICKLE LIQUOR NEUTRALIZATION

Hoak, R. D., Lewis, C. J., Sindlinger, C. J., and Klein, B., Ind. Eng. Chem., 40, 2062, (1948). The various economic factors that should be considered in designing a pickle liquor neutralization plant are discussed in some detail. An evaluation of various neutralization techniques and agents is given.

40-41 THE ACTION OF CERTAIN MICROORGANISMS IN ACID MINE DRAINAGE

Hinkle, M. E. and Koehler, W. A., AIME, Coal Div., Tech. Paper 2381 (1948). By means of bacteriological techniques, two organisms have been isolated from acid mine-drainage. These are believed to have a part in promoting the chemical reactions which produce discolored acid mine-drainage. One organism is considered to be Thiobacillus thiooxidans. The other has not been identified but is described as "Gram negative, non-spore forming rods approximately 0.4 micron wide by 0.8 to 1.0 micron long."

40-42 POLLUTION ABATEMENT - APPRAISAL OF CURRENT REGULATIONS

Anable, A. and Kite, R. P., Chem. Eng. Progr., 44 (1), 3-16, (1948). The answers to a 15-part questionnaire on state laws covering the discharge of waste into streams are tabulated and discussed.

40-43 REPORT ON THE PROBLEM OF STREAM POLLUTION FROM INDUSTRIAL WASTES

Hebley, H. F., Unpublished report to the Western Penna. Coal Operators Assn., July 28, 1948. This report contains a review of the trade wastes involved in stream pollution, the aim of legislation regarding stream pollution, the administration of the stream pollution laws, the cooperation of industry and a detailed outline of the research being carried on.

40-44 THE TREATMENT OF COAL WASHERY WATER TO AVOID STREAM POLLUTION

Hebley, H. F., Unpublished, (1948). The methods used by coal preparation plants to reduce the amount of solids and silt discharged to streams are discussed. Legislation is forcing coal companies to find suitable methods of treatment.

40-45 FLOOD-PREVENTION PROJECTS AT PENNSYLVANIA ANTHRACITE MINES. PROGRESS REPORT FOR FISCAL YEAR ENDED JUNE 30, 1947

Ash, S. H., Cassap, W. E., Eaton, W. L., Hughes, K., Romischer, W. M., and Westfield, J.,U. S. Bur. Mines Rept. Invest. 4288, (1948).. The purpose of this report is to describe the investigative work conducted by the Anthracite Flood-Prevention Section, Safety Branch, Bureau of Mines, during the period July 1, 1946 to June 30, 1947. The broad objective of the investigative work was to obtain factual data on: anthracite reserves of Pennsylvania; underground water pools; barrier pillars; the buried valley of the Susquehanna River; and the infiltration of surface water into underground mine workings.

40-46 PROBLEMS OF MINERAL CONSERVATION

Anon, Commonwealth of Penna. Dept. of Commerce, State Planning Board, (1948). The problem of mine water is discussed briefly in section 6. Some pictures of streams clogged with coal mine wastes are included.

40-47 OHIO RIVER VALLEY WATER SANITATION COMPACT

Anon, 1948, This is a copy of the duly executed Ohio River Valley Water Sanitation Compact for the purpose of the control and abatement of pollution of the waters of the Ohio River basin.

40-48 WASTE CONTROL IN A COKE PLANT

Bundy, K. N., and Jordan, P. E., Sewage Works J., 21, 694-9, (1949). This article discusses sources of pollution in a coking plant and steps to be taken to reduce pollution.

40-49 FACTORS INFLUENCING SELF-PURIFICATION AND THEIR RELATION TO POLLUTION ABATEMENT II SLUDGE DEPOSITS AND DROUGHT PROBABILITIES

Velz, C. J., Sewage and Ind. Wastes, 21, 309, (1949). Good design for sewage and waste treatment must be based on a knowledge of the stream's individual self-purification characteristics. Discussion of several cases.

40-50 TECHNICAL PROGRESS REPORT ON STREAM POLLUTION CONTROL IN PENNSYLVANIA

Hebley, H. F., Unpublished report to Western Pennsylvania Coal Operators Association, 1949. A report to acquaint the members with the measures being considered by the Pennsylvania Sanitary Water Board. The suggested measures are tabulated and comments are given.

40-51 WATER POLLUTION ABATEMENT MANUAL - INSOLUBLE AND UNDISSOLVED SUBSTANCES

Anon, Mfg. Chemists' Assoc., Inc., Washington, D. C., Manual Sheet W-2, (1949). It is often necessary to remove solids from water to prevent damage to plant and animal life and to keep river channels open. Screening, sedimentation and clarification, flotation and filtering are some of the accepted approaches to cleaning water containing solids. Methods of disposing of the sludge must also be considered. This manual considers the problem of solids removal.

40-52 A PROPOSED BIOLOGICAL MEASURE OF STREAM CONDITIONS BASED ON A SURVEY OF THE CONESTOGA BASIN, LANCASTER COUNTY, PENNSYLVANIA

Patrick, R., J. Acad. Natural Sci. Philadelphia, 51, 277-341, (1949). This article investigates the biological condition of a healthy stream and considers the use of this normal condition as a means of identifying the presence of pollution.

40-53 WATER POOLS IN PENNSYLVANIA ANTHRACITE MINES

Ash, S. H., Eaton, W. L., Hughes, K., Romischer, W. M., and Westfield, J., U. S. Bur. Mines Tech. Paper 727, Washington, (1949). The principal factor that threatens to cut short the life of the anthracite industry is inundation of the mines. The information covered in this report was obtained by studying geological maps and cross-sections, mine maps, and other pertinent data obtained from anthracite mining companies. The report includes maps, plans, cross-sections, and longitudinal sections of the underground water pools.

40-54 MUNICIPAL-WATER NEEDS VS. STRIP COAL MINING

Dexter, G. M., Mining Trans., 184, 137-58, (1949). Since acid contamination of mine waters is the result of chemical reactions of oxygen and water with pyrite, it will be reduced by the expulsion of either air or water. The application of this principle in "contouring" is considered to parallel its application in mine-sealing. The discussion of contouring effectively and of other methods of reducing acid mine drainage are of particular interest. The author discusses the ways in which usual chemical methods for the analysis of water fail to serve satisfactorily for acid mine water. Several methods of treatment to reduce the damage resulting from contaminated water are included.

40-55 OHIO RIVER VALLEY WATER SANITATION COMMISSION FIRST ANNUAL REPORT 1948-1949

Cleary, E. J., ORSANCO, Cincinnati, Ohio, (1949). The objectives and accomplishments of the Commission, together with a financial statement and list of people associated with the Commission are presented in this annual report.

40-56 REHABILITATION OF LANDS STRIPPED FOR COAL IN OHIO

Limstrom, G. A. and Merz, R. W., Central States Forest Experiment Station Technical Paper No. 113, The Ohio Reclamation Assn., (1949). This publication describes the varied conditions found in strip mined areas and points out possible productive uses for this land.

50-1 COMMENTS ON STREAM POLLUTION IN PENNSYLVANIA

Hebley, H. F., Unpublished report, 1950. Pennsylvania Sanitary Water Board has been vested with extremely broad powers which give practically complete control of the operation of coal mines within the Commonwealth. The present membership has used its powers with extreme care and discretion. However, if the membership were to change, a less tolerant viewpoint of the acid mine water problem might prevail. Methods of treatment for acid mine water drainage are discussed in the light of research on the problem. The mechanism of bacterial action in the formation of acid is outlined. The problems of neutralization of acid with lime are set forth. The objectives and results of the mine sealing program are discussed.

50-2 CLEAN WATER IS EVERYBODY'S BUSINESS

Anon, U. S. Public Health Service Publication No. 11, 1950. A pictorial booklet outlining in general terms the problems of water pollution and the actions the state and federal governments must take to overcome them.

50-3 NEUTRALIZATION OF ACID WASTES

Dickerson, B. W. and Brooks, R. M., Sewage Ind. Wastes Eng., 21 (4), 216, (1950). A five cell neutralization process for waste nitric and sulfuric acid is briefly described.

50-4 CORROSION-RESISTANT MATERIALS AND COATINGS IN TRAIL CHEMICAL OPERATIONS

Colls, E. A. G., Trans. AIME, Min. Branch, 187, 491-4, (1950). Corrosion in Trail chemical plants producing ammonia, sulfuric, nitric and phosphoric acids, ammonium phosphates, sulfate and nitrate, together with miscellaneous allied material problems and their solution, using erosion or corrosion proof materials is discussed. For work of this nature the most costly material may well be cheapest in the long run.

50-5 PENNSYLVANIA'S CLEAN STREAM PROGRAM

Moses, H. E., J. Am. Water Works Assoc., 42, 146-50, (1950). This is a general presentation of the Pennsylvania Clean Streams Program which the author finds a reasonable and practical plan that can be made effective.

50-6 WATER QUALITY IN THE MIDDLE ATLANTIC STATES

Love, S. K., J. Am. Water Works Assoc., 42, 257-65, (1950). The natural water supplies in the Middle Atlantic States are suitable for practically all municipal and industrial purposes. Although there is extensive pollution (including mine acid) efforts are being made to alleviate the situation.

50-7 IRON AND CARBON DIOXIDE REMOVAL

Hauer, G. E., J. Am. Water Works Assoc., 42, 553-61, (1950). Iron is often present in well water. Methods for removal include: aeration-settling-filtration; coagulation-settling; use of contact filters; use of special minerals and ores; nonatmospheric oxidation; removal incident to softening; stabilization or sequestration.

50-8 DEVELOPMENTS IN THE CHLORINE DIOXIDE PROCESS

Aston, R. N., J. Am. Water Works Assoc., 42, 151-4, (1950). Chlorine dioxide treatment has made considerable progress in the five years of its use and can now be regarded as an established process. It is not a "cure all" but has demonstrated its value in control of taste and odor due to phenolic or other industrial wastes, sewage, algae and decomposed vegetation.

50-9 TREATING TANK-CAR WASTES

Gutzeit, G., Chem. Eng. Progr., 46, 335-42, (1950). The variety of pollutants removed in cleaning tank cars calls for a variety of treatment. The heart of the treatment plant at Saegertown, Pa., is a coal flotation process. Removal of a number of pollutants is discussed briefly. Flowsheet for primary treatment plant is included. The filter cake from flotation cells is mixed with dry coal and used as boiler fuel.

50-10 CRITICAL REVIEW OF THE LITERATURE ON THE TOXICITY OF INDUSTRIAL WASTES AND THEIR COMPONENTS TO FISH - PART I ALKALIES, ACID AND INORGANIC GASES

Doudoroff, P. and Katz, M., Sewage and Ind. Wastes, 22, 1432-58, (1950). This is a general review of the literature relating to the toxicity of acids, alkalies, and inorganic gases to fish. The common strong acids apparently can be lethal to fish only when their presence reduces the pH to below 5.0. Of the 126 references, 29 were pertinent to acid wastes.

50-11 ACID IRON WASTES NEUTRALIZATION

Hoak, R. D., Sewage and Ind. Wastes, 22, 212-21, (1950). The principal factors that must be considered in designing a plant for waste pickle liquor neutralization are presented. The principles set forth should be applicable to most problems in acid waste treatment. The importance of choosing the proper alkaline agent has been emphasized, as well as the advantages to be gained by utilizing circumstances peculiar to a given locality. A new neutralization technique which is dependent on controlled oxidation of the iron in the presence of an alkaline agent to ferrosoferric oxide, has been presented to offer a solution to the problem of sludge disposal where lagoons cannot be installed.

50-12 BACTERIAL STANDARDS FOR NATURAL WATERS

Wolman, A., Sewage and Ind. Wastes, 22 (3), 346-52, (1950). Quality of natural waters varies greatly. Permissible limits of quality must be flexible depending on type of use.

50-13 ABATING STREAM POLLUTION IN THE ANTHRACITE COAL FIELDS

Hoffert, J. R., Mining Eng., 2, 340, (1950). Pennsylvania's Schuylkill River was, in November 1947, carrying a silt burden of 350,000 tons per month. By March of 1949 an eight-year program of State research and fine cooperation by the operators had reduced this figure to 7,000 tons. A discussion of the Sanitary Water Board and its functions.

50-14 REPORT ON THE STRIP OPERATORS' DISCUSSION OF THE TENTATIVE RULES AND REGULATIONS FOR THE OPERATION AND MAINTENANCE OF STRIP MINES

Hebley, H. F., Unpublished Western Pennsylvania Coal Operators Assoc., Ebensburg, Pa., (1950). Opening the strip, interference with streams, surface drainage, segregation of acid-forming material, and backfilling were the subjects discussed. The operators commented on the difficulties in meeting the "Tentative Rules and Regulations for the Operation of Strip Mines to Prevent Pollution of Waters of the Commonwealth."

50-15 WATER IN INDUSTRY - A SURVEY OF WATER USE IN INDUSTRY

Hagedon, G. G., Snider, R. G., Green, R. R., Bergen S. W., National Assoc. of Manufacturers and The Conservation Foundation, New York, (1950). The Conservation Foundation and National Association of Manufacturers conducted a survey of some 3,000 industrial plants on the subject of water use and disposition.

50-16 RECENT DEVELOPMENTS IN STREAM POLLUTION ABATEMENT

Hebley, H. F., Unpublished report, (1950). Mr. Hebley discusses the implications of the Sanitary Water Board in relation to parallel functions in the Federal government. The experimental rules for mining coal by stripping without causing pollution are cited.

50-17 STREAM POLLUTION FROM COAL MINES IN THE OHIO BASIN

Watson, K. S., Unpublished, (1950). This statement, prepared for a joint meeting of the West Virginia Coal Mining Institute and the Appalachian Section and Coal Division of the AIME, Charleston, West Virginia, forms part of the Reference Data Series of the Ohio River Valley Water Sanitation Commission.

50-18 AN IRON OXIDIZING BACTERIUM FROM THE ACID DRAINAGE OF SOME BITUMINOUS COAL MINES

Colmer, A. R., Temple, K. L., and Hinkle, M. E., J. Bacteriol., 59, 317-28, (1950). The morphological character of a bacterium, isolated from the acid mine-drainage of the Pittsburgh, Sewickley, and Upper Freeport coal seams, its autotrophic nature on thiosulfate medium, and its oxidative action on thiosulfate with the production of sulfuric acid to give a low pH indicate properties that most closely resemble those displayed in the genus Thiobacillus. Experimental methods and data are given for the action of the bacterium on ferrous iron solutions.

50-19 DEEP-WELL PUMPS AND SHAFT PUMPS IN ANTHRACITE MINES OF PENNSYLVANIA

Lesser, W. H., U. S. Bur. Mines Rept. Invest. 4656, (1950). The purpose of the report is to furnish data concerning application, design, and performance of deep-well and shaft pumps to the anthracite flood-prevention program for consideration when a pumping project develops that favors the use of these pumps.

50-20 DATA ON PUMPING AT THE ANTHRACITE MINES OF PENNSYLVANIA

Ash, S. H., Eaton, W. L., Gilbert, J. C., James, H. M., Jenkins, H. E., Kennedy, D. O., Kynor, H. D., Link, H. B., and Romischer, W. M., U. S. Bur. Mines Rept. Invest. 4700, (1950). This paper covers removal of water from mines by pumping.

50-21 INUNDATED ANTHRACITE RESERVES, EASTERN MIDDLE FIELD OF PENNSYLVANIA

Ash, S. H., Kynor, H. D., Fatzinger, R. W., Davies, B. A., and Gilbert, J. C., U. S. Bur. Mines Bull. 491, (1950). An engineering study is necessary to explore the various methods that can be used to unwater anthracite reserves that are now inundated by underground water pools in the various basins in the Eastern Middle fields. Any conclusions relating to projects for unwatering these pools must be based primarily upon the economic justification of each project and the ratio of the cost to the benefit that would result. In this report one major unwatering project was developed. Three pools that inundate considerable tonnage of anthracite reserves are close enough together to be unwatered by some centralized system. Three alternative plans were studied to estimate the cost of each.

50-22 BURIED VALLEY OF THE SUSQUEHANNA RIVER, ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., U. S. Bur. Mines Bull. 494, (1950). Buried valleys are quite common in regions that have been overridden by glaciers. This paper deals with the buried valley in that portion of the drainage basin of the North Branch of the Susquehanna River that overlies the anthracite measures in the Wyoming Valley and the lower part of the Lackawanna Valley. A set of maps accompanies the report.

50-23 REPORT ON THE STREAM POLLUTION PROGRAM, U. S. WATER RESOURCES COMMISSION, FEDERAL SECURITY AGENCY

Hebley, H. F., Unpublished report, (1950). This is a report of the organizational meeting of the National Technical Advisory Committee. It deals specifically with the scope of the Advisory Committee functions and the functions of Task Groups formed within the Committee.

50-24 SECOND ANNUAL REPORT OF THE OHIO RIVER VALLEY WATER SANITATION COMMISSION

Cleary, E. J., Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, (1950). This is a report on the activities of ORSANCO in the second year of its existence. PP. 29-34 deal with the acid mine drainage problem including a table summarizing the annual damages from acid mine drainage based on 1940 cost and a tabulation of significant court cases relating to stream pollution and the coal mining industry.

50-25 RECENT RESEARCH AS TO THE EFFECT OF COAL MINE DRAINAGE ON THE CLEAN STREAM PROGRAM

Braley, S. A., Paper presented before 2nd Annual Meeting of Pennsylvania Section of American Water Works Association, (1950). The pH, acidity, total poundage of acid and flow of water from four mines are presented graphically. The basis for neutralization is briefly discussed but this approach is not recommended because of its effect on domestic water supplies.

50-26 POLLUTION IN THE ALLEGHENY, MONONGAHELA AND OHIO RIVERS IN ALLEGHENY COUNTY, PENNSYLVANIA

Madison, K. M., Paper presented at 188th National Meeting, American Chemical Society, Chicago, Illinois, (1950). The oxygen demand data presented give evidence that the Allegheny, Monongahela, and Ohio Rivers carry significant amounts of organic pollution. The effect of acid mine water on organic wastes in these rivers needs to be considered in reviewing the need for treatment of the river waters. As effective controls of mine water discharge are developed, the need for sewage treatment plants will increase.

50-27 REPORT ON INDUSTRIAL WASTES IN THE POTOMAC RIVER BASIN

Interstate Commission on the Potomac River Basin, Washington, (1950). Acid mine drainage is only one of many industrial sources of pollution. Taken as a whole, the industrial reports indicate that much is still to be done by industry to abate pollution, yet there is evidence of a certain awareness of the need for pollution abatement in the Potomac Basin.

50-28 INDUSTRIAL WATER AND WATER-BORNE INDUSTRIAL WASTE

Hecht, Max, ASTM Bull., 31-3, Sept. 1950. The organization and activities of Committee D-19 of ASTM are summarized in this paper.

50-29 NATIONAL WATER POLICY--A STATEMENT OF DESIRABLE POLICY WITH RESPECT TO THE CONSERVATION, DEVELOPMENT, AND USE OF NATIONAL WATER RESOURCES

The Water Policy Panel of Engineers Joint Council, (1950). The Engineers Joint Council formed a panel of 75 engineers having long experience in the water resource development field to serve on voluntary Task Committees for the purpose of developing a statement of desirable water resources policy. This publication includes the reports of these committees. The subject of pollution from coal mines is considered specifically in Appendix I, pages 18 through 34.

50-30 INDUSTRY'S ROLE IN THE CLEAN STREAMS PROGRAM IN PENNSYLVANIA

Pennsylvania State Chamber of Commerce, Bull. 132, (1950). This bulletin discusses the Clean Streams program in Pennsylvania and describes the role of the Sanitary Water Board in this program.

50-31 SOLVING POLLUTION PROBLEMS IN THE POTOMAC RIVER BASIN

Kemp, H. A., Interstate Commission on the Potomac River Basin, Washington, (1950). The author summarizes the need for, and the steps taken toward, the control and abatement of pollution within the Potomac River basin. He touches on the problems of soil loss, water pollution by industrial, domestic, and mine wastes, sketches briefly the history and aims of the Potomac River Commission, and outlines its program for the future.

50-32 CLEANUP OF A RIVER

The Pittsburgh Equitable Water Journal, 34 (2), 2-5, (1950). With the advent of the wet preparation of coal, enormous quantities of silt were discharged into the Schuylkill River and its tributaries, choking the channel and causing flooding. As a result of the work of the Sanitary Water Board starting in 1941, the operators of all 43 operating collieries have installed desilting works. These range from sedimentation basins to froth flotation installations. These, together with the dredging operations, dam reconstruction, and river bank stabilization program of the Water and Power Resources Board have resulted in a dramatic revival of the river.

50-33 GUIDE TO SOURCE MATERIAL ON WATER POLLUTION CONTROL

Schwob, C. E., U. S. Public Health Service, Div. of Water Pollution Control, Washington, (1950). This pamphlet contains a list of illustrative and general material on the subject of water pollution control which is available from the Division of Water Pollution Control.

51-1 A PILOT PLANT STUDY OF THE NEUTRALIZATION OF ACID DRAINAGE FROM BITUMINOUS COAL MINES

Braley, S. A., Sanitary Water Board, Dept. of Health, Harrisburg, Pa., 1951. Neutralization of acid mine drainage is possible but not economically feasible. Prevention of formation by controlled drainage is a more realistic approach to the problem.

51-2 REPORT TO THE LAND USE COMMITTEE AND THE LAND USE ADVISORY COMMITTEE OF THE NATIONAL COAL ASSOCIATION

Hebley, H. F., Unpublished report, 1951. This is a discussion of the trends and activities of the U. S. Public Health Service and State Governments in the matter of water supply as related to coal mining and other mineral industries.

51-3 INDUSTRIAL WASTE TREATMENT

Feller, G., Newman, J., and Nord, M., Industry and Power, 75-98, (1951). A tabular analysis of laws pertaining to stream pollution is presented with a discussion of special aspects of the law.

51-4 ACID MINE DRAINAGE PROBLEMS, ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., Felegy, E. W., Kennedy, D. O., and Miller, P. S., U. S. Bur. Mines Bull. 508, (1951). This report indicates the scope of the pollution problem associated with mine-water discharge in the anthracite region of Pennsylvania and gives some suggestions concerning its solution. The average pH of all mine drainage from the anthracite region is 3.0 to 3.2. The average mine-water discharge of 472 million gallons a day carries a free-acid load of 431 tons as H_2SO_4 (methyl red) or a total acid load of 934 tons as H_2SO_4 (phenolphthalein). Diversion of individual mine drainage in the anthracite region from receiving streams and purification of mine drainage before entering streams are alternative remedial measures to combat pollution of surface streams by acid mine drainage. The 327,000 g.p.m. drainage from the mines of the anthracite region represents a not inconsiderable quantity of water, and the effect of its removal from the surface streams coursing through and beyond the anthracite region is one of the phases that must be considered.

51-5 PRETREATMENT OF INDUSTRIAL WASTES

Ashley, J. H., Wastes Eng., 22 (2), 75-6, (1951). Waste disposal problems of Los Angeles are touched upon. A cursory outline of pretreatment methods is given.

51-6 THE HYDROLYSIS OF FERRIC IRON IN SULFATE SOLUTION

Arden, T. V., J. Chem. Soc. (London), 350-63, (1951). Ferric sulfate hydrolyses in three stages, to $FeOH^{++}$, $Fe(OH)^{+}_2$, and a precipitate whose composition varies according to the dilution. The reaction constants for the formation of $FeOH^{++}$ and $Fe(OH)^{+}_2$ have been found from pH measurements to be $K_1 = 1.25 \times 10^{-3}$, $K_2 = 4.2 \times 10^{-4}$ at 25°C. There is evidence for the presence in solution of an acid complex, which may be ferrisulfuric acid, $(FeOH)(HSO_4)_2$. The reaction of sodium hydroxide with ferric sulfate solution and the effect of storage on solutions of various proportions are discussed.

51-7 WASTE PROBLEMS IN THE MINERAL INDUSTRIES

Boyd, J., Chem. Eng. News, 29, 4671-3, (1951). Air pollution and water pollution are closely related. The most common air-borne wastes are smoke, fly-ash fumes, and noxious gases such as sulfur dioxide. Although sewage disposal is the major stream pollution problem, water-borne wastes of some of our mining operations are even more serious. This is a general statement of the pollution problems of the mineral industry.

51-8 H. R. 1555 82ND CONGRESS, 1ST SESSION

This is a bill to encourage the prevention of water pollution by allowing amounts paid for industrial waste treatment works or disposal facilities to be amortized at an accelerated rate for income tax purposes. It was introduced by Mr. Tollefson and referred to the Committee on Ways and Means.

51-9 H. R. 5474 82ND CONGRESS, 1ST SESSION

This is a bill to encourage the prevention of water pollution by allowing amounts paid for industrial waste treatment works to be amortized at an accelerated rate for income tax purposes. It was introduced by Mr. Byrnes of Wisconsin and referred to the Committee on Ways and Means.

51-10 MISSOURI VALLEY AUTHORITY ACT 82ND CONGRESS, 1ST SESSION, H. R. 4881

A bill to establish a Missouri Valley Authority to provide for unified water control and resource development on the Missouri River, its tributaries and watershed, to prevent floods, reclaim and irrigate lands, encourage agriculture, stimulate industrial expansion, develop low-cost hydroelectric power, promote navigation, increase recreational possibilities, protect wildlife, strengthen the national defense, and for other purposes. This bill was introduced by Mr. Rankin and referred to Committee on Public Works.

51-11 CONSERVATION AUTHORITIES ACT OF 1951, 82ND CONGRESS, 1ST SESSION, H. R. 4882

A bill to provide for the creation of conservation authorities, and for other purposes. It was introduced by Mr. Rankin and referred to the Committee on Public Works.

51-12 WATER-POLLUTION ABATEMENT IN THE UNITED STATES

Hollis, M. D., Sewage and Ind. Wastes, 23 (1), 89-94, (1951). The purpose of this paper is to summarize the present status of the water pollution problem in the United States and to discuss some of the responsibilities of the states in preventing pollution and providing for the best uses of surface streams.

51-13 CHEMICAL COMPOSITION AND CORROSION IN RELATION TO THE UNDERGROUND MINE WATERS OF THE WITWATERSRAND

Johnson, F. C., J. South African Inst. Mech. Engrs., 1 (10), 285-315, (1951). The chemical composition of mine waters varies considerably, ranging from very acid to alkaline, the acid being derived mainly from the hydrolization of the ferric sulfate contained in the water due to chemical action of the pyrites in the gold-bearing ore. Methods of protection against corrosion are outlined. The use of a soluble oil as a protection against internal corrosion has been found to be effective. Methods to return normal saturated conditions in the circulating waters of a mine which has become supersaturated with calcium sulfate are discussed. Extensive discussion follows the article.

51-14 OHIO RIVER VALLEY WATER SANITATION COMMISSION - THIRD ANNUAL REPORT

Anon, 1951. An outline of program activities includes details of technical studies, river investigations and educational campaign. Status reports, by states, on municipal sewage treatment installations are given.

51-15 THE FORMATION OF ACID MINE DRAINAGE

Temple, K. L. and Colmer, A. R., Trans. AIME Min. Branch Mining Eng., 190 (3), 1090-2, (1951). The role of microorganisms in the formation of acid mine water is discussed.

51-16 STRIP-MINED LANDS OF THE WESTERN INTERIOR COAL PROVINCE

Rogers, N. J., Research Bull. 475, Univ. of Missouri, College of Agriculture, Agric. Expt. Sta., Columbia, Mo., (1951). Strip-mined land in Arkansas, Oklahoma, Kansas, Missouri, and Iowa presents a problem in land use. This is a thorough investigation of the character of the soil, the type of planting and economic results of reclaiming mined areas. Although acidity of the soil and banks is discussed, there is no indication of a problem in acid water.

51-17 WATER CONSERVATION THROUGH POLLUTION CONTROL - A MANUAL OF INFORMATION

Anon, Pennsylvania State Chamber of Commerce Bull. 133, Harrisburg, Pa., (1951). The origin of stream pollution problems, the benefits to be derived from realistic abatement measures, and the progress being made are all discussed in some detail.

51-18 RECLAIMING ILLINOIS STRIP COAL LANDS BY FOREST PLANTING

Limstrom, G. A. and Deitschman, G. H., Univ. of Illinois Agricultural Expt. Sta. Bull. 547, (1951). Most strip-mined lands in Illinois can be made productive by practical reclamation methods. Some locations are best used for wood production, some for pasture, and some as recreation areas. This publication describes site conditions that affect forest plantings on strip-mined lands in Illinois and sets up planting guides and recommendations for the major types and conditions of spoils in the state.

51-19 ACID DRAINAGE FROM COAL MINES

Braley, S. A., Mining Eng., 703-8, (1951). Laboratory results and investigations at four mines are discussed.

51-20 THE FORMATION OF ACID MINE DRAINAGE

Temple, K. L., and Colmer, A. R., Trans. AIME, 190, 1090-2, (1951). The presence of thiobacillus thiooxidans in all acid mine waters examined and in no other waters examined leads the authors to the belief that this bacterium is actively contributing to the formation of the acid in the water.

51-21 SPECIAL REPORT ON A STUDY OF THE ROLE OF AUTOTROPHIC BACTERIA IN THE FORMATION OF MINE ACID

Leathen, W. W. and Braley, S. A., Mellon Institute Special Report - Commonwealth of Pennsylvania Dept. of Health Industrial Fellowship No. 326B, 1951. This report covers the work done by the Fellowship on the function of autotrophic bacteria found in acid mine drainage for the period July, 1949, through July, 1951. It is the purpose of the experiments reported here to demonstrate the amount of acid formed from the sulfuritic constituents of coal which can be attributed to: the action of pure strains of autotrophic bacteria capable of oxidizing elemental sulfur and sulfur compounds; the action of crude strains of an unnamed ferrous iron oxidizing bacillus; the action of mixed cultures consisting of both iron and sulfur oxidizing bacteria; and the action of certain chemical solutions.

51-22 INDUSTRY'S INTEREST IN WATER POLLUTION ABATEMENT

Wachter, F. C., Trans. Bull. No. 21, Ind. Hygiene Foundation, 1-6, (1951). Industry's basic interest in water-pollution abatement is economic. A second factor is the practicability of abatement. Despite research, no practicable method for abatement of mine drainage is yet available. This should be considered in legislation.

52-1 CONTROL OF ACID DRAINAGE FROM COAL MINES

Anon, Sanitary Water Board, Commonwealth of Pennsylvania, Harrisburg, 1952. This booklet discusses means for reducing the pollution of streams by coal mine drainage. The principles of reducing acid formation by controlling the contact of water and sulfur bearing compounds by drainage, and by neutralization of standing pools are discussed in their direct application to strip mines, underground mines and mine waste minerals.

52-2 SURFACE-WATER SEEPAGE INTO ANTHRACITE MINES IN THE LACKAWANNA BASIN NORTHERN FIELD, ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., Eaton, W. L., and Whaite, R. H., U. S. Bur. Mines Bull. 518, (1952). Because of the condition of the strata overlying the mine workings, approximately one-third of the total runoff in the Lackawanna River drainage area becomes mine water. There is little doubt that water retained on the surface and diverted to surface-drainage channels has been handled more economically than it could be by pumping from the mines. Some anthracite and mining companies have applied several types of remedial measures to prevent or minimize surface and stream bed seepages with generally good results.

52-3 EXPERIMENTAL STRIP MINES SHOW NO STREAM POLLUTION

Braley, S. A., Mining Congr. J., 50, (1952). The basic rules to be followed to prevent stream pollution from strip mines are: (1) keep water out as much as possible by drainage ditches located to isolate the area being worked; (2) segregate sulfur-bearing shale; (3) cover sulfur-bearing material with compacted top cover. The problems vary from one operation to another and any legislation should be flexible enough to permit most effective use of the techniques available.

52-4 PROTECTION OF STREAMS AGAINST POLLUTION - THE PENNSYLVANIA PLAN

Teague, R. E., Paper given at Symposium on Stream Pollution and Industrial Waste, Am. Assoc. for Advancement of Science, (1952). The problems of stream pollution control in Pennsylvania are highly complex because of variations of topography, variations in population density, and wide diversity in industrial and sewage contamination. A brief review of legislative trends in the state and a discussion of the Sanitary Water Board's program to improve the situation are given. The results are promising in these areas, however acid mine water continues to be a special problem since no practical ways for treatment have been found.

52-5 COAL REMOVES PHENOL FROM WASTES

Gutzeit, G., Petrol. Process., 7 (6), 828-32, (1952). Description of Saegerstown, Pa., tank car cleaning establishment with particular emphasis on the primary treatment area where coal slurry is used to remove phenols from water. Process description and flowsheet are given.

52-6 THE TREATMENT AND FILTRATION OF THE UNDERGROUND MINE WATERS OF THE WITWATERSRAND

Johnson, J. C., J. South African Instit. Mech. Engrs., 2 (4), 91-118, (1952). The constituents of acid mine water are given, and the successive stages in its neutralization are outlined. The neutralizing agents and their properties are discussed, as well as the use of indicators for the determination of the pH value of the water. Comparison is made of the neutralizing agents used. Methods of feeding lime by various types of machines are described and determinative methods for acidity or alkalinity are commented upon. The filtration of the water after settling, so as to render it suitable in the rock-drilling machines, is outlined, and the grading of the suspensions by deep cell count defined. The types of filters used underground are discussed and the cost figures quoted.

52-7 VIABILITY OF ESCHERICHIA COLI IN ACID MINE WATERS

Joseph, J. M., and Shay, D. E., Am. J. Public Health, 42, 795-800, (1952). E. coli and a few other microorganisms can tolerate acid conditions in small numbers. Self-purification studies in situ showed that purification is not complete.

52-8 MINE-ACID STREAM POLLUTION CAN BE CONTROLLED

Anon, Chem. Eng. News, 30, 3006, (1952). S. A. Braley, of Mellon Institute, observes that a few principles of operation can lead to control of stream pollution. Keep surface water out, separate sulfur bearing materials uncovered in stripping, cover sulfur bearing material with at least eight feet of hard packed clay when backfilling mine.

52-9 CLEAN WATER IS EVERYBODY'S BUSINESS

Sanitary Water Board, Department of Health, Harrisburg, Pa., 1952. This brochure on "Clean Streams" lists as the four major sources of pollution - communities, industrial plants, mines and land erosion. It reviews the clean streams program with its recommendations for elimination of pollution from these sources.

52-10 EFFECTS OF VELOCITY ON CORROSION BY WATER

Copson, H. R., Ind. Eng. Chem. 44 (8), 1745-52, (1952). Velocity can be a major factor in the corrosion of metals by water, but most available information on the subject is scattered. A general review, therefore, was undertaken with emphasis on iron, zinc, copper and their alloys. Pertinent unpublished data are included. Generally, corrosion increases with velocity, but the effect may be just the opposite. Motion may sometimes eliminate and sometimes cause local attack. It may have a marked effect on galvanic couples. At high velocities mechanical damage accelerates attack by erosion corrosion and cavitation erosion. Experience and a detailed knowledge of operating conditions are essential for the analysis of a particular problem. It is important to be on the lookout for the secondary effects of velocity.

52-11 AN EVALUATION OF RECLAIMED COAL STRIP MINED LANDS AS WILDLIFE HABITAT

Riley, C. V., Dissertation Abstracts, 18 (3), (1958). The reclaimed strip mine land can provide effective cover for animal life. If gob has been carefully covered, lakes and streams in the area seem to be of good enough quality to support normal aquatic life. Where gob piles are exposed the pH of the water is lethal to fish.

52-12 FOURTH ANNUAL REPORT OF THE OHIO RIVER VALLEY WATER SANITATION COMMISSION

Cleary, Edward J., Published by The Commission, Cincinnati, Ohio, 1952. This is an accounting of activities and projects of the Ohio River Valley Water Sanitation Commission.

52-13 THEORY AND PRACTICE IN STREAM POLLUTION CONTROL

Hoak, Richard D., Scientific Monthly, 75 (3), 166-74, (1952). This is a general look at stream pollution control.

52-14 THE QUALITY REQUIREMENTS OF WATER FOR DOMESTIC USE

Cillie, G. G., The South African Industrial Chemist, (1952). This paper discusses the requirements of a domestic water supply from the point of view of bacterial, physical, and chemical requirements. The taste factors and physiological effects of consumption of saline water are also discussed. It has no direct relationship to acid mine drainage.

52-15 APPLICATION OF BIOLOGICAL RESEARCH IN THE CONTROL OF INDUSTRIAL WASTES AND BIOASSAY OF TOXIC WASTES

Tarzwell, Clarence M., and Doudoroff, Peter, Reprinted from Proceedings of the National Technical Task Committee on Industrial Wastes, 1952. In the biological approach to the industrial waste problem the effects of wastes on aquatic life are studied. This survey serves to summarize the information on the toxicity of industrial wastes to fishes and to indicate deficiencies in our knowledge and needs for further research. The interaction of mixtures of wastes must be studied in order to understand the pollution problem.

52-16 THE RECREATIONAL USE OF WATER IN OHIO

Dambach, Charles A., Proc. First Ohio Water Clinic, Ohio State Univ. Studies, Engineering Series Bull. 147, 27-33, 1952. Quantitatively, Ohio has far less water available for public use than her population requires. Qualitatively, too, the picture is unfavorable. At least one-third of the state streams are unsuitable for recreational use due to pollution from one source or another. Raccoon Creek, with its rusty color due to acid water from abandoned mines or its blue color due to the reaction of the acid mine-water with calcium from farms, roads, and quarries, is cited as an example of a useless stream.

52-17 WATER BALANCE SHEET FOR OHIO

Paulsen, Carl G., Proc. First Ohio Water Clinic, Ohio State Univ. Studies, Engineering Series Bull. 147, 1-6, 1952. The total supply of surface water and ground water in Ohio is much larger than any foreseeable demand, but the distribution of the supply in respect to time distribution of surface flow and to a real distribution of ground-water reservoirs is such that local or temporary shortages of water must be guarded against. Proper application of scientific methods of investigation, together with pollution and soil-erosion control, can and will assure successful and economic conservation and development of Ohio's abundant water supplies.

52-18 THE INCREASING USAGE OF WATER

Youngquist, C. V., Proc. First Ohio Water Clinic, Ohio State Univ. Studies, Engineering Series Bull. 147, 7-16, 1952. Ohio must conduct and maintain a water conserving program to cope with the increasing usage of water. A discussion of usage on a river basin basis and a tabular presentation of industrial water use are included.

52-19 INDUSTRIAL USAGE OF WATER IN OHIO

Snavely, Cloyd A., Proc. First Ohio Water Clinic, Ohio State Univ. Studies, Engineering Series Bull. 147, 12-20, 1952. No true water dearth is in sight in Ohio. The construction of reservoirs has smoothed out seasonal shortages in stream flows in some locations. The requirements of various industries are discussed briefly. Projected new processes could put a burden on the water supply but it seems reasonable to expect Ohio to be able to cope with it.

52-20 THE WATER SITUATION AND OHIO AGRICULTURE

Marion, A. W., Proc. First Ohio Water Clinic, Ohio State Univ. Studies, Engineering Series Bull. 147, 1952. Ohio is one of the leading agricultural states in the nation by reason of her natural resources. Statistics relating crop production to water consumption are presented.

52-21 MINE WATER TREATMENT

Braley, S. A., Proc. First Ohio Water Clinic, Ohio State Univ. Studies, Engineering Series Bull. 147, 114-8, 1952. The amount of acid mine water discharged into our streams can only be controlled by obtaining sufficient on-the-spot data upon which to base regulations and then applying these regulations to each individual mine according to the existing conditions.

52-22 THE RECLAMATION OF SEWAGE AND INDUSTRIAL EFFLUENTS FOR RE-USE

Stander, G. J., The South African Industrial Chemist, (1952). Municipal and industrial effluents are regarded as immediate sources of raw water supply, which can be treated for re-use for domestic, industrial and agricultural purposes. The discharge of industrial wastes into domestic sewage increases the mineral salt concentration thus imposing a limitation on the re-use of the final effluent. The need for treatment of industrial effluents, or control of their discharge when no satisfactory treatment is available is of utmost importance to the South African water resources.

53-1 BACTERIOLOGIC ASPECTS OF BITUMINOUS COAL MINE EFFLUENTS

Leathen, W. W., Proc. Penna. Acad. Sci., 27, 37-44, (1953). Thiobacillus thiooxidans, bacteria present in acid mine water, are sulfur oxidizing and do not increase the formation of acid. However other bacteria which are iron oxidizing increase the total acidity of mine waters substantially. Methods of controlling bacterial activity inside or outside the mine appear impractical. Rapid removal of water from the mine is the only feasible remedial measure now available.

53-2 MINE PUMPING PLANTS - ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., Hower, C. S., Kennedy, D. O. and Lesser, W. H., U. S. Bur. Mines Bull. 531, (1953). To obtain a reliable picture of the anthracite-mine-water problem and to solve that problem, it is necessary to have factual data on the volume and the quality and character of the mine water handled by the pumping plants in the anthracite region, as well as the kinds of pumps utilized and problems concerning their operation. Pumping data by mines are given for the anthracite region during the period 1944-51.

53-3 SURFACE-WATER SEEPAGE INTO ANTHRACITE MINES IN THE WESTERN MIDDLE FIELD ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H. and Link, H. B., U. S. Bur. Mines Bull. 532, (1953). The economics of handling mine water in the Western Middle field is of grave concern to that field. Because of the number of anthracite beds, extent of strippings and mine workings near the outcrops, general subsidence, likelihood of squeezes as mining progresses, cost of remedial measures, cost of mining active mines, and lack of legal control of mine-drainage practice, it does not appear possible to prevent undue infiltration of surface waters. A tunnel system, supplemented by a central pumping plant, appears to be the method by which the water problem can be solved and the life of mining in this area possibly doubled.

53-4 SURFACE-WATER SEEPAGE INTO ANTHRACITE MINES IN THE WYOMING BASIN NORTHERN FIELD-ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H. and Whaite, R. H., U. S. Bur. Mines Bull. 534, (1953). Because of its relatively flat terrain, the wide flood plain of Wyoming Valley does not facilitate rapid runoff; consequently much of the surface water seeps directly into the buried-valley deposits and eventually into the mine workings. Before a report outlining a solution of the mine-water problem can be completed, the possibilities of preventing surface seepage by corrective measures at its source must be explored. There is little doubt that water retained on the surface and diverted to surface-drainage channels has been handled more economically than it would have been by pumping from the mines. This report reveals that about 20 percent of the 70 mines between Pittston and Glen Lyon have been improved.

53-5 CRITICAL REVIEW OF THE LITERATURE ON THE TOXICITY OF INDUSTRIAL WASTES AND THEIR COMPONENTS TO FISH PART II. THE METALS AS SALTS

Doudoroff, P. and Katz, M., Sewage and Ind. Wastes, 25, 802-39, (1953). This is a review of the toxicity of metallic salts to fish. There is little verified information as to the toxicity of iron salts.

53-6 MICROBIOLOGICAL STUDY OF ACID MINE WATERS - PRELIMINARY REPORT

Joseph, J. M., Ohio J. Sci. 53 (2), 123-7, (1953). This is a preliminary study to isolate, cultivate, observe, and attempt identification of the various kinds of organisms capable of tolerating conditions existing in acid waters and to observe the direct or indirect effects of acid waters upon the existing microorganisms. Bacteria, fungi, diatoms may exist in acid waters - some of the types found are listed. However there is a great reduction of microfauna in acid waters.

53-7 RIVER PURIFICATION - A LEGAL AND SCIENTIFIC REVIEW OF THE LAST 100 YEARS

Pentelow, F. T. K., Edward Arnold and Co., London, (1953). This is a review of the laws of England and Scotland pertaining to river pollution by industrial effluents and sewage. The subject of acid mine drainage is not considered.

53-8 COMMON FALLACIES ABOUT ACID MINE WATER

Beal, G. D., Unpublished, 1953. The paper discusses the origin of acid mine water and gives the answers to some fifteen common fallacies about acid mine water. While all mining operations should be laid out in such a manner as to avoid the collection of acid water in the mine, there should be maintained a continuous water survey in the mine. Because ground water is normally alkaline where it enters a mine, it is often possible to conduct that water to the acid producing area and then pump the neutralized water out of the mine.

53-9 STREAM POLLUTION BY COAL MINE WASTES

Hebley, H. F., Trans. AIME, 196, 404-12, (1953). This paper contains a general description of the nation's water resources. It touches upon the phenomenal growth in the demand for water supply and emphasizes the problems facing the coal industry both with regard to acid mine water drainage discharged from active and abandoned mines and the suspended solids discharged to the stream system from wet coal preparation plants. Discussions of acid mine drainage investigations of Braley and others and the bacteriological approach as presented by Temple and Colmer and others are included.

53-10 AN ECOLOGICAL RECONNAISSANCE OF A NATURALLY ACID STREAM IN SOUTHERN LOUISIANA

Bick, G. H., Hornuff, L. E. and Lambremont, E. N., J. Tenn. Acad. Sci. 28 (3), 221-30, (1953). This is a study of the fauna of a small, sandy, acid stream in Louisiana over a five year period. Discussions of conditions and classification of macroscopic fauna are included.

53-11 LAKE ERIE POLLUTION SURVEY - SUPPLEMENT

Youngquist, C. V., Ohio Department of Natural Resources, Columbus, Ohio, (1953). This supplement contains the detailed chemical and physical analyses of stream tributaries and lake intakes. The significance of the components is discussed and allowable limits of concentration are stated in some cases. The bulk of the report is a tabular presentation of water quality data.

53-12 IDENTIFICATION AND OCCURRENCE OF SULFUR ON LAND STRIPPED FOR COAL

Deitschman, G. H. and Neckers, J. W., Central States Forest Expt. Sta. Tech. Paper 136, (1953). A field test for estimating the concentration of sulfides in overburden materials is reported. Using this test, examinations were made of 55 highwalls in Illinois and Indiana. Predictions of mine-bank acidity cannot be based upon sulfide tests alone. Consideration must also be given to the influence of initial pH and physical properties of the bank materials.

53-13 WATER POLLUTION ABATEMENT MANUAL - NEUTRALIZATION OF ACIDIC AND ALKALINE PLANT EFFLUENTS

Anon, Manufacturing Chemists' Assn., Inc., Washington, D. C., (1953). This is a discussion of treatment of acidic (or alkaline) industrial wastes. The materials used for neutralization are listed together with costs for the year 1953.

53-14 FIFTH ANNUAL REPORT OF INTERSTATE POLLUTION-CONTROL ACTIVITIES TO THE GOVERNORS OF ILLINOIS, INDIANA, KENTUCKY, NEW YORK, OHIO, PENNSYLVANIA, VIRGINIA AND WEST VIRGINIA

Cleary, E. J., Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, (1953). Reports of the various industry advisory committees are included as part of this discussion of the accomplishments of the Ohio River Valley Water Sanitation Commission.

53-15 WATER USE AND CONSERVATION POLICY

Hoak, R. D., Chem. Eng. News, 31 (34), 3448-54, (1953). This article is a brief review of the Symposium on Water Use and Conservation Policy at the 123rd ACS national meeting in Los Angeles March 16, 1953.

53-16 THE ROLE OF BACTERIA IN THE FORMATION OF ACID FROM CERTAIN SULFURITIC CONSTITUENTS ASSOCIATED WITH BITUMINOUS COAL. I. THIOBACILLUS THIOOXIDANS

Leathen, W. W., Braley, S. A. Sr., and McIntyre, L. D., Appl. Microbiology, 1, 61-4, (1953). The role of Thiobacillus Thiooxidans in the formation of acid from sulfuritic materials was determined by comparison of inoculated and uninoculated substrates containing sulfuritic materials. The most common sulfuritic constituent associated with bituminous coal and related rock strata, "sulfur balls," as well as museum grade pyrite and marcasite were included in substrates. The microorganisms were recovered from all inoculated solutions by subculturing in elemental sulfur medium at the termination of each experiment. Changes in the substrates were followed by periodic chemical analysis for acidity, ferrous iron, and pH for periods up to 56 weeks. The bacterium increased the acidity and the amount of sulfate when the medium contained elemental sulfur. Some acid was produced from museum grade marcasite but not from "sulfur balls" or museum grade pyrite.

53-17 ACID MINE DRAINAGE CONTROL IN PENNSYLVANIA

Morgan, L. S., Proc. Second Annual Ohio Water Clinic, Ohio State Univ. Studies Engineering Series, 85, (1953). The source of acid effect on stream composition, and possible methods of abatement are discussed. No satisfactory method of treatment has been found.

54-1 MONOGRAPH ON STUDIES OF ACID MINE WATERS WITH PARTICULAR REFERENCE TO THE RACCOON CREEK WATERSHED TO THE OHIO DIVISION OF WILDLIFE, DEPARTMENT OF NATURAL RESOURCES

Clifford, J. E. and Snavely, C. A., Battelle Memorial Institute, 1954. A comprehensive examination of the acid mine water problem in the Raccoon Creek, Ohio watershed. It covers in detail the sources of acid (strip, drift, slope, shaft mines, gob piles), neutralization, abatement through mine sealing, reservoir, and drainage control, cost analysis of various approaches, presence of other minerals and their overall influence on the problem. Appendix B is "A Correlated Abstract, Review and Bibliography of the Published Literature Relating to Acid Mine Drainage."

54-2 DRAINAGE FROM BITUMINOUS COAL MINES

Temple, K. L. and Koehler, W. A., West Virginia Univ. Bull. 25, Series 54, No. 4-1, Morgantown, W. Va., (1954). This investigation was sponsored by Bituminous Coal Research, Inc. A detailed discussion of the source, composition and properties of acid mine water is presented. The role of iron and/or sulfur-oxidizing bacteria is discussed. Possible courses of research on the prevention of acid formation are set forth, with the conclusion that no practical approach has yet been discovered.

54-3 FUNDAMENTAL RESEARCH IN WATER POLLUTION ABATEMENT AT MELLON INSTITUTE

Hoak, R. D., Paper Presented at Pittsburgh Regional Technical Meeting of Am. Iron and Steel Inst., 1954. The activities of the Fellowship in the field of water pollution abatement are discussed. The treatment of pickle liquor, the origins of tastes and odors, the handling of suspended matter in relation to steel industry effluent are all considered. Research has been started into the mechanism of chemical oxidation in a stream from an abandoned coal mine. The problem is complicated in mine-water streams because of the presence of iron-oxidizing bacteria. These organisms are most active at a pH of 3.5. The water leaves the mine at a pH of about 5.7 and contains 175 ppm of ferrous iron. As chemical oxidation proceeds the pH falls, finally reaching a point where biological oxidation begins and chemical oxidation ceases.

54-4 SURFACE-WATER SEEPAGE INTO ANTHRACITE MINES IN THE SOUTHERN FIELD--ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., Link, H. B., and Romischer, W. M., U. S. Bur. Mines Bull. 539, (1954). This report summarizes the engineering study conducted during 1953 by engineers of the Federal Bureau of Mines on seepage of surface water into mine workings underlying the Southern field drainage area. This report is the fourth of a series. The data show the volume and type of seepage in the drainage area and form a sound basis for considering remedial measures. They point to the value of repairing stream beds and surface areas overlying the coal measures as part of the solution of the mine-water problem affecting the mines in this field.

54-5 ACID MINE DRAINAGE. I. THE PROBLEM

Braley, S. A., Mechanization, 18 (1), 87-9, (1954). Acid mine water increases with coal production but does not decrease with cessation of production. If progress is to be made in the abatement of stream pollution by mine acid studies must be made into its production and delivery to the stream. It must be recognized that, since coal is one of the foundation stones of our economy, mines cannot be forced out of existence. However, the mine operators must accept their responsibility to the public.

54-6 ACID MINE DRAINAGE. II. SOURCES

Braley, S. A., Mechanization, 18 (2), 113-5, (1954). The natural chemical oxidation of FeS_2 is the principal source of coal mine acid. Thiobacillus thiooxidans and iron-oxidizing organism are always present, because they grow and thrive in the acid environment but they have little effect on the total acid production. The mechanism of oxidation is discussed.

54-7 ACID MINE DRAINAGE. III. SAMPLING AND ANALYSIS

Braley, S. A., Mechanization, 18 (3), 96-8, (1954). The article describes the method of taking a proper representative sample of mine or stream water and how to handle it prior to analysis. Also described are laboratory methods of determining the acidity and pH of the sample. Relationship between actual acidity and pH of the stream samples is discussed.

54-8 ACID MINE DRAINAGE. IV. COMPOSITION AND FLOW

Braley, S. A., Mechanization, 18 (4), 137-8, (1954). The article lists sample data obtained from the sampling of streams into which acid mine-water is discharged. The author demonstrates how such data must be interpreted and concludes that each mine must be studied separately to determine its effect on stream pollution. No overall rule can be established that will cover all cases of mine-water discharge.

54-9 ACID MINE DRAINAGE. V. CONTROL OF MINE ACID

Braley, S. A., Mechanization, 18 (5), 97-8, (1954). No economically feasible method for control of acid in mine drainage is presently known. The best avenue of control is to plan the drainage course so that water does not accumulate in pools in the mine but is removed as rapidly as possible.

54-10 ACID MINE DRAINAGE. VI. CONTROL OF OXIDATION

Braley, S. A., Mechanization, 18 (6), 105-7, (1954). The conventional procedure of "mine sealing" is ineffective in control of oxidation unless the coal seam is deep enough that the mine can be completely flooded by natural inflow of water and thus seal itself against air contact with sulfuritic material.

54-11 ACID MINE DRAINAGE. VII. STRIP MINING

Braley, S. A., Mechanization, 18 (8), 101-3, (1954). Proper drainage, separation of sulfuritic material and proper backfilling will eliminate or greatly reduce the formation of acid water in open-pit mines without major additional cost.

54-12 COMPREHENSIVE WATER RESOURCES AND CONSERVATION PLANNING

Carey, W. C., Military Engineering, 46 (314), 419-23, (1954). This is a general outline of the need for "basin" water control for flood prevention, irrigation and drainage.

54-13 THE WEATHERING OF PYRITE

Mapstone, G. E., Chem. and Ind. 577-8, (1954). A probable scheme for the course of weathering of pyrite is based on experimental observation of the heterogeneous reaction. The series of reactions outlined can explain all the products reported from weathering of pyrite, namely, ferrous sulfide, free sulfur, sulfur dioxide, and ferrous sulfate.

54-14 SIGNIFICANCE OF INDUSTRIAL WASTES

Hoak, R. D., Trans. of Nineteenth Annual Meeting Industrial Hygiene Foundation, Mellon Institute, Pittsburgh, 1954. The need for an organized program of fundamental research on water pollution is cited.

54-15 ORGANIZATION AND METHOD FOR INVESTIGATING WASTES IN RELATION TO WATER POLLUTION

Anon, Manufacturing Chemists' Assoc., Inc., Washington, D. C., 1954. This is a general outline of a program to combat pollution of streams by industrial wastes.

54-16 SIXTH ANNUAL REPORT, 1954 OF INTERSTATE POLLUTION-CONTROL ACTIVITIES TO THE GOVERNORS OF ILLINOIS, INDIANA, KENTUCKY, OHIO, NEW YORK, PENNSYLVANIA, WEST VIRGINIA AND VIRGINIA

Cleary, E. J., Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, 1954. The activities of the Ohio River Valley Water Sanitation Commission together with lists of people working on the various committees are presented. A discussion of sewage treatment standards forms an important part of the report.

54-17 THE ROLE OF BACTERIA IN THE FORMATION OF ACID FROM CERTAIN SULFURITIC CONSTITUENTS ASSOCIATED WITH BITUMINOUS COAL II. FERROUS IRON OXIDIZING BACTERIA

Leathen, W., Braley, S. A., and McIntyre, L. D., Appl. Microbiology, 1, 65-8, (1953). The bacteria tested oxidized ferrous iron in acid solutions. They produced acid and formed sulfate from sulfur ball material and museum grade Marcasite but had no effect on pyrite. Acid production by bacteria may, in part, cause the high acidities encountered in many bituminous coal mine effluents.

54-18 MINUTES OF THE MEETING OF THE ANTHRACITE MINE DRAINAGE STUDY COMMISSION HELD ON MONDAY, APRIL 5, 1954

Williams, R. Y., Unpublished, Issued by M. K. Mellott Co., Pittsburgh, Pa., 1954. A report of a meeting of the Anthracite Mine Drainage Study Commission to discuss an engineering report on the subject of alleviation of mine drainage problems in the anthracite fields.

54-19 A NEW IRON-OXIDIZING BACTERIUM: FERROBACILLUS FERROOXIDANS

Leathen, W. W., and Braley, S. A., Bacteriological Proc., (1954). A physiologic study of ferrous iron oxidizing bacteria isolated from bituminous coal mine effluents warrants the establishment of a new genus: Ferrobacillus. The specific designation Ferrobacillus ferrooxidans is proposed for the bacterium.

54-20 STREAM POLLUTION FROM COAL MINES

Hebley, H. F., Proc. Third Annual Ohio Water Clinic, Ohio State Univ. Engineering Conference Series, 41-4, (1954). In contrast to many water-borne industrial trade wastes, those emanating from the activities and operations of mining and preparation of coal are inorganic in nature. Briefly, the problems are: acid water that drains from the mine workings and suspended solids that are discharged to the stream system with the waste water leaving coal preparation plants. Various methods of reducing the acid mine water are discussed briefly. The suspended solids problem is one aspect of stream pollution that can be alleviated.

55-1 CORROSIVE AND EROSIVE EFFECTS OF ACID MINE WATERS ON METALS AND ALLOYS FOR MINE PUMPING EQUIPMENT AND DRAINAGE FACILITIES, ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., Dierks, H. A., elegy, E. W., Huston, K. M., Kennedy, D. O., Miller, P. S., and Rosella, J. J., U. S. Bur. Mines Bull. 555, (1955). Corrosion of pumping equipment by acid mine waters has been experienced at tremendous cost by mining companies in the anthracite region of Pennsylvania for many years. The design and specifications of the large centrifugal pumps as provided in the proposed mine drainage system make it imperative that a metal or alloy be recommended that has the highest corrosion resistance and, at the same time, properties suitable for workability (welding, machinery). This report presents data on the corrosive and erosive effects of acid mine water as well as data on the volume and quality of water pumped from underground workings. Twenty-five different metals and alloys were studied. Corrosion tests utilized the two methods (weight loss and microscopic examination) most likely to yield valid data on the behavior of metals and alloys in the environment in which pumping equipment constructed from these materials will operate.

55-2 THE KINETICS OF THE OXYGENATION OF FERROUS IRON IN PHOSPHORIC ACID SOLUTION

Cher, M. and Davidson, N., J. Am. Chem. Soc., 77, 793-8, (1955). The rate of the Fe^{++}, O_2 reaction in H_3PO_4, NaH_2PO_4 solutions at an ionic strength of 1.0-1.1 M ($NaClO_4$) has been studied by a manometric technique. The effects of such variables as the Fe^{++} Fe^{+++} concentration, temperature, oxygen concentration, and surface exposed are discussed. The catalytic effect of the presence of Cu^{++} on the reactions is reviewed.

55-3 ACID DRAINAGE

Anon, Business Week, No. 1364, 123, (1955). As a result of laboratory tests, Patrick and McCollum of Johns Hopkins feel that pollution of streams by acid mine drainage can be cured. The polar nature of the pyrite reaction led to tests that indicate that solutions of phosphate or chromate sprayed on the pyrite would halt the formation of H_2SO_4.

55-4 WATER FOR INDUSTRY

Smallwood, C. Jr., and Nemerow, N. L., North Carolina State Univ.: Facts for Industry Series Bull. No. 2, (1955). This pamphlet describes the sources, purity and availability of water for industrial use in North Carolina.

55-5 HOW TO DEVELOP WATERSHEDS

Frost, S. L., Ohio Forestry Association, Columbus, Ohio, 1955. This public relations brochure on improving watersheds contains five maps of Ohio watershed areas.

55-6 ANTHRACITE DRAINAGE PROGRAM

Anon, Mining Cong. J., 76, (1955). A measure providing for the expenditure of $8.5 million of Federal funds, on a 50-50 matching basis with the State of Pennsylvania, for the control and drainage of water in anthracite coal formations was signed into law by the President (Public Law 162). Passage of this legislation was first urged in 1942.

55-7 THE INFLUENCE OF BACTERIA IN THE FORMATION OF ACID MINE WATERS

Ashmead, D., Colliery Guardian, 190, 694-8, (1955). Experiments have been carried out showing that the cause of the acid mine waters at the two collieries concerned is the oxidation of pyrites by chemical and bacteriological means to form ferric hydroxide and sulfuric acid. For every ton of sulfuric acid produced by chemical means, approximately four are produced by bacteriological means.

55-8 SEVENTH ANNUAL REPORT OF THE OHIO RIVER VALLEY WATER SANITATION COMMISSION

Cleary, E. J., Published by The Commission, Cincinnati, Ohio, 1955. This is a report of the work of the commission and its various committees in the seventh year of its existence.

55-9 ACID DRAINAGE

Anon, Business Week, (1955). A news item on the work of Patrick and McCollum at Johns Hopkins University indicates that solutions of phosphate or chromate sprayed on pyrite would halt the formation of sulfuric acid.

55-10 FLOOD PREVENTION IN ANTHRACITE MINES, WESTERN MIDDLE AND SOUTHERN FIELDS, PROJECT NO. 2

Ash, S. H., Dierks, H. A., Kynor, H. D., Lesser, W. H., Miller, P. S., and Romischer, W. M., U. S. Bur. Mines Bull. 546, (1955). This report covers the second in a series of five projects into which the Conowingo tunnel system has been divided for geographical and practical reasons. Project No. 2 covers the Western Middle and Southern fields and deals with the following items: (a) economic development, (b) geology and hydrology, (c) statement of basic problem, (d) plan and cost of work contemplated, (e) economic analysis and justification of project, and (f) recommendations and conclusions.

55-11 FLOOD PREVENTION IN ANTHRACITE MINES, NORTHERN FIELD, PROJECT NO. 3 (WYOMING)

Ash, S. H., Dierks, H. A., Kynor, H. D., Lesser, W. H., Miller, P. S. and Romischer, W. M., U. S. Bur. Mines Bull. 547, (1955). This report covers the third in a series of five projects into which the Conowingo tunnel system has been divided for geographical and practical reasons. The project as outlined is a self-contained drainage unit that will permit unwatering inundated mines and safeguarding active mines in the Wyoming Basin of the northern field and also will handle the water in the Lackawanna basin.

56-1 REPORT ON FIELD TESTS; REPORT ON LABORATORY RESULTS OF ACID MINE DRAINAGE PROJECT

McCollum, J. W., Unpublished Report to Mr. Tisdale, 1956. The experiments consisted of suspending various samples of pyrites in Agar Agar gel with various indicators which gave a visual check of the reaction with time. Conclusion was that the reaction was electrolytic and similar to the corrosion of iron. It was also established that oxygen and water were both necessary for the reaction to occur. Chromates and phosphates would serve to interrupt the reaction but in different ways. The chromates selectively receive the free electrons in the initial reaction and deposit an insoluble compound on the pyrites which prevents further reactions. The phosphates form an insoluble iron phosphate which deposits on the pyrites and prevents further reaction. The field tests were carried out by spraying with either a solution or suspension or by dusting.

56-2 WATER WASTES OF INDUSTRY

Nemerow, N. L., North Carolina State Univ.: Facts for Industry Series Bull. 5, (1956). The contribution to stream pollution of various industrial activities - textile, paper, packing-houses, etc. - is discussed in this bulletin.

56-3 WATER HARDNESS - OHIO RIVER

Ehlers, N. J., Subcommittee Report of Chemical Industry Committee to Ohio River Valley Water Sanitation Commission, 1956. Methods of analysis for water hardness are outlined. Sources of hardness include limestone, dolomite and gypsum. Acid mine drainage is another source of hardness. Natural sources, such as surface run-off, industrial sources, including underground mine drainage and strip mining operations, make their contributions. Hardness conditions in the Ohio River are discussed, with tables and figures to illustrate the statements.

56-4 PROTECTING OUR LIVING WATERS

Anon, National Wildlife Federation, 1956. This brochure points the way to a pollution abatement program.

56-5 SOME COMMENTS ON WATER POLICY

Biery, H., Speech to Rotary Club of Pittsburgh, 1956. A discussion of the President's Committee (Secys. Benson, Wilson & McKay) report on water resources policy which suggested that user charges should be investigated as a source of repayment of some of the costs of new navigation facilities. This points out the problems inherent in this approach.

56-6 CONTROL OF SLUDGE VOLUMES FOLLOWING LIME NEUTRALIZATION OF ACID WASTES

Faust, S. D., Orford, H. W. and Parsons, W. A., Sewage Ind. Wastes, 28 (7), 872-81, (1956). The objective of this study was to systematically investigate crystal seedings as a means of concentrating sludges formed from lime neutralization of sulfuric acid wastes. The three processes presented are the addition of native gypsum powder, the return of a sludge initially seeded with gypsum, and the return of unseeded sludge.

56-7 TRUTH AND FALLACY ABOUT ACID COAL MINE DRAINAGE

Braley, S. A., Mining Eng., 8 (3), 314-8, (1956). Both field and laboratory experiments are discussed. The conclusions based on these experiments are: application of inhibitors in a gaseous form to an interior surface was ineffective; phosphates, chromates, or NaOH have little effect upon the rate of oxidation of pyrite or pyritic material; reaction rate of pyritic material from a coal measure is greater than the reaction rate of yellow pyrite; the reaction rate of sulfuritic waste is greatly increased by aeration either wet or dry; pH determination is a poor criterion of reaction rate in buffered solutions; there is no known inhibitor capable of deterring or stopping the reaction between the sulfuritic material associated with the coal measures and the oxygen in the air.

56-8 FLOOD PREVENTION IN ANTHRACITE MINES, ANTHRACITE REGION OF PENNSYLVANIA PROJECTS NOS. 4 AND 5

Ash, S. H., Dierks, H. A., Kennedy, D. O., and Miller, P. S., U. S. Bur. Mines Bull. 560, (1956). These projects are concerned with the construction of gravity-flow tunnels connecting with three other projects. The complete system would be known as the Conowingo tunnel system.

56-9 EIGHTH ANNUAL REPORT OF THE OHIO RIVER VALLEY WATER SANITATION COMMISSION

Cleary, E. J., The Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, 1956. In this report the Commission outlines eight years of accomplishment by eight states in a regional crusade for clean streams.

56-10 FROM FOOL'S GOLD TO STREAM POLLUTION

Anon, Clean Waters for Ohio, 5 (1), 1-7, (1956). This is a presentation of the acid mine drainage story in a popular vein. It is the report of a field trip to consider steps to be taken to improve the streams in the Raccoon Creek area.

56-11 INPROVEMENTS IN AND RELATING TO THE TREATMENT OF ACID WASTE WATERS AND THE LIKE

Wedekind, C. L. and Wedekind, C., British Patent 744,480, Application 12/21/51 and 4/25/52. Complete specification published 2/8/56. This patent claims a method of neutralizing acid waste waters in which ignited magnesite is used as the basic reagent.

56-12 THE INFLUENCE OF BACTERIA IN THE FORMATION OF ACID MINE WATERS. PART 2

Ashmead, D., Colliery Guardian, 192, 483-7, (1956). The following conditions prevented or diminished the rate of oxidation of iron disulfide in the presence of unsterilized mine water: cetyl trimethyl ammonium bromide in the solution at a minimum concentration somewhere between 5 and 50 ppm; tetra decyl pyridinium bromide in the solution at a minimum concentration somewhere between 6 and 60 ppm; absence of free oxygen; pH conditions constantly above 4.0. Addition of free chlorine and high concentrations of sulfate had no effect on the rate of oxidation. From a practical point of view only the control of oxygen and pH are of interest.

56-13 WATER HARDNESS - OHIO RIVER

Anon, Report of subcommittee to the Chemical Industry, 1956. The main sources of hardness in the Ohio River are from:

(1) Natural leaching of Ca and Mg ions from rock formations and soil.
(2) Acid mine drainage.
(3) Strip mine operations due to leaching of exposed strata not previously subjected to surface runoff.

Secondary water hardness sources in the Ohio R. are industrial wastes such as the effluents from:

(1) Acid-lime neutralization operations
(2) Soda ash chemical plants
(3) Coal washing operations
(4) Tanneries
(5) Salt water from present and past oil well operations
(6) Misc. chemical operations

At low flow conditions there is a significant decrease in the non-carbonate (permanent) hardness from the upper to the lower reaches of the river. Non-carbonate hardness in the upper reaches is due primarily to acid mine drainage. Some analytical methods are given.

57-1 MINE FLOOD PREVENTION AND CONTROL-ANTHRACITE REGION OF PENNSYLVANIA

Ash, S. H., Dierks, H. A. and Miller, P. S., U. S. Bur. Mines Bull. 562, (1957). The engineering survey, summarized in this report, consisted of studies on acid mine water, underground water pools, seepage of surface water into mines, the buried valley of the Susquehanna River, inundated anthracite reserves, mine pumping plants, barrier pillars between mines and geologic features of region. The corrosion and erosion resistance of certain metals and alloys and their suitability as components of pumps to be used in handling acid mine water were studied. A plan providing immediate and permanent solution of the mine-drainage problem by means of a gravity-drainage-tunnel system throughout the entire anthracite region is set forth. The gravity-drainage-tunnel would extend either from tidewater in the Delaware River at Marcus Hook, Pa. or from tidewater in the Susquehanna River just below the Conowingo Dam in Maryland to near Eddy Creek, Pennsylvania in the northern field. The report includes a summary discussion of characteristics of acid mine water and determination of its properties. Anthracite mine water is not as acid as mine waters formed in bituminous regions. Corrosion tests (Immersion and revolving spindle) are described briefly. Methods of treatment of acid mine water to reduce corrosion and to prevent stream pollution are discussed.

57-2 MINE WATER PROBLEMS OF PENNSYLVANIA ANTHRACITE REGION

Dierks, H. A., Mining Eng., 9 (10), 1140-4, (1957). Geologic structures, character of mine water, history of engineering study, legislative action and flood control program in action are the subjects discussed in this paper.

57-3 MINE ACID CONTROL: A NEW APPROACH

Braley, S. A., Coal Age, 62 (3), 68-9, (1957). Reduced exposure to acid-forming material is the most promising method of solving the acid problem. A new mine of the Christopher Coal Co. will permit testing of the worth of frequent water discharge to cut down contact with sulfuritic materials.

57-4 EVALUATION OF MINE DRAINAGE WATER

Braley, S. A., Trans. AIME, 208, 76-8, (1957). Drainage water from coal mines is probably the most serious water pollution problem today. In the extensive literature on acid mine water there appears to be a great deal of confusion about the importance of various components and the method of analysis. It is believed that total acidity or alkalinity as determined by titration in hot solution to a phenolphthalein end point is the most valuable factor in determining quality of mine water. The author believes that use of a common method of evaluating the quality of mine water discharge will eliminate much misunderstanding concerning the effect and control of mine acid.

57-5 REVIEW OF MINING TECHNOLOGY, DRAINAGE

Allsman, P. T., Hill, J. E. and Lewis, W. E., Minerals Yearbook, Metals and Minerals, 1, 65, (1957). A revision of American Recommended Practice for drainage of coal mines (M6) was published by the Bureau of Mines. The publication lists (1) standard practice for using gathering and permanent pumps; (2) piping for pumps; (3) methods of operation of pumps, storage of water, natural drainage, and unwatering abandoned workings; (4) the composition of mine waters, their action on mine drainage equipment, and alloys that are acid-resisting; and (5) methods for reducing electrolysis in pipelines. The newly recommended standards were formulated according to the procedure of the American Standards Association. Bureau of Mines, American Standard Recommended Practice for Drainage of Coal Mines (M6. 1-55, UDC 622.5) Bul. 570, 1957, 18 pp.

57-6 THE THIOBACILLI

Vishniac, W. and Santer, M., Bacteriol. Rev., 21, 195-213, (1957). A review of the field of thiobacilli is presented.

57-7 RECLAMATION OF COAL STRIP-MINED LANDS WITH REFERENCE TO WILDLIFE PLANTINGS

Riley, C. V., J. Wildlife Management, 21 (4), 402-13, (1957). The suitability of various types of plantings for reclaiming strip-mined areas is discussed. This is an evaluation of plantings and does not relate directly to acid mine water.

57-8 WATER QUALITY AND FLOW VARIATIONS IN THE OHIO RIVER - 1951 - 1955

Cleary, E. J., The Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, 1957. The assembled data include a four-year continuous record of analyses at eleven points throughout a 600-mile stretch of the Ohio River.

57-9 NINTH ANNUAL SUMMARY REPORT OF THE OHIO RIVER VALLEY WATER SANITATION COMMISSION

Cleary, E. J., The Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, 1957. A brief summary of The Commission's view of acid mine drainage is given.

57-10 THE ACID MINE-DRAINAGE PROBLEM IN OHIO

Moulton, E. Q., Ohio State Univ. Eng. Expt. Sta. Bull. 166, (1957). This report presents the results of a nine month research program in acid mine-drainage. It reviews and discusses the problem, suggests future research and presents an extensive bibliography.

57-11 POLLUTION CONTROLS: SOME OF INDUSTRY'S PROBLEMS AND OPPORTUNITIES

Doolittle, R. F., American Association for the Advancement of Science, Indianapolis, Indiana, 1957. This paper stresses the need for adequate data in treatment of streams. As an illustration, the Mahoning and Beaver River surveys for phenol are discussed.

57-12 THE QUESTION OF THE ABILITY OF SULFATE-REDUCING BACTERIA TO UTILIZE METHANE FOR THE REDUCTION OF SULFATES TO HYDROGEN SULFIDE

Sorokin, Yu I., Doklady Akad. Nauk SSSR, 115, 816-818, (1957). Since the reduction of a sulfate by methane is accompanied by an increase in free energy, the author states that changes in bacterial life at the expense of the energy of oxidation of methane by the combined oxygen of sulfates is thermodynamically impossible.

57-13 PREVENTING STREAM POLLUTION

Hebley, H. F., Mining Congr. J., 43 (8), 82-6, (1957). The two major trade wastes that are encountered in the mining and preparation of coal are acid drainage water and suspended solids. There is no system of handling acid mine water which has proven itself effective and economically feasible. A number of suggestions are made for reducing the amount of acid formed.

58-1 THEORY AND PRACTICE IN RECOVERY OF FLUE DUST AND MILL SCALE

Hoak, R. D. and Bramer, H. C., Cleveland Regional Tech. Meeting of American Iron and Steel Institute, 1958. An empirical equation has been developed from laboratory and field data for predicting the performance of scale pits in recovering finely divided material.

58-2 PREVENTING STREAM POLLUTION

Cook, L., Mining Congr. J. 44 (1), 62-4, (1958). Prevention of acid pollution of water is the aim of the Ohio Reclamation Association. Generally this is accomplished by segregating the sulfur bearing material and covering with earth or water to eliminate contact with air.

58-3 COLOR MEASUREMENT WITH THE STREAM COLORIMETER

Cross, J. C. and Nemerow, N. L., Sewage Ind. Wastes, 30, 804-11, (1958). An instrument is described and illustrated for determining color pollution in streams.

58-4 CLEANING UP OUR WATER

Stein, M., House of Representatives Congressional Record, A6739-41, (1958). This is a concise and yet detailed explanation of the Federal water pollution control program and its importance to the future development of the country.

58-5 SOME CONSIDERATIONS IN WATER POLLUTION FROM BITUMINOUS COAL

Hall, E. P. and Hebley, H. F., Unpublished report, 1958. The sources of acid mine water and the chemical mechanics of acid production are discussed.

58-6 SOCIETAL ASPECTS OF POLLUTION CONTROL

Hoak, R. D., A.M.A. Archives of Industrial Health, 17, 446-52, (1958). This is a lengthy statement of the problem of air and water pollution.

58-7 ACID MINE WASTES STUDIED BY OSU EXPERIMENT STATION

Anon, Clean Waters, Columbus, Ohio, 1958. Results of a research project on stream pollution by acid water from coal mines together with suggestions for future work, were presented at an Ohio State University Conference by the University's Engineering Experiment Station. The project was supervised by Prof. Robert F. Baker. One result of the project was the publication of the 160-page Bulletin No. 166 "The Acid Mine-Drainage Problem in Ohio" published November 1957, edited by Prof. Edward Q. Moulton. G. H. McFadden made a survey of literature on the various phases of the problem. R. A. Brant charted the geologic formations in the Sandy Run area and found them favorable for the formation of acid mine drainage. The McDaniels mine - a small drift mine - was selected as the test mine for evaluating the effect of mine seals. Recommended further research: (1) further study of biological and chemical aspects of the formation of sulfuric acid in mines; (2) studies of the use of bacteria to counteract conditions found in the formation of acid; (3) further use of the test mine installation; and (4) publication for all persons concerned with the problem.

58-8 WEST VIRGINIA'S CLEAN STREAMS PROGRAM - PRESENT AND FUTURE

Wright, B., Presented at the West Virginia Conference on Water and Related Natural Resources, 1958. This is a review of the accomplishments of the State Water Commission in four areas: (1) Municipal, (2) Industrial, (3) Coal Washery Wastes and (4) Acid Mine Drainage. In the first three areas there has been much accomplished. A lack of effective means of controlling acid mine drainage has hampered the activity of the commission in the fourth area.

58-9 YOUR CLEAN STREAMS PROGRAM

Anon, Penna. Dept. of Health, Harrisburg, Pa., 1958. This is a brochure on the Clean Streams program.

58-10 THE OHIO RIVER VALLEY WATER SANITATION COMPACT AND THE CHEMICAL INDUSTRY

Rhodes, R. S., Presented at Meeting of the Chemical Industry Committee in Albany, N. Y., 1958. The purpose of this report is to review the Compact provisions and procedures, and the actions taken by the Commission to implement the intent of the Compact which have a bearing on the chemical industry operating in the Ohio River Basin. Suggestions are offered for revising and clarifying the waste control requirements developed by the Commission. Proposed regulation of mine drainage wastes is discussed.

58-11 REPORT OF PROGRESS, 1957-58. STATE OF WEST VIRGINIA, STATE WATER COMMISSION

Wright, B., State of West Virginia State Water Commission, 1958. State Water Commission report shows progress in all areas of water pollution control. Reference to acid mine drainage control as part of the program is made on pp. 29-30.

58-12 10TH ANNUAL SUMMARY - OHIO RIVER VALLEY WATER SANITATION COMMISSION, A REPORT ON THE INTERSTATE CRUSADE FOR CLEAN STREAMS

Cleary, E. J., Ohio River Valley Water Sanitation Commission, (1958). Graphic and tabular analysis is presented of the progress being made in control and treatment of industrial and municipal wastes. The report discusses the various projects being supported by the commission.

58-13 PENNSYLVANIA PLANT LOCATION FACTORS - REPORT NO. 3 INDUSTRIAL WATER SUPPLIES IN PENNSYLVANIA

Patterson, J. A., Penna. Dept. Commerce, Industrial Dev. Bur., (1958). This report presents in summary form Pennsylvania's basic water data most commonly used by industries in evaluating areas for plant location. The effect of climatological conditions and drainage patterns on the availability of water, as well as such basic data as stream flow, ground water, and quality of water are reviewed for the overall state picture. In addition, the water resources are discussed by drainage basins. The range of pH and water hardness values of Pennsylvania streams obtained at key sampling stations are presented as an appendix to the report. Sources of data are thoroughly discussed.

58-14 NATIONAL WATER QUALITY NETWORK - ANNUAL COMPILATION OF DATA, OCTOBER 1, 1957 - SEPTEMBER 30, 1958

Public Health Service Publication No. 663. Water quality data collected at some 50 stations throughout the United States are tabulated.

58-15 THE IMPORTANCE OF MINERALS IN THE STATE'S GROWING ECONOMY

Price, P. H., Presented at West Virginia Conference on Water and Related Natural Resources, Beckley, West Virginia, (1958). The mineral resources, coal, natural gas, petroleum, limestone, building stone, sand and gravel, salt, water, and mineral springs, are discussed. No mention of any form of pollution of water. A general, Chamber of Commerce-type paper.

58-16 THE BIOLOGICAL STREAM SURVEY IN RELATION TO POLLUTION

Anon, Unpublished Report by Consulting Biologists, (1958). Consulting Biologists have devised a graphic method of presentation of data collected on biological surveys that clearly illustrates stream conditions. This is a discussion of the method.

58-17 SPENT SULFITE LIQUOR DEVELOPMENTS

Black, Hayse H., Ind. Eng. Chem., 50, 95A-99A, (1958). Water pollution problem in sulfite industry has instigated further development and research on spent sulfite liquor.

58-18 ARMY PACKAGE POWER REACTOR - WATER TREATMENT AND WASTE DISPOSAL

Medin, A. L., Ind. Eng. Chem., 50, 989-90, (1958). This article is of interest in the field of water treatment for special use. It has no application to the acid mine drainage problem.

58-19 RECENT LEGISLATION AFFECTING INDUSTRIAL WASTE DISPOSAL

Nemerow, N. L., and Wilson, W. L., Ind. Eng. Chem., 50 (2), 95A-96A, (1958). Recent legislative activities in the field of water pollution control which should be of interest to industry are the enactment of a new federal water pollution control act, the enactment or revision of many state laws, and the development of proposals to amend basic state water use laws.

59-1 POTOMAC RIVER WATER QUALITY NETWORK - COMPILATION OF DATA, WATER YEARS 1958-1959

Anon, Interstate Commission on the Potomac River Basin, Washington, D. C., (1959). Comprehensive analyses of samples from stations in the Potomac River Basin for flow, temperature, turbidity, alkalinity, pH, dissolved O_2, BOD, bacteria and solid are tabulated.

59-2 THE DISCHARGE OF SULFATES INTO CONCRETE SEWERS

Notes on Water Pollution, 6, (1959). Based on research work carried out at the Building Research Station, information is given on the effect of sulfates on concrete, with particular reference to the corrosion of concrete pipes by effluents containing sulfate. The aspects considered include the chemical reactions involved, the resistance of concrete to sulfate, the effect of the basic constituent of the sulfate and of other factors, internal corrosion of concrete sewer pipes, methods for the protection of pipes, and corrosion caused indirectly by bacteria reducing sulfate and organic sulfur compounds of H_2S which is later converted to H_2SO_4.

59-3 POLLUTION OF THE SAAR AND MOSEL BY THE MINING INDUSTRY OF THE SAARLAND-LORRAINE INDUSTRIAL DISTRICT

Schon, K., Fischwirt Wasserwirtschaft Stuttgart, 49 (2), 168, (1959). A description is given of the pollution of the Saar by mining and industrial wastes from Lorraine and Saarland. At the mouth of the Rossel some 12,000 cu. m. of coal and mine sludge reaches the Saar daily. Photographs show the serious condition caused. Organic pollution causes deficiency of oxygen. The salt content has reached an exceptional height. The Saar below Saarbrucken contains no fish. The condition of the Mosel is also discussed.

59-4 THE BITUMINOUS COAL OPEN PIT MINING INDUSTRY IN PENNSYLVANIA

Hohnka, L. C., Central Pa. Open Pit Mining Assn., Philipsburg, Pa., (1959). This booklet is issued to place before the public the facts and figures concerning the industry's compliance with the Bituminous Coal Open Pit Mining Conservation Act and the Mine Drainage Laws relative to acid mine drainage and industrial wastes from coal mines. The record of the industry in reclamation and statistics covering the economics of the industry are included.

59-5 THE INTEREST OF THE NETHERLANDS IN THE PROTECTION OF THE RHINE FROM POLLUTION

Biemond, C., Gas-u. Wasserfach, 100, 1137, (1959). The author gives a general description of the water problem, the importance of the analyses of Rhine water, construction of reservoirs and effects of pollution. The three main types of pollution being by sewage and industrial waste waters, pollution by salts from mines and the soda industry, and pollution by radioactive materials. The reduction required in such pollution and steps being taken to achieve it are discussed.--In German.

59-6 PROGRESS REPORT ON THE RECLAMATION AND REFORESTATION OF STRIP MINED AREAS IN CENTRAL PENNSYLVANIA

Jones, W. G., Central Pennsylvania Open Pit Mining Assn. Conservation Div., Philipsburg, (1959). Strip mining followed by a planting program have improved areas mined. One of the most beneficial and unnoticed effects of stripping in Pennsylvania is the dramatic effect it is having in the elimination of acid drainage from old deep mines.

59-7 STUDIES ON THE CHEMOAUTOTROPHIC IRON BACTERIUM FERROBACILLUS FERROOXIDANS - I. AN IMPROVED MEDIUM AND A HARVESTING PROCEDURE FOR SECURING HIGH CELL YIELDS

Silverman, M. P., and Lundgren, D. G., J. Bact., 77 (5), 642-7, (1959). The growth and harvesting of ferrobacillus ferrooxidans are discussed. The demonstration of the coincidence of ferrous iron oxidation and growth further confirms the autotrophy of this organism.

59-8 STUDIES ON THE CHEMOAUTOTROPHIC IRON BACTERIUM FERROBACILLUS FERRO-OXIDANS - II. MANOMETRIC STUDIES

Silverman, M. P., and Lundgren, D. G., J. Bact., 78, 326, (1959). The physiological properties and iron-oxidizing system of the obligate chemoautotrophic bacterium Ferrobacillus ferro-oxidans were studied manometrically using intact cells. Ferrous ions were oxidized at an unusually rapid rate; endogenous metabolism did not occur. The optimal conditions for the iron-oxidizing system were pH 3.0-3.6 and temp. 37°C. The effect of increased concentration of ferrous ions and the presence of other ions is discussed.

59-9 GLUTATHIONE AND SULFUR OXIDATION BY THIOBACILLUS THIOOXIDANS

Suzuki, I., and Werkman, C. H., Proc. Natl. Acad. Sci. U. S., 45, 239-244, (1959). Experimental results of an investigation of the role of glutathione in sulfur oxidation by Thiobacillus Thiooxidans are presented.

59-10 SAFEGUARDING WATER RESOURCES THROUGH POLLUTION CONTROL - THE CHALLENGE IN THE OHIO RIVER VALLEY

Cleary, E. J., Statement prepared for Senate Select Committee on National Water Resources, Detroit, Michigan, (1959). This is a resume of the aims and accomplishments of the ORSANCO program. One of the areas of the program which is not yet satisfactory is the control of pollution from acid mine drainage.

59-11 SURVEY OF FERROUS-FERRIC CHEMICAL EQUILIBRIA AND REDOX POTENTIALS

Hem, J. D., and Cropper, W. H., Geological Survey Water-Supply Paper No. 1459-A, (1959). This report covers a preliminary phase of research by the Geological Survey into the chemistry of iron in natural waters. The report provides a brief introduction to theoretical aspects of dilute aqueous solutions that contain iron, affords a better basis for understanding the chemical principles which control such solutions and illustrates the use of theory to explain observed characteristics of natural water.

59-12 A MACRO-INVERTEBRATE SURVEY OF A LOWLAND STREAM

Wurtz, C. B., Presented at the 7th Annual Meeting of the Midwest Benthological Society, Gull Lake Biological Station, (1959). This survey is aimed at evaluating the effect of organic pollution on stream life. The method is also applicable to non-organic pollution such as mine wastes.

59-13 FORAGE FROM STRIP MINES

Gamble, H. R., Eastern States Cooperator, 22, (1959). "Useless" strip mine land was reclaimed by careful choice of pasture crop and application of lime and fertilizer.

59-14 HUTCHISON MINE - A PROBLEM IN COAL MINE-DRAINAGE

Hall, E. P., and Rozance, J. L., Society of Mining Engineers of AIME Preprint No. 59F309, (1959). This resume of water drainage conditions in a mine typical of the Pittsburgh area is presented to illustrate some of the problems and difficulties caused by water drainage in some coal mining operations, and to point out that these problems must be considered and overcome if coal is to be mined.

59-15 HOW FAR BEHIND PUBLIC OPINION ARE WE ON THE QUESTION OF WATER POLLUTION CONTROL

Gordon, S., Report presented to the Water Pollution Control Advisory Board, Washington, D. C., (1959). Public Opinion is behind a strong program of control of water pollution from all sources. This report calls for action.

59-16 STREAM BIOLOGY AND POLLUTION

Wurtz, C. B., A seminar for Sanitary Water Board of Pennsylvania, (1959). This talk defines pollution as a product of legislation. That is, pollution is whatever the lawmakers interpret it to be. The use of biological patterns to identify pollution is discussed.

59-17 ANNUAL REPORT, FISCAL YEAR 1959, STATE WATER COMMISSION, WEST VIRGINIA

Wright, B., State of West Virginia Water Resources Commission, (1959). One section (p. 27-8) deals with treatment of water from coal washeries. There is no direct mention of acid-mine water in this report.

59-18 COMPENDIUM OF WATER POLLUTION LAWS

Geuther, Carl E., Water Pollution Abatement Manual Mfg. Chemists Assoc., Inc., Manual Sheet W-5, (1959). This is a practical analysis of the working laws and regulations as they are now being enforced in relation to water pollution and water pollution abatement. It covers 49 states, District of Columbia, Territory of Hawaii, Puerto Rico and the federal laws of the United States.

59-19 WHAT IS YOUR MINE-WATER QUALITY?

Braley, S. A., Mechanization, (1959). The coal operator can help to protect himself from charges of stream pollution by determining the quality and volume of water discharged from his mines - without placing his reliance on some agency of the government.

59-20 AM-9 CHEMICAL GROUT

Anon, American Cyanamid Co. Brochure, (1959). Job descriptions are given for a number of applications of AM-9 chemical grout. It is used for the stabilization of soil and for reducing permeability.

59-21 A BIOLOGICAL SURVEY OF LITTLE SEWICKLEY CREEK

Unpublished report submitted to Consolidation Coal Co., (1959). The biological nature of the stream is discussed in detail. The overall character of the stream is typical of a stream carrying toxic and inert materials harmful to aquatic life. The bacteriological data indicate the stream is unsafe for bathing, etc.

59-22 THE NEXT TEN YEARS

Dwork, Dr. R. E., Speech presented at meeting of Ohio Sewage and Industrial Waste Treatment Conference, Cincinnati, June 17, 1959. This is a general look at the water pollution problem and its solution for the next ten years.

59-23 WATER POLLUTION RESEARCH 1958

Her Majesty's Stationery Office, London, (1959). The following subjects of research are covered in the report:

Sewage
Industrial Waste Waters
Effects of Pollution on Fish
Fresh Water Streams
Survey on the Thames Estuary
Water - Recharge of Underground Supplies
Automatic Equipment

60-1 THE OXIDATION OF PYRITIC CONGLOMERATES

Braley, S. A., Industrial Wastes, 5, (1960). Work on the basic mechanism for the production of acid mine wastes is reported. Two reactions are presented, one for the oxidation of Fe_2S by dry air, the other the reaction of FeS_2 in the presence of oxygen and water. The dry oxidation proceeds to $FeSO_4$ and SO_2. In the presence of moisture $FeSO_4$ and H_2SO_4 are the end products. A most interesting aspect of these reactions is the effect of lime when it is present in the conglomerate. This information tends to explain the question developed by the absence of free acid in the waste although sulfuric acid is produced by the reaction. Details of the experimental work carried out to establish these reactions are given.

60-2 ACID-DRAINAGE CURBS ARE HERE

Raleigh, W. A., Jr., Coal Age, 65 (4), 80-4, (1960). ORSANCO Resolution 5-60 is stated. Present practice in acid-drainage control is discussed. The natural cycle of oxidation of iron sulfide and transport in percolating waters must be broken at any point to solve the problem of stream pollution. Abandoned mines are source of 60 to 90 percent of total acid discharged. Sealing of mines or use of contact antioxidants have been unsuccessful because of continuing oxygen supply through fractured or porous cover. Flooding is successful but not always physically possible. Modified methods of water handling are being investigated. Continuous discharge and use of demand storage reservoirs can help prevent "slugging" of streams. Proper handling reduces the acid producing area of a "gob" pile. Refuse should be sized to eliminate large particles, dumped in a site selected to eliminate water flow through the refuse pile, compacted and covered with adequate vegetated soil cover to reduce cover erosion.

60-3 STRIPPING FOR PROFIT

Anon, Coal Age, 65 (7), 267-86, (1960). This is a general article which covers stripping operation from the preliminary study of the land and coal through drainage. Brief discussions of prevention of inflow, gravity drainage, and pumping are included. Two methods of neutralizing acid-water with limestone are described briefly.

60-4 TREATMENT OF SURFACE AND WELL WATERS AND USE OF DOLOMITE MATERIALS FOR FILTERING

Borner, Hans, Termotecnica (Milan), 14, 439-46, (1960). Dolomite materials, calcined below 800°, maintain in water an ideal alkalinity which favors the precipitation of iron and manganese without clogging filters.

60-5 THE MINING GUIDEBOOK: HANDLING MINE WATER

Anon, Coal Age, 65 (7), 254-6, (1960). This is a general article on water in mines. Pressure to prevent mine water from entering public waterways may influence pumping schedules, etc.

60-6 RELATIONS BETWEEN HARDNESS OF WATER AND DEATH RATES FROM CERTAIN CHRONIC AND DEGENERATIVE DISEASES IN THE UNITED STATES

Schroeder, H. A., J. Chron. Disease, 12 (6), 586-91, (1960). In hardness or softness of potable water may lie a clue to an influence affecting death rates from hypertension and atherosclerosis, and possibly a few other chronic disorders.

60-7 RELATION BETWEEN MORTALITY FROM CARDIOVASCULAR DISEASE AND TREATED WATER SUPPLIES

Schroeder, H. A., J. Am. Med. Assoc., 172 (17), 98/1902-104/1908, (1960). Some negative correlation seems to exist between hardness of finished water and total mortality, cardiovascular mortality, male mortality from coronary heart disease and male mortality from all other cardiovascular diseases. No correlations between hardness of water and non-cardiovascular deaths were found. Significant negative correlations were found between constituents of finished water of magnesium, calcium, bicarbonate, sulfate, fluoride, and dissolved solids, specific conductivity of water, pH, silica, and noncarbonate hardness and total death rates and mortality from coronary heart disease. No significant correlations between death rate and 10 other factors in finished water were found: silica, iron, sodium and potassium chloride, the ratio of sulfate or bicarbonate, nitrate, manganese, carbonate, color, turbidity or the number of treatments given water.

60-8 POTOMAC RIVER WATER QUALITY NETWORK - COMPILATION OF DATA, WATER YEAR 1960

Anon, Interstate Commission on the Potomac River Basin, Washington, D. C., 1960. Comprehensive analyses of samples from stations in the Potomac River Basin on flow, temperature, turbidity, alkalinity, pH, dissolved O_2, BOD, Bacteria and solid are tabulated.

60-9 INDUSTRIAL WASTES I HAVE KNOWN

Dixon, C. M., Wastes Eng., 31, 315,350, (1960). The author gives a brief account of his experiences of problems in the treatment of acid waste waters from the manufacture of nitrocellulose (for gunpowder), resin manufacture waste waters which were treated with sewage, phenolic waste waters and sewage. Problems occurring with the acid wastes consisted of the control of the pH value, and the neutralization with quicklime, which was found to be unsatisfactory and was replaced by slaked lime.

60-10 SOLUBLE IRON - AND HOW TO REMOVE IT FROM PUBLIC WATER SUPPLIES

Priester, M. U., Amer. City, 75 (5), 123-4, 189-91, (1960). The author reviews general methods for removal of soluble iron, in the ferrous and ferric states, from public water supplies, drawing attention to the limitations of these methods.

60-11 CONTROLLED MINE WATER DRAINAGE

Steinman, R. E., Ind. Water and Wastes, 5, 201-3, (1960). The measures applied by the Jones and Laughlin Steel Company for the control and disposal of acid mine-drainage in their Vesta mines are discussed. A wide variety of controls used include air sealing of abandoned workings, collection of drainage in sumps, controlled pumping, blending of acid and alkaline waters and the use of pipes where possible instead of open ditches. Waste waters from the Coal Preparation Plant are impounded for solids removal.

60-12 THE U. S. HAS A CHOICE: CLEAN UP OR MAKE DO WITH DIRTY WATER

Eng. News Rec. 164 (4), 94, (1960). In a review of developments in water resources and supplies in the U. S. in 1959 subjects discussed include legislation required for the prevention of pollution of surface waters by sewage and trade waste waters, and schemes at present completed or in operation for the extension or introduction of potable water in all areas, especially those short of water; examples are given. A comprehensive list of towns and cities in the U. S. in which the construction of water - or sewage - treatment plants is in progress or has been completed and of schemes for harnessing the water resources of river basins and lakes for water supplies and hydro-electric power is supplied.

60-13 SOME CHEMICAL RELATIONSHIPS AMONG SULFUR SPECIES AND DISSOLVED FERROUS IRON CHEMISTRY OF IRON IN NATURAL WATER

Hem, J. D., U. S. Geological Survey, Water Supply Paper 1459-C, 1960. The stability fields for the five sulfur species most likely to occur in natural water are shown on an Eh-pH diagram. A second Eh-pH diagram shows the range of conditions under which iron activity could amount to 10^{-7} molal or more in the presence of solid-phase ferrous sulfide and a total dissolved sulfur content 10^{-5} molal, in the absence of bicarbonate. Reactions involving oxidation or reduction of sulfur are slow but may be speeded by biochemical influences. If equilibrium is established, natural water containing a few hundred ppm of sulfate and bicarbonate could contain over 10 ppm of iron only if pH is less than about 6.1 over a rather wide Eh range. Some ground-water samples are not at equilibrium, however. Wells may obtain water from several poorly interconnected zones in which Eh, iron, and sulfur content differ. Oxidation of pyrite evidently can be an important source of iron in ground water. The changes in Eh with depth below the water table and the fluctuation of the water table may result in stratification of iron content in ground water and in erratic changes in iron content of water from wells; they may cause iron deposits to form in aquifers and wells. Such deposits could reduce the capacity of wells to yield water and might interfere with ground-water movement.

60-14 COMPLEXES OF FERROUS IRON WITH TANNIC ACID--CHEMISTRY OF IRON IN NATURAL WATER

Hem, J. D., U. S. Geological Survey, Water Supply Paper 1459-D, 1960. Solutions of tannic (digallic) acid at concentrations of 5 or 50 ppm reduce dissolved ferric iron to the ferrous state when the pH is less than 4. In solutions with a pH of 4 or more, a black material containing ferric iron and tannic acid is precipitated. In a solution containing 500 ppm of tannic acid, a ferrous complex forms at a pH of more than 5. This complex is oxidized at a slow rate, and some ferrous iron remains in solution after a month of storage in contact with air. Uncomplexed ferrous iron is oxidized and precipitated from solution in a few hours or less at pH levels of more than 5. The approximate value of the first dissociation constant for tannic acid is between 1×10^{-5} and 1×10^{-6}. The stability constant for the ferrous complex is comparable in magnitude to that of the pink bipyridine complex used in the determination of iron.

60-15 COPRECIPITATION EFFECTS IN SOLUTIONS CONTAINING FERROUS, FERRIC, AND CUPRIC IONS - CHEMISTRY OF IRON IN NATURAL WATER

Hem, J. D. and Skougstad, M. W., U. S. Geological Survey-Water Supply Paper 1459-E, 1960. Precipitates of ferric hydroxide that form when solutions containing ferrous iron are raised in pH or Eh may remove other ions from solution by coprecipitation. Solutions containing from 1 to 10 ppm of iron and about 0.5 ppm of copper were adjusted to pH values ranging from 3.8 to 8.5 by adding sodium carbonate or sodium bicarbonate. More copper was lost from solutions whose pH was 5.5 or more than would have been expected had iron been absent. Stable or metastable colloidal suspensions of ferric hydroxide have a positive zeta potential and do not absorb copper; but when the zeta potential decreases or becomes negative as a result of an increase in the pH of the solution, copper is absorbed by the ferric hydroxide precipitate. Iron precipitating from water samples after they have been collected may remove dissolved copper. Samples from which iron has precipitated can be acidified at the time of analysis to return all the copper to solution. Precipitation of iron can be prevented by lowering the pH of the sample to 4.5 or less at the time of collection if the amount of copper originally dissolved is to be determined.

60-16 A SURVEY OF PERTINENT BIOCHEMICAL LITERATURE - CHEMISTRY OF IRON IN NATURAL WATER

Oborn, E. T., U. S. Geological Survey, Water-Supply, Paper 1459-F, 1960. Only three references are given relating directly to acid mine drainage (see page 119), however the review of IRON in aspects related to water is comprehensive and thorough.

60-17 IRON CONTENT OF SELECTED WATER AND LAND PLANTS - CHEMISTRY OF IRON IN NATURAL WATER

Oborn, E. T., U. S. Geological Survey Water-Supply, Paper 1459-G, 1960. The role of aquatic vegetation in bringing iron into solution or in removing dissolved iron from surface water has been studied as part of research on chemistry of iron in natural water by the Geological Survey. Before aquatic vegetation could be tested some information was needed on the iron content of different species and the amount contained in different plant parts. Samples of aquatic plants were collected and analyzed along with a few varieties of land plants and lichens.

60-18 SIGNIFICANCE OF CHEMICAL LIMITS IN USPHS DRINKING WATER STANDARDS

Welsh, G. P. and Thomas, J. F., Am. Water Works Assoc. J., 52 (3), 289-300, (1960). Present standards provide maximum permissible limits for lead, fluoride, arsenic, selenium, and hexavalent chromium, because of their known or suspected physiologic effects. In addition, recommended permissible limits are provided for copper, zinc, iron and manganese, magnesium, chlorides, sulfates, phenolic compounds, total solids. Certain alkalinity requirements are also provided. Consideration should be given to providing limits for cadmium, cyanides, nitrates and radioactive material.

60-19 BIOLOGICAL ASPECTS OF THE POLLUTION OF SURFACE WATER SUPPLIES

Pentelow, F. T. K., Contract. Rec., 74 (14), 22-3, (1960). In a paper presented at a symposium on pollution held by the Society for Water Treatment and Examination, the author discussed the biological factors affecting the suitability of surface waters for the preparation of potable supplies. The aspects considered included water-borne infectious diseases, tastes and odours, toxic materials, and factors affecting treatment by chlorination and filtration. Special consideration was given to the effects of pollution, distinguishing between the effects of organic and inorganic waste waters, and to the use of biological criteria in the detection and measurement of pollution. Proposals for future studies include the quantitative assessment of biological data in relation to pollution, and determination of the optimal degree of treatment of domestic and trade waste waters before discharge to surface waters.

60-20 GRAPHIC EXPRESSION OF BIOLOGICAL DATA IN WATER POLLUTION REPORTS

Ingram, W. M. and Bartsch, A. F., Water Pollution Control Federation J., 32, 297-304, (1960). Various graphical analyses of biological data are discussed for use in reports on the effects of water pollution.

60-21 WATER SUPPLY - AMERICA'S GREATEST CHALLENGE

Grayson, L. W., Am. Water Works Assoc. J., 52, 1-5, (1960). Adequate water supply is a challenge for the present and future. A general discussion of types of facilities, costs and public relations program needed.

60-22 MINE DRAINAGE CONTROL IN INDIANA

Hert, O. H., J. Water Pollution Control Federation, 32, 505-8, (1960). This is a review of the problems of drainage from strip mine operations and program to reduce the effects of acid discharge in Indiana. Proper planning prior to the opening of a strip mine so that surface drainage can be controlled is the basis of the program. Abatement of acid discharge from abandoned areas is more expensive, however continuous cover of sulfuritic material either by water flooding or earth cover minimizes the pollutional effects.

60-23 NEW SULFUR-OXIDIZING IRON BACTERIUM: FERROBACILLUS SULFOOXIDANS SP. N.

Kinsel, N. A., J. Bact. 80, 628-32, (1960). An autotrophic bacterium has been isolated from water in an abandoned coal mine in western Pennsylvania. It is similar in many ways to Thiobacillus ferrooxidans, ferrobacillus ferrooxidans, and Thiobacillus thiooxidans, but differs from these organisms by using both ferrous iron and elemental sulfur as sources of energy. The organism has been given the name Ferrobacillus sulfooxidans sp. n.

60-24 DETERMINATION OF FERROUS IRON IN THE PRESENCE OF FERRIC IRON WITH BATHOPHENANTHROLINE

Lee, G. J. and Stumm, W. H., J. Am. Water Works Assoc., 52, 1567-74, (1960). Results of tests have shown that the 1,10-phenanthroline method for the specific determination of ferrous iron is applicable only under certain conditions which are listed and discussed. Of three other methods available, volumetric titration procedures and polarography are limited to relatively large concentrations of ferrous iron and the coulometric titration procedures require special instrumentation. A method using bathophenanthroline as a colorimetric reagent is sensitive to low concentrations. A suggested procedure for this method is presented.

60-25 RESTRAINTS ON DISSOLVED FERROUS IRON IMPOSED BY BICARBONATE, REDOX POTENTIAL, AND pH - CHEMISTRY OF IRON IN NATURAL WATER

Hem, J. D., U. S. Geological Survey Water-Supply Paper 1459-B, 33-55, 1960. Chemical equilibrium involving carbon dioxide, bicarbonate, carbonate and pH influences the amount of ferrous iron in much natural water. Values of pH computed from assumed equilibrium involving calcite or siderite approximate measured values of pH in 13 or 20 samples of ground water from different geologic terranes; thus, some degree of equilibrium probably existed. At equilibrium, pH and iron content provide a basis for estimating the Eh of ground water. If much bicarbonate is present, however, the amount of iron dissolved may not change with change in Eh.

60-26 BRIEF ON THE STATES' WATER RIGHTS PROBLEM

Hardenbrook, D. J., For the Select Committee on National Water Resources, U. S. Senate, 1960. The rights and obligations of states on an interstate waterway are discussed. The question of the limits of the federal governments activity in the use of water rights is raised. It is believed that agencies of the federal government are authorized to construct projects only if they can obtain the necessary water rights in accordance with the state law.

60-27 WATER MANAGEMENT IN OHIO

DiSalle, M. V., Ohio Water Commission, Dept. of Natural Resources, Columbus, Ohio, 1960. A review of proposed and existing activities in management of water in Ohio is presented. The role of the state should be in research, planning and promotion of activity in improving watersheds.

60-28 REPORT ON RECLAMATION OF LANDS STRIPPED BY THE OPEN CUT METHOD OF COAL PRODUCTION

Crowl, J. M., Submitted to Fifth World Forestry Congress, Seattle, 1960. Restoration of strip mine areas directly affects the watershed units of the area. It has been estimated that 95 percent of the stripped land will eventually be restored to productive use, with propitious effect on the streams and lakes and rivers. A list of suitable plants for reclamation of strip mine areas with the pH range of those plants is given.

60-29 AUTOMATIC NEUTRALIZATION OF WASTE WATERS

Eifert, G. and Muller, E., Regelungstech. Praxis, 2, 61-3, (1960). An automatically operating plant for neutralization of waste waters from a chemical works with milk of dolomite is described. Dolomite was found to produce much less sludge than lime and to be less costly than sodium hydroxide. On addition of milk of dolomite to the waste water in a stirring hopper, the dolomite reacts with the acid in the waste water with formation of carbon dioxide which is withdrawn through a flue. The mixed waste water and dolomite then pass to a sedimentation tank where further reaction takes place between the free dolomite and residual acid, and the waste waters, now approximately neutral are discharged to the sewers.

60-30 PUMPING AND PUMPING PROBLEMS IN MINES

Woodley, J. N. L., Trans. Inst. Min. Eng., 119 (11), 685-97, (1960). The general operating principles of positive displacement, centrifugal pumps, and submersible pumps are presented. Problems which arise from operation in mine water which is acidic or which contains high proportions of suspended solids are discussed.

60-31 A STUDY OF THE EFFECT OF TANNINS IN THE GROWTH OF SULFATE-REDUCING BACTERIA

Booth, G. H., J. Appl. Bact., 23, 125-9, (1960). To determine whether tannins could be used to control underground microbial corrosion, experiments were carried out on the effect of tannins on the growth of Desulfovibrio desulfuricans. It was found that inhibition of sulfate-reducing bacteria by tannins was primarily the result of unfavorable pH value.

60-32 THE ROLE OF THE FEDERAL GOVERNMENT IN THE ABATEMENT OF STREAM POLLUTION

Warrick, L. F., A.M.A. Archives of Industrial Health, 21 (3), 174-83, (1960). This article outlines the provisions of the Federal Water Pollution Control Act, frequently referred to as P.L. 660, provides information on administration of the Act by the Public Health Service and describes the work with industry as exemplified in the National Technical Task Committee on Industrial Wastes.

60-33 THE ELIMINATION OF SULFUR FROM COAL BY MICROBIAL ACTION

Rogoff, M. H., Silverman, M. P., and Wender, I., Photocopy - Bureau of Mines Paper, Proj. No. 3451, 1960. The role of microorganisms in the oxidation of sulfur-containing materials is presently under study. Mine waters contain iron-sulfur and thiosulfate-oxidizing and sulfate-reducing bacteria. A rapid manometric method for studying the biological oxidation of pyrites has shown that pyrite oxidation is increased 8 to 13 fold over controls in the presence of ferrobacillus ferrooxidans; thiobacillus thiooxidans apparently plays no role in pyrite oxidation. The rate of pyrite oxidation in the presence of the bacteria is affected by particle size of the crushed material, crystalline form of the iron disulfides, pH and other factors. Other experiments are concerned with oxidation of organically combined sulfur by microorganisms. Problems inherent to bacterial coal desulfurization and their role in acid mine drainage formation and treatment are discussed.

60-34 WATER RESOURCES ACTIVITIES IN THE UNITED STATES - POLLUTION ABATEMENT

Anon, 86th Congress - 2nd session, Committee Print No. 9, U. S. Government Printing Office, 1960. This is the Public Health Service report to the United States Senate Committee on National Water Resources. A statement of the problem of acid mine drainage is given with a list of ten basic measures which might improve the situation, (pp. 10-11). Water quality in the North Branch, Potomac River is adversely affected by acid mine drainage from abandoned coal mines in the reaches of the river above Luke, Md., (p. 28). The Ohio River Valley has made great strides but among the remaining problems is acid mine drainage, (p. 31).

60-35 THE SHEBAN PROJECT

Hall, E. P., Cook, L., Braley, S. A., Brant, R. A., Riley, C. V., Fisher, E. H., and Williams, N. E. Unpublished Progress Report to October, 1960. The Sheban Project is a cooperative experiment in controlling water pollution by impoundment of water in an abandoned strip mining operation which had in turn been preceded by an underground mining operation. The report covers the first two years of the project, including a year of preliminary studies and a year of impoundment, and is complete to the date of October, 1960.

60-36 ACID MINE DRAINAGE MANUAL

Brant, R. A. and Moulton, E. Q., Eng. Expt. Sta., Ohio State Univ., Bull. 179, (1960). This is a well illustrated treatment of the formation and steps towards abatement of acid mine drainage. It appears to be particularly useful for illustrating various causes of acid mine water.

60-37 THE PROBLEMS OF INTERDEPARTMENTAL COORDINATION IN WATER RESOURCES ADMINISTRATION

Staats, E. B., Executive Office of the President, Published - Bureau of the Budget Release, Address before a Joint meeting of Interagency River Basin Committees, Memorial Center, University of Colorado, Boulder, Colorado. This is an evaluation of the present Federal activity in water resources administration. Three major issues of water policy need attention. (1) The definition of Federal responsibility for water resources development; (2) Uniform standards of project evaluation; and (3) Uniform arrangements for cost-sharing and reimbursement.

60-38 A FERROUS-ION-OXIDIZING BACTERIUM. I. ISOLATION AND SOME GENERAL PHYSIOLOGICAL CHARACTERISTICS

Beck, J. V., J. Bact., 79, 502-9, (1960). An iron-oxidizing bacterium has been isolated from acid mine drainage water in Bingham Canyon, Utah. It grows on completely inorganic media at pH 2-3, obtaining its carbon by fixation of carbon dioxide and its energy by oxidation of either ferrous to ferric ion or sulfur to sulfate. Its utilization of thiosulfate, although detectable in manometric experiments, is slow compared to its action on sulfur. Morphologically it seems identical with other previously described autotrophic iron-oxidizing Pseudomonadales.

60-39 MINE ACID CONTROL

Braley, S. A., Mellon Institute Annual Report, 48, 28, (1960). The long-range application of the principles of mine-acid control in mining operations, the effect of water impoundment in pits from strip-mining operations, the composition of mine discharges from various geological areas, the relationship of sulfur content of geological strata and their acid-producing potential are the areas under investigation by the project sponsored by the Coal Industry Advisory Committee to the Ohio River Valley Water Sanitation Commission, Pittsburgh. A special report "The Oxidation of Pyritic Agglomerates" has been completed.

60-40 NEW SULFUR OXIDIZING IRON BACTERIUM: FERROBACILLUS SULFOOXIDANS SP. N.

Kinsel, Norma A., J. Bact., 80, 628-32, (1960). This recently identified organism, Ferrobacillus sulfooxidans, was isolated from coal-mine water from Western Pennsylvania and is characterized by its ability to derive energy by oxidizing both elementary sulfur and ferrous iron.

60-41 WHERE DOES INDUSTRY STAND IN WATER POLLUTION CONTROL?

Steffen, A. J., Presented at 33rd Annual Meeting of Water Pollution Control Federation, Philadelphia, Pa. This is an evaluation of the control of water pollution by industry. A tabulation of the pollution control situation as estimated by state agencies is included with this paper.

60-42 OXYGENATION RATE OF FERROUS IRON IN NATURAL WATERS

Stumm, W. H., U. S. Dept. of Health, Education and Welfare Notice of Research Project 7-WP-13. The proposed studies should evaluate quantitatively the kinetics of the oxidation of ferrous iron by oxygen in bicarbonate solutions. The kinetic results obtained will be applied to the evaluation of pertinent criteria in the processes of iron removal in water supply and waste-water treatment.

60-43 EFFECTS OF HEATED DISCHARGES ON THE TEMPERATURE OF THE THAMES ESTUARY - I

Gameson, A. L. H., Hall, H., and Creddy, W. S., Combustion, 33-40, (1960). A study of one phase of the "thermal waste" problem - estimating the changes in temperature which follow any alteration in position or amount of heat discharge.

60-44 MINE DRAINAGE CONTROL IN INDIANA

Hert, O. H., J. Water Pollution Control Federation, 32 (5), 505-8, (1960). It was found that pollutional effects can be abated by proper planning of surface drainage prior to opening of mine and proper operation of mine from opening to closing. Reforesting, earth covering, and flooding are all possible tools of abatement of pollutional effects of acid and sulfuritic materials from strip mine operations.

61-1 POSSIBLE USES FOR BACTERIA IN METALLURGICAL OPERATIONS

Sutton, J. A., and Corrick, J. D., U. S. Bur. Mines Inform. Circ. 8003, (1961). The purpose of this paper is to acquaint the mining and metallurgical engineer with micro-organisms and some of their possible applications in the field of extractive metallurgy.

61-2 QUARTERLY REPORT OF COAL INDUSTRY ADVISORY COMMITTEE TO THE OHIO RIVER VALLEY WATER SANITATION COMMISSION RES. PROJ. 370-7, 1-1-61 THRU 3-31-61

Braley, S. A., Unpublished Report, 1961. This report on status of long range pumping programs includes analysis of samples taken from augur drilling of strip operation high walls, exposed to air for six months. Results support the hypothesis that the contamination of water by acid and other contaminants is primarily the result of the oxidation of pyritic or sulfuritic materials.

61-3 TITRIMETRIC DETERMINATION OF FERROUS AND FERRIC IRON IN SILICATE ROCKS AND MINERALS

Clemency, C. V. and Hagner, A. F., Anal. Chem., 33 (7), 888-92, (1961). The automatic derivative spectrophotometric titration method for the determination of iron in titanium and its ores, using coulometric generation of titanous ion as the titrant, has been adapted successfully to the determination of total iron in silicate rock, magnetite, pyrrhotite, pyrite or mixtures of these, and to the determination of the ferrous-ferric ratio of silicate rocks, magnetite or mixtures of these. The method measures the amount of ferric iron present. Using a rapid method of sample dissolution by a hydrofluoric-sulfuric acid mixture both total iron and the ferrous-ferric ratio can be obtained within one hour.

61-4 ROBOT MONITOR KEEPS WATCH ON RIVER CONDITIONS

Cleary, E. J., and Kline, W. L., Public Works, 92, 73-5, (1961). River surveillance on the Ohio River is to be augmented by a system of automatic monitoring installations with associated telemetering equipment terminating at Cincinnati. The prototype ORSANCO robot monitor provides for the measurement of pH, chloride ion concentration, specific conductance dissolved oxygen concentration, oxidation-reduction potential, temperature and solar radiation. An automatic sampler is included to permit storing a water sample which shows abnormal quality.

61-5 INSTRUMENTATION IN WATER POLLUTION CONTROL

Jones, R. H., Water and Sewage Works, 108 (6), 244, (1961). This is a general article on the problems and future of continuous instrumentation in prevention of stream pollution.

61-6 PINE CREEK---THE STORY OF A RECLAIMED STREAM

Central Penna. Open Pit Mining Assoc., (1961). Pine Creek, a stream polluted by acid mine drainage from abandoned deep mines, has been reclaimed by open pit coal recovery and subsequent planting.

61-7 BACTERIA IN FLOOD WATER - WHAT THEY ARE, WHAT THEY MEAN

Sharpley, J. M., Pet. Engr., 33, B 55, (1961). This discussion is concerned with the effects of bacteria present in water on waterflood techniques (filter clogging, etc.). Several classes of bacteria are discussed, among them sulfur metabolizing bacteria and iron oxidizing bacteria.

61-8 PUBLIC HEALTH SERVICE TO SEEK FUNDS FOR POLLUTION CRACKDOWN

Anon, Chem. Eng., 68 (17), 62, (1961). PHS is seeking funds to use for policing streams. They will recommend ways to clean up any pollution found. If voluntary action fails, the Secretary of HEW has the authority to issue a cease-and-desist order.

61-9 PLASTIC GRIDS HELP SOLVE WASTE-DISPOSAL PROBLEMS

Anon, Chem. Eng., 68 (17), 70,72, (1961). New polyvinyl chloride grids used in trickling filter at Rome Kraft is described. More economical installation, more effective reduction of BOD, decreased possibility of plugging are among the reasons for great interest in this development.

61-10 DEEP-MINING GUIDEBOOK: MINE DRAINAGE AND PUMPING

Anon, Coal Age, 66 (7), 211-13, (1961). General mine water handling problems are discussed. Acid control is one of the important items in setting pumping schedules from deep mines.

61-11 QUALITY COAL PREPARATION

Anon, Coal Age, 66 (7), 244-6, (1961). The treatment of wash water to prevent loss of coal to refuse and to conform to stream-pollution regulations is discussed. This is one aspect of coal preparation under consideration in this paper.

61-12 PROFITABLE STRIPPING

Anon, Coal Age, 66 (7), 231, (1961). This general discussion of water drainage in strip mine operations deals with the subjects of preventing inflow, gravity drainage, pumping, and neutralizing water.

61-13 THE ADVANCED WASTE TREATMENT RESEARCH PROGRAM OF THE PUBLIC HEALTH SERVICE

McCallum, G. E., Berger, B. B., and Middleton, F. M., Paper presented at Div. of Water and Waste Chemistry, (1961). The reasons for an advanced waste treatment program are outlined. It is the purpose of this paper to discuss the first year's experience in the new program and to outline future plans for research on waste treatment and water recovery.

61-14 INDUSTRIAL WATER CONSERVATION AND RE-USE

Hoak, R. D., TAPPI, 44 (2), 40A-44A, (1961). Water conservation is essential to industrial operations in areas of shortage, but conservation even where water is plentiful is generally economically advantageous. This paper considers the role of the pulp and paper industry in conservation.

61-15 OHIO RIVER VALLEY INDUSTRIAL WASTE DECLARED "SATISFACTORY"

Anon, Ind. Water and Wastes, 6 (2), 48, (1961). In the Ohio River basin, 54 percent of industrial plants have adequate water treatment. W. S. Watson, Consultant, Water Management and Waste Control, General Electric Co. based his figure on a report of the Ohio River Valley Water Sanitation Commission.

61-16 ZETA POTENTIAL: NEW TOOL FOR WATER TREATMENT PART I

Riddick, T. M., Chem. Eng., 68 (13), 121-6, (1961). Zeta potential (Z-P) is a measure of the electro-kinetic charge (in millivolts) that surrounds suspended particulate matter. This long-known principle of physical chemistry can be used to control the coagulation of difficult raw-water colloids.

61-17 ZETA-POTENTIAL: NEW TOOL FOR WATER TREATMENT PART II

Riddick, T. M., Chem. Eng., 68 (14), 141-6, (1961). This is a theoretical consideration of zeta potential as a tool in flocculation. A description of author's device for measurement is given.

61-18 MINED AREA RESTORATION IN INDIANA

Sawyer, L. E., Unpublished Report, 1961. The problems encountered in recovering strip mine areas must be treated on an individual basis, not only from one mining area to another, but often, also, within a single strip. The grading of "good spoil" is often justified but, grading makes "poor spoil" worse. The choice of tree cover depends on the type of soil. Less than six percent of the area disturbed in Indiana is unreclaimed to date.

61-19 CONTROL OF WATER-CARRIED WASTES FROM THE COAL INDUSTRY

Hall, E. P., Paper presented to Ky.-Tenn. Section of the Water Pollution Control Federation, Louisville, Ky., 1961. The principal water-borne waste of the coal industry is suspended solids from coal preparation operation, commonly referred to as black water. The control of these solids can be accomplished through effective sedimentation and clarification, which removes the solids from the water. The problem of acid mine drainage, which is not a waste, is being vigorously investigated and definite progress has been made toward finding solutions to it. The problem of sedimentation from the erosion of stripped areas is presently being defined and reclamation activities to minimize it are being carried out effectively.

61-20 THE POTENTIAL APPLICATIONS OF RADIOISOTOPE TECHNOLOGY TO WATER RESOURCE INVESTIGATIONS AND UTILIZATION

Feely, H. W., Walton, A., Barnett, C. R. and Bazan, F., Office of Technical Services, Department of Commerce, Washington, D. C., 1961. This is the Final Report Contract AT (30-1) - 2477 Prepared for the Office of Isotopes Development, United States Atomic Energy Commission. A review has been made of past work on the application of radionuclear techniques to research in water resources and supply.

61-21 CHEMISTRY OF IRON IN NATURAL WATERS - MICROBIOLOGICAL FACTORS IN THE SOLUTION AND TRANSPORT OF IRON

Oborn, E. T. and Hem, J. D., Geological Survey Water-Supply Paper 1459-H, 1961. Amounts of iron dissolved by distilled water from soil, sand and mixtures of organic matter with soil and sand were determined before and after two weeks of incubation at temp. from 35 to 100 F. The increase in the amount of iron leached from soils after incubation is related to microbiologic activity. Organic complexes of iron aid in retaining in solution the iron made available by the microbiota. By helping to bring iron into solution, microbiota influence the iron content of surface and ground water in many areas.

61-22 ANALYSIS OF FUNDAMENTALS OF ACID MINE DRAINAGE: A BASIS OF FUTURE INVESTIGATIONS

Hanna, G. P., Jr., Brant, R. A., Lucas, J. R., Randles, C. I., and Smith, E. E., Final Report, Project EES-175, Engineering Expt. Sta., The Ohio State Univ., Columbus, Ohio, 1961. It is intended that the results of this study will provide the framework for a broad plan of research, and will serve as a guide and reference for future studies of acid mine drainage to the end that reductions or abatements in this pollution problem may be realized. The phenomena associated with the production and abatement of acid mine drainage are classified for simplicity into the four fundamental areas of: chemistry, microbiology, minerology-petrology, and geology-hydrology. The chemical end-products are generally well-defined. Some effect of micro-organisms in the oxidation processes is acknowledged. The general description of pure sulfide materials is well established, as are techniques for defining the system geology and hydrology. Further intensive research to determine this relation to the oxidation of sulfuritic materials is recommended in:

1. The fundamental kinetics of the chemical reactions,
2. The exact role of bacteria in acid production,
3. Lattice structure and element arrangements in the reacting minerals.

The application of sound geological and hydrological principles and techniques is recommended to delineate the extent of both the sulfur bearing material and the water problem, and to provide a key to the solution by water controls and acid containment. The report cites in detail the current information status and indicates specific investigations to be pursued to fill voids in the existing knowledge. A section on applied studies is also included with specific recommendations relating to mine seal studies including design and development of adequate seals, specific surface mining investigation, and general water controls. Basically this study deals with acid production and alleviation measures, and has therefore considered only those biologic organisms related to acid and acid formation.

61-23 RIVER - QUALITY CONDITIONS DURING A 16-WEEK SHUTDOWN OF UPPER OHIO VALLEY STEEL MILLS

Anon, Ohio River Valley Water Sanitation Commission, Cincinnati, Ohio, 1961. During a shutdown of the upper Ohio Valley steel mills the phenols, manganese, alkalinity, fluorides, and temperature all decreased. Only minor changes in hardness, sulfates, and dissolved solids were observed demonstrating the impact of mine drainage in these areas. On the Mahoning River, where there is little mine drainage, the decrease in these qualities was greater.

61-24 NEW STRIP MINING LAW PASSED IN PENNSYLVANIA

Anon, Mining Congr. J., 47 (11), 88-9, (1961). Pennsylvania has enacted a new strip mining law to become effective January 1, 1962. An increase in backfill requirements and bond requirements are two of the important features of this law.

61-25 GOVERNMENT FUNCTIONS IN POLLUTION CONTROL

McCallum, G. E., and Nelle, R. S., J. Am. Water Works Assoc., 53, 851-61, (1961). A discussion of federal activities in the field of pollution control by Mr. McCallum and of State of Illinois activities by Mr. Nelle. This was presented at a March 23, 1961, Illinois Section Meeting AWWA.

61-26 POLLUTION CONTROLS TIGHTENED IN WEST VIRGINIA

Anon, Coal Age, 66 (12), 36, (1961). New regulations, effective Dec. 1, 1961, provide, among other things, that surface and ground water must be diverted from the mine pit, where practicable, to reduce the flow of black water through the open working. These regulations were made public by State Mines Director Leonard J. Timms and State Natural Resources Director Warden M. Lane.

61-27 KENTUCKY INITIATES RESEARCH PROGRAM

Anon, Mechanization, 25 (12), 69, (1961). A research program to develop ways to reduce stream sedimentation and pollution that may occur when coal is stripped and augured in mountainous forest water sheds was started in Kentucky in November. The program was announced by J. O. Matlack, Commissioner of the Kentucky Department of Conservation and R. D. Lane, Director of the Central States Forest Experiment Station USBA, Columbus, Ohio. The research is headed by Robert Q. May, a mining engineer. The program will study the engineering properties of materials that must be removed in order to recover the coal; the ways of removing and placing overlying materials to give better protection to forest resources and make restoration of the land are discussed.

61-28 WATER

Anon, Chem. Week, 89 (14), 50-78, (1961). The welfare of the chemical process industries is keyed to solution of perplexing water problem. This article gives extensive coverage to the present and projected water needs of various areas, as well as outlining the government sponsored research being done in the areas of supply and pollution control.

61-29 POLLUTION OF THE SUSQUEHANNA RIVER WITH ACID MINE WATER HALTED

Anon, Mining Congr. J., 47 (12), 80, (1961). Pennsylvania Sanitary Water Board ordered three mine pumps of the Glen Alden Corp. stopped. A fish kill, with bass affected most, and the report that Merck and Co. might have to stop operations because of the high iron content of the river were the reasons for the order.

61-30 DEFINING THERMAL POLLUTION

Hoak, R. D., Power Eng., 65 (12), 39-42, (1961). This is a discussion of the legal and scientific aspects of the problem of discharging heated waste water to streams.

61-31 DOES PRODUCTION OF POWER POLLUTE OUR RIVERS

Berger, B. B., Power Eng., 65 (3), 60-1, (1961). The principal sources of pollution associated with power plants are heat and, increasingly, radioactivity. Although power plants have not been considered as a serious source of pollution in the past, expansion of facilities to meet needs may present problems in the future.

61-32 ADMINISTRATION OF THE FEDERAL WATER SUPPLY AND POLLUTION CONTROL PROGRAM

Anon, Chem. Eng. News, 39 (48), 21, (1961). Assistant Secretary of HEW, James M. Quigley, will be the official responsible for operation of the Federal Water Supply and Pollution Control program. This is the first time a senior policy-making official has been involved in this program.

61-33 BIOLOGICALLY ACTIVE MATERIAL IN COAL

Rogoff, M. H. and Wender, I., Nature, 192 (4800), 378-9, (1961). The name "vitricin" has been applied to the group of biologically active substances found in coal. The effect of material soluble in acetone, methanol and hydroxide on Bacillus subtilis was studied.

61-34 THREE CHEMOSYNTHETIC AUTOTROPHIC BACTERIA IMPORTANT TO LEACHING OPERATIONS AT ARIZONA COPPER MINES

Corrick, J. D. and Sutton, J. A., U. S. Bur. Mines, Rept. Invest. 5718, 1961. Three species of chemosynthetic iron and sulfur-oxidizing autotrophic bacteria have been isolated from the leaching waters of copper mining areas. These species are: the sulfur-oxidizing thiobacillus concretivorus, the iron-oxidizing ferrobacillus ferrooxidans, and a sulfur and iron-oxidizing bacterium closely resembling thiobacillus ferrooxidans.

61-35 BACTERIAL OXIDATION OF PYRITIC MATERIALS IN COAL

Silverman, M. P., Rogoff, M. H. and Wender, I., Applied Microbiol., 9 (6), 491-6, (1961). Applicability of the manometric method for studying the oxidation of pyritic material in the presence of bacteria has been demonstrated. Resting cells of ferrobacillus ferrooxidans accelerated the oxidation of coal pyrites and coarsely crystalline marcasite, but were inactive on coarsely crystalline pyrite. Resting cells of thiobacillus thiooxidans were inactive on all pyrites tested. Oxidation rates in the presence of ferrobacillus were increased by reducing the particle size of pyritic samples, and in one case, by removing the $CaCO_3$ from a calcite containing sample.

61-36 HARDNESS OF LOCAL WATER SUPPLIES AND MORTALITY FROM CARDIOVASCULAR DISEASE IN THE COUNTY BOROUGHS OF ENGLAND AND WALES

Morris, J. N., Crawford, M. D. and Heady, J. A., The Lancet, 860-2, (1961). The softer the water supply is in the county boroughs of England and Wales, the higher the local death-rate from cardiovascular disease tends to be. What this means is not at present clear, and further investigation is indicated.

61-37 GREEN CUCUMBER VALLEY PAINTED ORANGE

Anon, Water, Land and Life, 3 (3), 13, (1961). The Western Pennsylvania Conservancy comments on a strip mining operation which opened up an abandoned mine, thus discharging large quantities of acid water into Little Cucumber Run.

61-38 PRINCIPLES OF RESOURCE CONSERVATION POLICY WITH SOME APPLICATIONS TO SOIL AND WATER RESOURCES

Anon, National Academy of Sciences, National Res. Council Publ. No. 885, Washington, D. C., 1961. This is a detailed look at the theories of conservation.

61-39 WHERE INDUSTRY STANDS IN WATER POLLUTION CONTROL

Steffen, A. J., J. Water Pollution Control Federation, 33 (6), 593-602, (1961). This is a very general review of the efforts being made by industry.

61-40 CLEAN WATER

Jensen, L. T., Chairman and Warrick, L. F., Secretary, Report, National Technical Task Committee on Industrial Wastes, 1961. This is a report on the organization and policies of the National Technical Task Committee on Industrial Wastes.

61-41 WATER SUPPLY

Morgan, R. A., Pollution and Environmental Health, Chem. Eng. Progr. Symposium Series No. 35, 57, 13-7, (1961). This is a review of five demonstration plants for potable water recovery from brackish water.

61-42 INDUSTRIAL WASTES TREATMENT

Watson, K. S., Pollution and Environmental Health, Chem. Eng. Progr. Symposium Series No. 35, 57, 18-20, (1961). The role of the chemical engineer in the control of pollution from industrial wastes is discussed.

61-43 THE EFFECTS OF HEATED DISCHARGES ON AQUATIC LIFE AND WATER USE

Wurtz, C. B., Am. Soc. Mech. Engrs. Paper No. 61-WA-142, 1961. This paper discusses the effects of heated discharges on the biological structure of a receiving stream. Fish and bottom organisms are discussed insofar as they are directly affected by heat. Water uses that are temperature-limited are also discussed, as are the relationships between dissolved oxygen and temperature.

61-44 AT CUCUMBER FALLS MINE ACID DOES ITS DIRTY WORK

Jones, F., Pittsburgh Press, (11/12/61). Pictures of the effect of a sudden flow of acid mine water into a stream are the predominant feature of this article.

61-45 BRITISH SCIENTISTS VERIFY SOFT WATER - HEART DISEASE LINK

Anon, Water Newsletter, 3 (10), 1, (1961). A study by a British research team suggests confirmation of Dr. Henry A. Schroeder's findings on the relationship of cardiovascular disease to soft water.

62-1 OF HEAT AND THE RIVER

Wurtz, C. B., Mech. Eng., 84 (2), 44-5, (1962). This paper is an examination of the effect of stream temperature on the various uses of water and on the aquatic organisms. This paper also appeared as an ASME paper 61-WA-142.

62-2 ORSANCO REPORTS A GOAL IN SIGHT

Anon, Eng. News Record, 168 (4), 48, (1962). When 600 small Ohio Valley communities install sewage facilities (cost $150 million), the $1-billion municipal phase of the program to clean up the Ohio River will be wrapped up. A brief report on the current status of ORSANCO.

62-3 U. S. TO PULP MILLS: STOP POLLUTING

Anon, Eng. News Record, 168 (4), 48, (1962). This is a report on Federal-State hearing on pollution of Puget Sound. It is of interest to the acid mine drainage library because of the relationship between Federal and State governments in dealing with a water problem.

62-4 POLLUTION CRACKDOWN

Anon, Chem. Week, 90 (3), 118, (1962). The states of Washington and New York are trying new anti-pollution strategy. Report of federal-state conference on water pollution in Olympia, Washington (CW Business Newsletter January 13, 1962) and New York will require state approval of plans for production or modification of industrial installations that may pollute the air.

62-5 CLEANUP ORDER

Anon, Chem. Week, 90 (5), 48-9, (1962). Murray Stein, chief enforcement officer USPHS, ordered operators of seven pulp mills to take steps to end pollution of Puget Sound. Lawson Turcotte, President of Northwest Pulp and Paper Assoc. protested the order.

62-6 WATER RESOURCES - TECHNIQUES AND TRENDS, WASHINGTON'S WATER DEVELOPMENT ROLE STILL CONTINUES TO EXPAND

Anon, Eng. News Record, 168 (4), 106-13, (1962). This is a review of some of the areas of water control now within the federal province. The Administration Pollution-Control Bill calls for more and bigger grants, more research and broader enforcement powers.

62-7 POLLUTION SUITS

Anon, Chem. Week, 90 (6), 32, (1962). Fish deaths caused by alleged stream pollution could prove costly to dependents in damage suits in Washington and Illinois. Health Plating, Inc. (Kent, Washington) is charged with polluting the Duwamish River with sodium, cyanide and cadmium cyanide causing the death of 2000 salmon. In Illinois nine (9) cases of alleged fish-killing stream pollution have been filed.

62-8 DESALTING PROCESSES MAY GET TRYOUT IN SEWAGE TREATING

Anon, Chem. Eng., 69 (2), 52, (1962). An unexpected benefit of the present water-desalting program may be improved methods for ridding fresh-water streams of refractory organic impurities.

62-9 MACHINE NEUTRALIZES MINE ACID

Latham, R., Pittsburgh Press, 49, (3/28/62). Rochez Bros., Inc., of East Pittsburgh, has developed a portable machine which can neutralize mine acid entering streams from strip-mine operations or from deep mines. The unit treated 100 gal/min. or 6000 gal/hr. The pH of the stream was 4. The neutralizing unit is made up of a pumping system and a lime dispensing unit which treats the water as it is pumped through the unit. It was estimated that the average strip-mine operation could treat its acid water for less than $10 a day.

62-10 AN EVALUATION OF MINE SEALING

Braley, S. A., Mellon Institute Special Report on the Coal Industry Advisory Committee to ORSANCO Res. Proj. No. 370-8. This report presents a discussion of the theory of mine sealing and the criteria upon which evaluation of the procedure can be made. Data collected on a group of selected isolated mines before sealing and for a period of years after sealing are given. The seasonal effects on acid production and sealed mine atmosphere are shown. The conclusions are that mine sealing is ineffective for the reduction of acid discharged from drift mines. It does not reduce the oxygen content of the mine atmosphere. The sealing of two mines whose discharge entered a clean mountain stream did not beneficiate the stream.

62-11 RECLAMATION AND LAND USE PROJECTS INSPECTED

Anon, Mining Cong. J., 48 (2), 148, (1962). Six members of the Land and Water Use Committees of American Mining Congress and National Coal Association toured reclamation and land use projects on mined out areas near Bartow, Fla. The Florida phosphate industry has adopted a joint policy calling for reclamation of mined lands.

62-12 EFFECTS OF RIVER PHYSICAL AND CHEMICAL CHARACTERISTICS ON AQUATIC LIFE

Patrick, R., J. Am. Water Works Assoc., 54, 544-50, (1962). In natural rivers, a great diversity of aquatic life exists and areas of occurrence or amount vary according to the structure of the river. The hardness, O, org. matter, temp., and suspended-solid loads are important characteristics considered for their effect upon aquatic life.

62-13 NEUTRALIZATION OF ACIDIC WASTE WATERS IN BEDS OF CALCINED MAGNESITE

Wheatland, A. B., and Borne, B. J., Water Waste Treatment J., 8 (11), 560-2, (1962). A calcined magnesite upward-flow bed for neutralization of acidic waste waters is described.

62-14 GROUTING FOR CONTROL OF GROUND WATER

Reed, J. J., York, L. A., and Stevens, V. L., Mining Congr. J., 48 (1), 49-56, (1962). In a symposium held by American Mining Congress the subject of control of ground water was discussed under the following titles: "Systematic Approach to Grouting," "Grouting by Cementation," and "Chemical Grouting."

62-15 WATER POLLUTION - ECONOMIC ASPECTS AND RESEARCH NEEDS

Kneese, A. V., Resources for the Future, Inc., Washington, (1962). This is a review of the water pollution problem in an idealized economic framework. Research needs based on this idealized economy are outlined.

62-16 INFLUENCES OF STRIP MINING ON THE HYDROLOGIC ENVIRONMENT OF PARTS OF BEAVER CREEK BASIN, KENTUCKY 1955-1959

Collier, C. C., Geological Survey Professional Paper 427-B, (1962). This report presents the results of a study of the influences of strip mining in the Beaver Creek Basin during the period 1955-59. Strip mining has occurred in about 10 percent of the Cane Branch area since 1955. The Helton Branch area has had no mining activity. A comprehensive comparison of chemical content, flooding characteristics, effect on aquatic life and on flora and fauna in these areas is presented.

62-17 STRATIGRAPHIC RELATIONS TO ACID MINE WATER PRODUCTION

Hanna, G. P., Jr. and Brant, R. A., Paper presented at 17th Annual Purdue Industrial Waste Conference, 1962. The work outlined in this paper has attempted to relate acid formation to various strata. While acid generators do not parallel the oxidation in situ of pyritic materials it is possible through their use to compare oxidation rates and thereby begin to develop a quantitative means of measurement. A diagram of the apparatus used for testing and graphic presentation of the results are included.

62-18 FINAL REPORT - GROUP 3 - NATIONAL SYMPOSIUM ON COAL MINE DRAINAGE TECHNICAL ASPECTS OF CONTROL OF DRAINAGE FROM ABANDONED MINES

Anon, Unpublished, (1962). This is a report on the problems associated with acid mine drainage from abandoned mines and the recommendations for research and development needed to overcome the problem.

62-19 COMPREHENSIVE PLANNING FOR WATER QUALITY MANAGEMENT

Reed, P. W., Paper presented at 17th Annual Purdue Industrial Waste Conference, 1962. A broad look at the comprehensive planning for Water Quality maintenance as the Public Health Service sees it.

62-20 ARE WE REALLY RUNNING OUT OF WATER?

Hoak, Richard D., Trusts and Estates Magazines, 1962. The author reviews present demand for water and projects future needs. He discusses some of the probable sources for supplemental supplies.

62-21 SOIL AND WATER CONSERVATION IN MANY COUNTRIES

Anon, Miscellaneous Publication 908, Soil Conservation Service, U. S. Dept. of Agric., (1962). This picture book is intended to tell in a small measure the story of soil and water conservation around the world.

62-22 WILDLIFE AND RECREATION ON RECLAIMED STRIPLANDS

Riley, C. V., This one-page brochure gives some statistics on the value of coal strip mining and a list of animals, fish, and birds found in well managed reclaimed areas.

62-23 WATER MANAGEMENT IN COAL STRIP LAND RECLAMATION

Riley, C. V., Kent State University, Ohio, 1962. This is an illustrated brochure giving information on pond planning and construction on strip mine areas to give most effective final use of the area.

62-24 MINE WATER CONTROL PROGRAM, ANTHRACITE REGION OF PENNSYLVANIA, JULY, 1955 - DECEMBER, 1961

Dierks, H. A., Eaton, W. L., Whaite, R. H., and Moyer, F. T., U. S. Bur. Mines, Inform. Circ., 8115, (1962). Implementation of the Joint Federal-State Control program established in 1955 to cope with the mine water problem in the Pennsylvania Anthracite Region is described in this report.

62-25 A NEW RIGID FOAM FOR STOPPINGS AND SEALING MINE RIBS AND ROOF

Mitchell, Donald W., Paper presented at 52nd Annual Convention of the Mine Inspectors' Institute of America, Springfield, Ill., June 11-13, 1962. A rigid urethane foam formulation has been developed for sealing stoppings, inhibiting moisture deterioration of mine surfaces, binding structurally weakened ribs and roof, and for thermal insulation in mines. Tests are being conducted in coal and copper mines to improve chemical formulations, spray equipment and application techniques.

62-26 SPEARHEADING THE OHIO VALLEY INTERSTATE MINE DRAINAGE CONTROL

Cook, Larry, Paper presented at the 17th Annual Purdue Univ. Industrial Waste Conference, Lafayette, Ind., 1962. The activity of the Coal Industry Advisory Committee in finding measures for the control of Acid Mine Drainage are discussed. The control measures contained in ORSANCO Resolution 5-60 are outlined.

62-27 WATER POLLUTION CONTROL

Anon, Western Penna. Coal Operators' Assn., (1962). A six-year water quality management plan for the upper Ohio River basin has been announced by the Dept. of Health, Education and Welfare. Wheeling, W. Va. has been selected as headquarters. Staff will reach 40-50.

62-28 CRISIS ON THE KANAWHA

Finley, S., Stuart Finley, Falls Church, Virginia, (1962). This is descriptive material relating to a 20-minute color film produced to show the effects of industrial pollution. Also included in this brochure are short descriptions of other films available:

"Good Riddance," - 25 minutes - color - ORSANCO program for clean streams
"Beargrass Creek," - 20 minutes - color - effect of municipal pollution on a small stream
"Oil on the River," - 23 minutes - color - oil pollution
"River Watchers," - 20 minutes - color - robot monitor
"Coal and Water," - 20 minutes - color - effect of acid mine drainage
"The First Fifteen Years," - 20 minutes - color - ORSANCO story
"20th Century River," - 30 minutes - color - Corps of Engineers, federal and local agencies, and the citizens all have roles in river development

62-29 FLOODING OF A DEEP MINE

Braley, S. A., Special Report, ORSANCO-Coal Industry Advisory Committee, Res. Proj. 4370-8, Mellon Institute, (1962). The results of a study of the water discharge of a sealed and abandoned mine are presented. The conclusion is that complete abandonment of deep mines will ultimately result in beneficiation of the water naturally discharged therefrom as a result of flooding irrespective of the air sealing procedure.

62-30 NATURAL BENEFICIATION OF AN ABANDONED MINE

Braley, S. A., Special Report, ORSANCO-Coal Industry Advisory Committee, Res. Proj. 4370-8, Mellon Institute, (1962). Report on the improvement of water quality of the free flowing discharge from an undisturbed abandoned mine which had not been sealed. The data indicate that the discharge improves measurably without regard to correctional procedures with the passage of time.

62-31 WEST VIRGINIA ACTS TO PREVENT STREAM POLLUTION

Anon, Mechanization, 26 (4), 84, (1962). State Mines Director Leonard J. Timms and Natural Resources Director Warden M. Lane released a series of new regulations designed to prevent stream pollution by the open pit mines to become effective December 1.

62-32 DORR-OLIVER MARKETS FS DISPOSAL SYSTEM

Chem. Eng. News, 40 (19), 82-3, (1962). Organic sludges from municipal primary treatment plants are reduced to inert ash and non-noxious gases in this disposal system.

62-33 REPORT OF THE COMMITTEE ON ENVIRONMENTAL HEALTH PROBLEMS REPORT OF THE SUBCOMMITTEE ON WATER SUPPLY AND POLLUTION CONTROL

U. S. Department of Health, Education and Welfare, Washington, D. C., (1962). The subcommittee on water supply and pollution control presents an analysis of the present problem, a projection of the problem and recommendations for a program vested in one organizational unit.

62-34 COAL OPPOSES LEGISLATION FOR STRIP MINING STUDY

Anon, Coal Age, 67 (6), 41, 44, (1962). Fred B. Bullard testifying for coal industry members of the Land and Water Use Committee of the American Mining Congress said that the coal industry is aware of the problems and is promoting sound reclamation practices. The NCA opposes the bill on the ground that it encourages federal encroachment into state and local responsibilities. The proposed survey would cost from $650,000 to $900,000.

62-35 STRIP REVEGETATION

Brohard, E., Coal Age, 67 (3), 64-5, (1962). Some of the problems of reseeding stripped areas are discussed and suitable plants and trees are recommended.

62-36 TREES AND ENOS

Anderson, J. I., Coal Age, 67 (6), 90-1, (1962). A tree-growing program dating back to 1926 is producing seed for future trees, fence posts, and other forest products for present use, and recreational and wildlife benefits for the community. It is a way to bring stripped land back into useful productivity.

62-37 LIBERATION OF PYRITE FROM STEAM COALS

Glenn, R. A. and Harris, R. D., J. Air Pollution Control Assoc., 12 (8), 388-95, (1962). This paper presents the results of research on the separation of pyritic sulfur from coal. Because it expands the understanding of pyrites, it is of interest to this Acid Mine Drainage library.

62-38 TRIPLE-PLAY STRIPPING

Atha, C. H., Mining Congr. J., 48 (5), 25-8, (1962). Reclamation of the strip-mined area is an important part of the overall operation. Selective planting helps to control run-off, wash and de-nudation of hills.

62-39 DEVELOPMENT OF WATER QUALITY CRITERIA FOR AQUATIC LIFE

Tarzwell, C. M., J. Water Pollution Control Federation, 34 (11), 1175-85, (1962). When based on detailed, well-planned, and adequate studies, water quality criteria for aquatic life can be the yardstick for the detection, evaluation, and abatement of pollution.

62-40 NEW TECHNOLOGY OF LEACHING WASTE DUMPS

Malouf, E. E. and Prater, J. D., Mining Congr. J., 48, 82-5, (1962). This article is primarily concerned with leaching of copper from mine waste. Of interest to the Acid Mine Drainage library is a discussion of the oxidizing bacteria found in mine waters.

62-41 COAL DIVISION - EASTERN GAS AND FUEL ASSOCIATES - PUMPING AND DRAINAGE

Anon, Coal Age, 67 (10), 125-7, (1962). Ditching to keep water out is the first possibility explored by the planners of the Coal Division's operations. Follow-up steps are: using gravity flow wherever possible, sometimes to outfalls at crop holes; employing sufficient pumps where necessary; and maintaining the system to meet company standards. Maximum water-handling load is 33 tons of water outflow per ton of coal produced at Sonman mine in Pennsylvania.

62-42 THE RECLAMATION OF LANDS STRIPPED FOR BROWN COAL

Knabe, W., Ohio Agricultural Expt. Sta., Forestry Dept. Series 49, (1962). This is a condensation of a book by Dr. Knabe, "Zur Wiederurbarmachung in Braunkohlenbergbau." Duetscher Verlag der Wissenschaften. Berlin, 1959. The acidity of the various layers of overburden and of drainage from the stripped areas are an intrinsic part of the problem of reclamation. This condensation outlines the soil scientists approach to rebuilding areas after strip mining.

62-43 DEVELOPMENT OF WATER QUALITY CRITERIA FOR AQUATIC LIFE

Tarzwell, C. M., J. Water Pollution Control Federation, 34 (11), 1178-85, (1962). Adequate data on the environmental requirements of aquatic life or the concentration of wastes which are not detrimental to their continued survival are not available. Continuing research programs, adequate to secure the needed data, are essential to deal with the problems of waste discharged into receiving waters.

62-44 PROGRESS IN CONTROLLING ACID MINE WATER: A LITERATURE REVIEW

Lorenz, W. C., U. S. Bur. Mines Inform. Circ. 8080, (1962). In connection with its renewed study seeking solutions to problems created by release of acid water from bituminous coal mines, the Bureau of Mines recently surveyed the literature. 207 references are included with the report.

62-45 CHEMISTRY OF MICROBIAL ACTION IN MINE DUMP LEACHING OPERATIONS

Chem. Eng. News, 40 (38), 41, (1962). Chemistry of microbial action in mine dump leaching operations becomes clearer from studies made by J. A. Sutton and J. D. Corrick of the U. S. Bureau of Mines, College Park, Md. Iron oxidizing bacteria (Ferrobacillus ferrooxidans and Thiobacillus ferrooxidans) greatly accelerate the dissolution of iron compounds in pyrite and chalcopyrite, Mr. Sutton told the fall meeting of the Society of Mining Engineers, held at Gatlinburg, Tenn. Ferrobacillus ferrooxidans is also capable of producing sufficient quantities of ferric sulfate and sulfuric acid from ferrous iron to dissolve significant quantities of copper from chalcocite, covellite, and boraite. Ferrobacillus ferrooxidans isn't active above pH 4.6, while Thiobacillus ferrooxidans becomes active at pH 6.0, the Bureau of Mines scientists find.

63-12 NEXT FIFTY YEARS IN WATER PURIFICATION

Hazen, R., Am. Water Works Assoc. J., 55 (7), 825-30, (1963). Processes will be improved and greater standardization and greater reliance on factory-built units for purification will become evident. This article is not specifically related to acid mine drainage.

63-13 EVALUATION OF METHODS FOR DETERMINATION OF MINERALS IN WATER

Lishka, R. J., Kelso, F. S., and Kramer, H. P., J. Am. Water Works Assoc., 55 (5), 647-56, (1963). This study, conducted by the Analytical Reference Service of the USPHS, provides data for the evaluation of some of the methods currently in use for the determination of minerals in water. The study also indicates the degree of accuracy and precision obtainable when many laboratories participate and a variety of methods are used.

63-14 MAN IMPROVES HIS WORLD--THE WATER STORY

Heffernan, H., and Shaftel, G., L. W. Singer Co., Inc., Syracuse, 1963. This school text on water supply discusses over-supply, under-supply, industrial needs, flood control, and irrigation projects and the effects of pollution.

63-15 INTRODUCTION TO GEOLOGICAL MICROBIOLOGY

Kuznetsov, S. I., Ivanov, M. V. and Lyalikova, N. N., McGraw-Hill Book Company, Inc., New York, 1963. The role of micro-organisms in the formation of acid from pyrite in the presence of water is recognized as a significant area for study in the acid mine drainage problem. This text discusses the effect of microbial activity on deposits of sulfur, iron, fossil fuels, and related minerals and presents a good review of the literature relating to the subject.

63-16 AN APPROACH TO THE PROBLEM OF COAL STRIP MINE RECLAMATION

Deasy, G. F. and Griess, Phyllis R., Mineral Industries, 33 (1), 1-7, (1963). State and national legislation for dealing with the reclamation of strip-mined areas has shown a recent tendency to be radical in its approach. The authors advocate consideration of a more moderate course which would permit limited planting of some areas, flooding of others, as a measure for holding large areas for future development to meet local needs.

63-17 SEPARATION AND DETERMINATION OF IRON (II) AND IRON (III) WITH ANTHRANILIC ACID USING SOLVENT EXTRACTION AND SPECTROPHOTOMETRY

Dinsel, D. L. and Sweet, T. R., Anal. Chem., 35 (13), 2077-81, (1963). Iron (III) is determined in the presence of iron (II) by extracting as the anthranilate into 1-pentanol and measuring the absorbence of the pentanol extract. The iron (II) is then oxidized, extracted as the anthranilate and determined by measuring the absorbence.

63-18 VARIATIONS IN THE CHEMICAL CHARACTER OF THE SUSQUEHANNA RIVER AT HARRISBURG, PENNSYLVANIA

Anderson, P. W., Geol. Survey Water-Supply Paper 1779-B, 1963. The influence of streamflow, anthracite and bituminous coal mine drainage, and geology on the chemical quality of the Susquehanna River is discussed in this paper. The sampling pattern of the Harrisburg cross-section indicates that the water from the principal tributaries above Harrisburg does not mix sufficiently to lose its chemical quality identity probably due to the small depth-width ratio and the extreme width of the river.

63-19 AUTOMATIC ANALYZERS HELP COMBAT RIVER POLLUTION

Anon, Chem. Eng., 70 (3), 49-50, (1963). Automatic analyzers have been set up to continuously feed data on river quality to a headquarters office in Cincinnati. By this means, the Ohio River Valley Water Sanitation Commission is able to detect and characterize any natural or man-made disturbances of the river as soon as they occur.

63-20 ELIMINATING STREAM POLLUTION FROM A COAL PREPARATION PLANT

Noone, W. H., Coal Age, 68 (6), 109, (1964). This is the abstract of a paper presented at the 1963 AMC Coal Convention. The Harewood water clarification plant is described.

63-21 FIFTY YEARS OF PROGRESS IN WATER PURIFICATION 1913-63

Fair, G. M., J. Am. Water Works Assoc., 55 (7), 813-24, (1963). The period discussed is described by the author as one of consolidation and expansion of water treatment knowledge brought forward from the previous half century. Specific pollution problems are not discussed.

63-22 GROUND WATER CONTROL, PART II

Mooney, W. G., Construction Methods and Equipment, 1963. In some situations, contractors find it necessary to dewater areas before excavation. Several approaches are available to them. The conventional method depends on pumping, but freezing, injection of a grout curtain wall, or construction of sand drains are all useful tools. The use of a grout curtain wall may have potential in the reduction of acid mine drainage so this article is of interest.

63-23 WATER POLLUTION CONTROL IN THE MONONGAHELA RIVER BASIN

Wilbar, C. L., Penna. Dept. of Health, Div. of Sanitary Eng., Publication No. 6, 1963. The position of Pennsylvania in relation to clean streams is discussed. The clean streams law and the mine drainage control program have made it possible to hold the line against additional pollution from acid mine drainage on streams that are not acid. Good progress has been made in abating pollution from sewage and industrial wastes in the basin. Abandoned mines discharging more than 1000 tons of acid per year and active mines discharging more than 300 tons/year are listed tabularly. A compilation of the Rules and Regulations of the Sanitary Water Board are included.

63-24 REPORT ON POLLUTION OF THE INTERSTATE WATERS OF THE MONONGAHELA RIVER SYSTEM

Sidio, A. D. and Mackenthun, K. M., U. S. Dept. of Health, Education, and Welfare, Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, 1963. This is a report of a study made of the Monongahela River system. The study included analyses and observations of chemical, biological, bacteriological, and physical indicators of water quality. Acid mine drainage, untreated sewage, and industrial wastes discharged in one state have an adverse effect on water quality in other states, thus constituting an interstate pollution subject to federal control. The data collected during the 1963 study have been presented and discussed.

63-25 ACID MINE DRAINAGE RESEARCH POTENTIALITIES

Hanna, G. P., Lucas, J. R., Randles, C. I., Smith, E. E., and Brant, R. A., J. Water Pollution Control Federation, 35 (3), 275-96, (1963). The phenomena associated with the production and abatement of acid mine water are classified for simplicity into the four fundamental areas of chemistry, microbiology, mineralogy, petrology, and geology-hydrology. A planned program of research based on these fundamental areas is outlined.

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