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DEPARTMENT OF KEGISTKATION AND EDUCATION

DIVISION OF THE
STATE WATER SURVEY
A. M. BÜSWELL, Chief

BULLETIN NO. 19

SOLUBILITY AND RATE OF SOLUTION OF GASES

BIBLIOGRAPHY

BY

S. L. NEAVE

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INTRODUCTION

This bibliography has been prepared as a part of the Illinois State Water Survey program for the study of sewage treatment and the effect of pollution on streams. Particular attention has therefore been given to oxygen and air. We have attempted however to include references to work on other gases, wherever such work contained Information of value on the general question of rate of Solution and solubility of gases.

An exhaustive survey of the literature has not been made, but rather an attempt to select some references covering each of the several lines of interest in dissolved gases. Furthermore, to facilitate selection of those articles having a bearing on any one problem, a rough grouping by reference numbers under general headings has been included.. While such artificial grouping is necessarily only approximate, it is hoped that a table of contents of this form may render the bibliography more serviceable.

Urbana, Illinois
1924

S. L. NEAVE.

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STATE OF ILLINOIS
DEPARTMENT OF REGISTRATION AND EDUCATION
STATE WATER SURVEY DIVISION

URBANA, ILLINOIS, *December 15, 1924*.

A. M. Shelton, Chairman, and Members of the Board of Natural Resources and Conservation Advisors:

GENTLEMEN: I herewith submit an annotated bibliography on The Solubility and Rate of Solution of Gases and request that it be printed as Bulletin No. 19. This search of the literature was undertaken in connection with the researches of this Division on sewage treatment, stream pollution and the recovery of streams from pollution.

On account of the usefulness of this bibliography to a variety of problems we are submitting it for separate publication.

Respectfully submitted,

A. M. BUSWELL, *Chief.*

SOLUBILITY AND RATE OF SOLUTION OF GASES. BIBLIOGRAPHY.

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J. Chem. Soc. *61,* 310-22 (1892).
New apparatus is described for the indigo-hyposulphite method of dissolved oxygen determination.

2 ADENEY, W. E. Apparatus for Determining Rate of Oxygen Absorption of Polluted Waters, etc.
Sci. Proc. Roy. Dublin Soc. *11*, 280-7 (1900).
The oxygen absorbed is measured by the capillary rise in a water seal.

3 ADENEY, W. E. Disposal of Sewage by Dilution: a Biochemical Method of Purification.
Surveyor *48,* 600-4 (1915).
General principles of purification by dilution with water containing oxygen are set forth.

4 ADENEY, W. E. and BECKER, H. G. Determination of Rate of Solution of Atmospheric Nitrogen and Oxygen by Water.
Sci. Proc. Roy. Dublin Soc. *15,* 385-405 (1918); Phil. Mag. *38, 317-38* (1919); *39,* 385-404 (1920); 42, 87-96 (1921).
Preliminary experiments show that water becomes saturated by two steps: rapid absorption by surface layers, and very slow diffusion to lower depths. Measurements were made on rate of absorption from bubbles of photographically-determined size for salt and fresh water, and an expression developed for calculating the per cent Saturation under different conditions.

5 ADENEY, W. E., LEONARD, A. G. G. and RICHARDSON, A. Aeration of Quiesceht Columns of Distilled Water and of Solutions of Sodium Chloride.
Phil. Mag. *43,* 835-45 (1923).
Under natural conditions aeration is effected by mixing of the exposed layer to depths of 10 feet; mixing is caused by "streaming" which depends upon cooling by evaporation from the surface layer and is most marked in 1% salt Solution.

6 AIMÉ, M. Note sur les Gaz dégagés par les Plantes marines (The Gases Evolved by Aquatic Plants).
Ann. chim. phys., (3), *2*, 535-8 (1841).
Observations on bubbles formed on leaves of water plants under the influence of the sun; analyses of thegas are given.

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Am. J. Pub. Health *8*, 838-42 (1918); Can. Eng. *33,* 531 (1918); Eng. Contr.51, 33 (1919).

Analytical results on 4201 samples with a comparison of the dissolved oxygen in winter and summer.

8 ALLEN, K. Sewage and Dissolved Oxygen in New York Harbor.
Eng. News-Record *83*, 228-9 (1919).
Diagram showing the per cent Saturation of oxygen at various points are given.

9 ALLISON, R. V. and SHIVE, J. W. Micro-sampling for the Determination of Dissolved Oxygen.
Soil Science *15*, 489-91 (1923).
25-30 cc sample bottle filled by suction and, after adding the reagents, the titration is made by the micro-Winkler method.

10 ANDERSON, R. P. The Specific Absorption of Reagents for Gas Analysis.
J. Ind. Eng. Chem. 7, 587-96 (1915).
Investigation of completeness of gas absorption by reagents commonly employed in gas analysis, with suggested modifications in these reagents.

11 ANGSTROM, K. Ausdehnung des Wassers durch Absorption von Gasen. (The Dilation of Water by Gas Absorption.)
Svenska Vet. Ak. Förh. *6*, 37 (1881); Ann. Phys. Chem. *15*, 297-308 (1882).
Accurate determination of dilations for air, nitrogen, carbon monoxide and dioxide, oxygen, and hydrogen in water.

12 ANON. Air Separation Process: Elimination of Economizer and Boiler Corrosion.
Power Plant Eng. *24*, 561-6 (1920).
A process of deactivation is described.

13 ANON. Report on Investigation of the Pollution of Streams.
N. Y. State Conservation Commission, 1923, 50 pp.
A discussion of the cycle of formation and decomposition of organic matter, aerobic and anaerobic decomposition, and the function of oxygen in oxidizing and stabilizing organic matter in water.

14 ANON. Dissolved Gases in Water Supplies.
Chem. Age (London) 5, 694-5 (1921).
Brief review of origin and significance of dissolved gases with methods for their determination.

15 ANON. Kestner System for the Degassing of Boiler Feed Water.
Iron Coal Trades Rev. *106*, 84-5 (1923).
Oxygen is removed by finely divided steel in a prepared condition.

16 ANON. Degassing of Boiler Feed Water.
Arch. Wärmewirtschaft 5, 30 (1924).
Nitrogen is blown through the water to remove the harmful gases.

17 ANTROPOFF, A. v. Solubility of Xenon, Krypton, Argon, Neon, and Helium in Water.
Proc. Roy. Soc. London, (A), 83, 474-82 (1910).
Apparatus described and solubilities plotted; Estreicher's results (see No. 95) found in error and corrected.

18 ARKAD'EV, V. Solubility of Chlorine in Water.
J. Russ. Phys. Chem. Soc. 50, 205-9 (1918).
Experimentally determined solubility agrees - with that calculated by the formula of Jakowkin (see No. 150).

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J. Ind. Eng. Chem. *12,* 161-4 (1920).
The reagent formerly suggested by Hempel for oxygen absörption is found unsatisfactory and a modification is suggested.

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Eng. Record, Dec. 8, 1906.
In Lake Weequahic (N. J.) 15 tons of fish died due to depletion of oxygen when a floating algae bed settled to the bottom.

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111. State Wäter Survey, Bull. 15, 116-20 (1917).
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Publ. Carnegie Inst. Washington, No. *186,* 88 pp. (1912).
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Proc. Natl. Acad. Sci. 7, 133-4 (1921).
Experiments are described and treated mathematically.

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Sci. Proc. Roy. Dublin Soc. *16,* 334-44 (1921); Phil. Mag. *45,* 581-92 (1923)..
Apparatus utilizes ferrous hydroxide to absorb oxygen, the excess being titrated with permanganate; the rate of

Solution is a linear function of the rate of stirring if surface area is assumed constant.

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Paper read at Ithaca meeting, Am. Chem. Soc. (1924); J. Ind. Eng. Chem. *16*, 1220.
Calculation of absorption rates based on diffusion as the limiting factor.

26 BECKER, H. G. and ABBOTT, W. E. Determination of Dissolved Air in Small Quantities of Water.
J. Soc. Chem. Ind. *42*, 484-6 (1923).
An apparatus suitable for samples of less than 50 cc is described, and considerable data tabulated on the addition of different solid substances to cause the evolution of gas from the Solution.

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20-30 cc of sample are saturated with solid potassium hydroxide and the evolved gas measured before and after treatment with pyrogallol.

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Ber. *13*, 2277-83 (1880).
Preparation and uses of the reagent are described.

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Wis. Geol. & Nat. Hist. Survey, Bull. *22*, (1911).
Methods of sampling and analysis are given, and extensive data compiled from a survey of the inland lakes.

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Ann. Phys. Chem. *62*, 644-51 (1897).
Data of previous workers is collected and an expression is derived for calculating the solubility.

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Ann. Phys. Chem. *44*, 319-43 (1891).
Data on the absorption of oxygen, nitrogen, hydrogen, and carbon dioxide by water.

37 BOOT, J. C. Sur quelques Améliorations apportées à l'Appareil employe par M. Romijn pour le Dosage de l'Oxygène dans l'Eau. (Some Improvements applied to Romijn's Apparatus for the Quantity of Oxygen in Water.)
Rec. trav. chim. 1*3*, 88-92 (1894).
A modification of Romijn's apparatus (see No. 245) is advocated.

38 BRAUN, L. Uber die Absorption.von Stickstoff und von Wasserstoff in wässerigen Lösungen verschieden dissociierte

Stoffe. (The Absorption of Nitrogen and Hydrogen by Solutions of Differently Dissociated Solutes.)
Z. physik. Chem. *33,* 721-39 (1900).
Solubilities of nitrogen and hydrogen are determined in Solutions of urea, propionic acid, sodium chloride, and barium chloride at different temperatures, with a mathematical discussion of the results.

39 BREMER, G. J. W. Appareil pour l'Extraction des Gaz dissous dans 1'Eau. (Apparatus for Extracting the Gases Dissolved in Water.)
Rec. trav. chim. 11, 278-83 (1892); J. Chem. Soc. *64,* 432 (1893).
The apparatus is very similar to that of Hoppe-Seyler (see No. 141), utilizing a combination of mercury vacuum and heat.

40 BREMER, G. J. W. Bouteille destinée à puiser de l'Eau d'une Manière simple à une Profondeur déterminée. (Bottle suited to readily Sampling Water at any given Depth.)
Rec. trav. chim. 11, 284-5 (1892).
Bottle fitted with two tubes of unequal length bridged across with a rubber-tubing loop which is pulled off by a cord when desired depth is reached.

41 BROWN, A. C. On the Chemical Processes Involved in the Rusting of Iron.
J. Iron Steel Inst. *33,* 129 (1888).
Rusting is caused by the action of dissolved carbon dioxide and oxygen.

42 BRUCKMILLER, F. W. Oxygen Demand of Sewages.
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An experimental comparison of the nitrate and the dilution method for oxygen demand.

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Chem. Ztg. *39,* 845-8 (1915); *40,* 45-6, 71-3 (1916).
Alterations in Winkler's method (see No. 315) are proposed to adapt it to field work. The effect of iron salts on the results is investigated.

44 BRUNNER, E. Reaktionsgeschwindigkeit in heterogenen Systemen. (Reaction Velocity in Heterogeneous Systems.)
Z. physik. Chem. *47,* 56 (1904).
Ä theoretical paper applied chiefly to solids dissolving in liquids.

45 BUNSEN, R. Ueber das Gesetz der Gasabsorption. (The law of Gas Absorption.)
Ann. Chem. Pharm. *93,* 1-50 (1855).
Methods of calculation, and solubility coefficients at different temperatures for a number of gases, are given.

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Gasometrische Methoden, 2nd. Ed., pp 192-266 (1877).
Comprehensive treatment of laws governing solubility, and collected data on solubilities in water and alcohol, are given.

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J. Ind. Eng. Chem. *14*, 840 (1922).
Review of the Status of sanitary chemistry, including the increasing part played by aeration in modern practice an the importance of dissolved oxygen in corrosion.

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J. Ind. Eng. Chem. *15*, 1186-8 (1923).
A brief review of the literature is given; the modified Winkler method is inaccurate in presence of iron salts, but no systematic correction was found; the Levy method as modified by Letts & Blake checked the gasometric method in presence of iron and organic matter.

49 CARIUS, L. Absorptiometrische Untersuchungen. (Absorption Studies.)
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Absorption coefficients were determined for oxygen, carbon monoxide and dioxide, nitrogen, nitric oxide, hydrogen Sulfide, and sulphur dioxide in alcohol, and for nitrous oxide in water and alcohol, with a comparison of the calculated and-observed solubilities for gas mixtures.

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J. Am. Chem. Soc. *33*, 1027-32 (1911).
Observed diffusion rates for oxygen and carbon dioxide in water agree with those of Stefan and of Hüfner (see Nos. 273 and 142); they also check calculated results based on rate of escape and on the Exner rule (see No. 96).

51 CARLSON, T. Sur la Vitesse de Dissolution dans le Système Gaz-Fluide. (The Rate of Escape for a Gas-Liquid System.)
J. chim. phys. 9, 228-44 (1911).
Rates of dissolution for oxygen and carbon dioxide are determined for water Solutions, and results mathematically expressed; the temperature effect is found to follow the formula of Arrhenius.

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Z. angew. Chem. *26*, (1), 713-4 (1913).
Historical review and comparison of methods for determining the solubility of oxygen in water; a formula is derived on the basis of the solubility at 25° for calculating the solubility at any other temperature.

53 CHLOPIN, G. W. Bestimmung des im Wasser gelösten Sauerstoffes. (Determination of Dissolved Oxygen in Water.)
Arch. Hyg. 27, 18-33 (1896).
A comparison of Winkler's method with Bunsen's methpd, and a discussion of errors in the former.

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Arch. Hyg. *32,* 294-309 (1898).
A comparison of the methods of Winkler, Schützenberger, and Mohr-Levy.

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Arch. Hyg. *34,* 71-85 (1899).
An application of manganous hydroxide Solutions to gas analysis.

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Arch. Hyg. *37,* 322-28 (1900).
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Z. physik. Chem. *79,* 456-60 (1912).
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J. Ind. Eng. Chem. 8, 653-4 (1916).
Early development is reviewed, and a comparison of slate colloiders with aeration tanks is given.

59 CLARKE, R. W. Determination of Amount of Dissolved Oxygen Absorbed by Sewage Effluents Containing Nitrites, etc.
Analyst 36, 393-6 (1911).
A modified biochemical oxygen demand method is described.

60 CLOWES, F. An Apparates for Collecting the Gases Dissolved in Water or other Liquids.
J. Soc. Chem. Ind. *16*, 210 (1897).
A vacuum extraction apparatus devised by Truman (see No. 292) is advocated. .

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J. Soc. Chem. Ind. *23*, 358 (1904).
Laboratory determinations show that the quantity of oxygen decreases with increasing salt content.

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J. Soc. Chem. Ind. *33*, 403-7 (1914).
Oxygen found to be greatly decreased by passing the water through a heater; pre-treatment methods are discussed.

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Z. Elektrochem. 29, 1-5 (1923).
Size of bubbles increases with concentration of electrolyte to a maximum; bubbles are electrically charge d may change sign with increasing concentration.

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Experiments show that 2¼ cubic feet of air per gallon will satisfactorily purify sewage under winter conditions.

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Ann. Rept. Milwaukee Sewage Commission, 1918; Can. Eng. 35, 302 (1918).
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67 COSTE, J. H. Absorption of Atmospheric Gases by Water.
J. Soc. Chem. Ind. *36*, 846-53 (1917); *37, 170-1* (1918).
Tables of Saturation constants are given for both fresh and salt water. Errors due to neglect of barometric pressure are pointed out and a diagram given to facilitate calculation.

68 COSTE, J. H. Oils do not Exclude Oxygen from Water.
J. Soc. Chem. Ind. *36,* 954 (1917).
The futility of trying to protect water from oxygen absorption by a, layer of oil is pointed out.

69 COSTE, J. H. Gases Dissolved in Water.
Chem. Age (London) 3, 447 (1920); Chem. News *121,* 265-8 (1920).
Resumé of subject of gas solubilities and their determination, with mention of the impprtance and significance of dissolved gases.

70 COSTE, J. H. Absorption of Atmospheric Gases by Water.
Analyst *48,*433-5 (1923).
A graph is given for solubility of oxygen and nitrogen in water of varying salinity.

71 COSTE, J. H. and ANDREWS, E. R. Case in which Winkler's Manganous Process for Dissolved Oxygen is Untrustworthy.
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The effect of ammonium chloride on the process is discussed.

72 COSTE, J. H. and ANDREWS, E. R. Solubility of Atmospheric Gases in Solutions of Ammonium Chloride..
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Prolonging the air-sewage contact by a downward sewage stream entraining air bubbles is suggested.

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From the increase in carbon dioxide and the decrease in oxygen, about 5% of the air is calculated to be absorbed.

75 CUMMING, H. S. Investigation of the Pollution and Sanitary Condition of Potomac Watershed.
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Experiments indicate that water and oxygen are the only . essentials for. corrosion.

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Science Progress 1, 408 (1907).
Traces development of theories, concluding that rusting is caused by water containing traces of acid in presence of oxygen.

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Power 58, 930-3 (1923).
A modified Winkler procedure with the sample collected under a layer of light transformer oil. (See No. 148).

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Tests on the Thames, the Sutton Sewage Works, and on a country stream receiving a farm effluent.

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Rept. on Chem. and Physics 1, 172 (1884).
Data on the nitrogen content of sea water is given.

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Proc. Roy. Soc. London *85* A, 557-74 (1912).
Gibb's theory verified by passing bubbles through a Solution of nonylic acid and by allowing them to. break in a separate vessel, the concentration changes were measured.

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Previous work is reviewed; formulae are developed to show that efficiency depends upon high interfacial area between gas and liquid, high degree of turbulent motion in one or both phases, and sufficient rate of flooding to obtain maximum drip effect.

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Z. physik. Chem. 75, 405-35 (1910).
Ä new apparatus is described for precise measurement of actual gas absorbed; solubilities of hydrogen and nitrogen in water and glycerine, and of nitrogen in isobutyric acid, are determined and deviations from Henry's law are discussed.

90 DUNCAN, C. and HOPPE-SEYLER, F. Ueber die Diffusion von Sauerstoff und Stickstoff in Wasser. (The Diffusion of Oxygen and Nitrogen in Water.)
Z. physiol. Chem. *17,* 147-64 (1893); 19, 411-21 (1894).
Oxygen absorption by quiescent cylinders of water 1 meter deep is determined, and oxygen absorbed per square meter of surface then calculated.

91 DUNSTAN, W. R. Rusting of Iron.
J. Chem. Soc. *87,* 1548-73 (1905).
Only water and oxygen are considered necessary; no electrical action is needed to effect corrosion.

92 DUPRE, A. Estimation of Dissolved Oxygen in Water.
Analyst 10, 156-61 (1885).
The apparatus and method for the hyposulphite-indigo method of determination are described.

93 EGGERT, J. Uber die Absorptionsgeschwindigkeiten von Wasserstoff und Sauerstoff durch Metallsalzlösungen. (Rates of Absorption of Hydrogen and Oxygen by Metal Salt Solutions.)
Z. Elektrochem. *20,* 370-81 (1914).
The velocities of oxidation and reduction of iron salts by oxygen and hydrogen were found by measuring the volume of gas absorbed, using stirrers coated with platinum black; other metals were tried as catalysts.

94 ELVOVE, E. Comparison of Methods for the Determination of Oxygen in Waters in Presence of Nitrites.
U. S. Hyg. Lab.Bull. 96, 15-35 (1914).
Extensive investigation favors the Winkler method of preference to the Levy method and precautions to be observed even with the Hale Melia modification of the former are pointed out.

95 ESTREICHER, T. Die Löslichkeitsverhältnisse von Argon und Helium im Wasser. (The Solubility Relations of Argon and Helium in Water.)
Z. physik. Chem. *31,* 176 (1899).
Solubilities from o° to 50° are given.

96 EXNER, F. Ueber den Durchgang der Gase durch Flüssigkeitslamellen. (The, Passage of Gases through Liquid Films.)
Ann. Phys. Chem. (2) 155, 321-36,443-64 (1875).
Considerable experimental data is given together with a mathemetical expression of the results to show the "rule" that diffusion rates vary inversely with the gas density.

97 FISCHER, F. and PFLEIDERER, G. Uber die Löslichkeit von Sauerstoff in verschiedenen organischen Lösungsmitteln. (The Solubility of Oxygen in different Organic Solvents.)
Z. anorg. allgem. Chem. *124,* 61-9 (1922).
Solubility data is given for 16 organic solvents, together with specific gravities and vapor pressure values.

98 FLINN, WESTON and BOGERT. Rate of Rise of Air Bubbles through Water.
Waterworks Handbook, 1st. Ed., p. 591 (1916).
Tabulation of results obtained from experiments on bubbles of different sizes.

99 FLORENCE, A. Die Bestimmung des Sauerstoffs im Wasser. (The Determination of Oxygen in Water.)
Pharm. Zentralhalle 39, 28 (1897).
A vacuum-heat extraction apparatus is described.

100 FORT, E. J. Aeration of Sewage in Presence of Activated Sludge.
J. Ind. Eng. Chem. *8,* 643-5 (1916).
Tests at Brooklyn show little promise for activated sludge as an efficient means of sewage treatment.

101 FOWLER, G. J. Biochemical Factors in Modern Water Purification.
Water & Water Eng. *25,* 359-62 (1923).
Aeration of waters is advocated to oxidize food material and keep down bacterial growth.

102 Fox, C. J. J. On the Coefficients of Absorption of Nitrogen and Oxygen in Distilled Water and Sea Water, and of Atmospheric Carbon Dioxide in Sea Water.

Trans. Faraday Soc. 5, 68 (1909).
Experimental results are given as indicated.

103 FRANZEN, H. Ueber die Verwendung des Natriumhydrosulphites in der Gasanalyse. (Application of Sodium Thiosulphate in Gas Analysis.)
Ber. 39, 2069-71 (1906).
Alkaline sodium thiosulphate is advocated as an absorbent for oxygen in place of pyrogallol, phosphorus, etc.

104 FREMY, E. Rèsultat de l'Examen des Eaux de le Mer recueilles pendant le Voyage de la Bonite. (Analysis of Water Collected by the French Exploring Ship Bonite.)
Compt. rend. *6,* 616-20 (1837).
Oxygen, nitrogen, and carbon dioxide were determined at various depths from the surface to about 450 fathoms.

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Chem. News *81,* 13 (1900).
Solubilities for oxygen, nitrogen, air, and carbon dioxide are given.

106' FRICKE, R. Growth of Gas Bubbles in Liquids which are Supersaturated with the same Gas.
Z. physik. Chem. *104,* 363-402 (1923).
Förmulae for diffusion and hydrodynamic relations are given; these relations were investigated for carbon dioxide by the Photographie method.

107 FRICKE, R. and BLENCKE, W. Growth of Freely Floating Gas Bubbles in Liquids Saturated with the same Gas.
Z. physik. Chem. *107,* 136-9 (1923).
A continuation of Fricke's previous work; an improved apparatus and larger bubbles were used.

108 FRITZ, H. E. and WITHROW, J. R. The Rate of Absorption of Hydrochloric Acid Gas in the Tyler Vitreosil System.
Trans. Am. Inst. Chem. Eng. 75, I, 217-29 (1923).
Tests made on special vitreosil S-bends are described.

109 FRIVOLD, O. E. Dichtebestimmungen an Lösungen, nebst Bestimmung der Dichtenunterschiede zwischen Wasser und Wasser mit Luft gesättigt. (Density Determination of Solutions, including the Difference in Density between Air-free and Air-saturated Water.)
Physik. Z. *21,* 529-34 (1921).
A differential apparatus is described for comparing the densities of liquids; the difference in density between air-free and air-saturated water at 15.6° is 19.02 x 10-?

110 FRUMKIN, A. Phasengrenzkräfte und Adsorption an der Trennungsfläche Luft / Lösung anorganischer Elektrolyte.

(Phase Boundary Forces and Adsorption at the Interface Air / Inorganic Salt Solution.)
Z. physik. Chem. 109, 34-48 (1924).
The potential difference at the interface agrees with surface tension measurements.

111 FULWEILER, W. H. Gas Absorption Apparatus.
Paper read at the Ithaca meeting, Am. Chem. Soc. (1924).

112 GARFIELD, J. Progress in the Development of the Activated Sludge Process.
Surveyor *62,* 357-8 (1922).
Tests indicate that circulation alone will not suppor.t oxidation unless the surface is broken up into a spray.

113 GEFFCKEN, G. Beiträge zur Kenntnis der Löslichkeitsbeeinflussung. (Contributions to the Knowledge of Solubility Relations.)
Z. physik. Chem. *4g,* 257-302 (1904).
Solubilities of hydrogen, oxygen, nitrous oxide, and carbon dioxide are determined in various concentrations of different salt Solutions; colloids have practically no influence on solubility.

114 GERLAND, B. W. Use of Hyposulphite for the Estimation of Oxygen in Water and Sewage Effluents.
J. Soc. Chem. Ind. *18,* 340-2 (1899). '
The method, apparatus and precautions are described.

115 GILL, A. H. A Modification of Schützenberger's Method for Dissolved Oxygen.
J. Anal. Appl. Chem. *6,* 601-5 (1892).
A simplification similar to the changes suggested by Roscoe & Lunt (see No. 248) is advocated.

116 GILL, A. H. On the Difficulty with which Water Parts with its Dissolved Oxygen.
J. Anal. Appl. Chem. *6,* 606-9 (1892).
The "lagging behind" of oxygen, or its very slow evolution from saturated Solutions, is discussed.

117 GNIEWOSZ, S. and WALFISZ, A. Uber die Absorption von Gasen durch Petroleum. (The Absorption or Gases by Petroleum.)
Z. physik. Chem. 1, 70-2 (1887).
The coefficient of absorption of oxygen, and many other gases, is found to be much higher for petroleum than for water.

118 GORDON, V. Ueber die Absorption des Stickoxyduls in Wasser und in Salzlösungen. (The Absorption of Nitrous Oxide by Water and Salt Solutions.)
Z. physik. Chem. *18,* 1-16,(1895).
The solubility in various salt Solutions is determined and the absorption coefficients found for 5°, 10°, 15° and 20°.

119 GRANDCHAMP, L. E. L'Oxygène et le Vin. (Oxygen and Wine.)
Chimie et Industrie, Special No. 631-2 (May, 1924).
An apparatus for oxidizing wine, using compressed oxygen to removeiron in combination with tannin, is described.

120 GREENFIELD, R. E. and MICKLE, F. L. A New Sampler for Collecting Dissolved Oxygen Samples.
111. State Water Survey, Bull. *16,* 197-200 (1919).
An apparatus which is efficient and simple in construction is described in detail.

121 GREGOIRE, A. Bestimmungsmethode für Sauerstoff in Wasser. (Method of Determination for Dissolved Oxygen.)
Bull, assoc. belg. chim. 17, 120-5 (1903).
A modification of Müller's apparatus (see No. 204) is suggested.

122 HACKL, O. Ein praktische Vorrichtung zum Sammeln von Quellgasen. (A Practical Device for Collecting Gases from Springs.)
Chem. Ztg. 43, 421-2 (1919).
An ingenious apparatus for collecting gases is given.

123 HAGENBACH, A. Ueber Diffusion von Gasen durch wasserhaltige Gelatine. (The Diffusion of Gases through Gelatine Solutions.)
Ann. Phys. Chem. *65,* 673-706 (1898).
The solubilities of carbon dioxide, nitrous oxide, hydrogen, hydrogen sulphide, oxygen, and ammonia did not differ greatly from those in water, but the diffusion rates deviated considerably from the Exner rule (see No. 96).

124 HAMBERG, A. Beiträge zur Chemie des Meerwassers. (Contributions to the Chemistry of Sea Water.)
Bihang til Svensk Akad. Handl. *10,* No. 13 (1885); Z. prakt. Chem. *33,* 140-50, 433-63 (1886).
A vacuum-heat extraction apparatus for determining nitrogen and carbon dioxide in sea water, and considerable data, are given; also a discussion of previous work is included.

125 HAND, P. G. T. Colorimetric Estimation of Small Amounts of Oxygen.
J. Chem. Soc. 123, 2573-6 (1923).
An iodine-manganous-hydroxide method applicable chiefly to traces of oxygen in gases; one tenth of a part per million can be detected by matching the starch-iodide colors.

126 HANNAN, F. Micrdforces: Orientating and Curvature.
J. Am. Water Works Assoc. *10,* 1035 (1923).
Discussion of the properties of the stagnant layer in fluids with sorrie reference to the air-water interface.

127 HARINGTON, C. R. The Accurate Gasometric Determination of Small Quantities of Oxygen.
J. Physiol.58, 24 (1924).
A modification of Van Slyke's apparatus (see No. 300) is proposed.

128 HARPF, A. Die Löslichkeit von Schwefeldioxyd in Wasser. (The Solubility of Sulphur Dioxide in Water.)
Chem. Ztg. *4,* 136-7 (1905).
A calculation of the solubility is made.

129 HARVEY, S. Apparatus for Extraction of Gases Dissolved in Water.
Analyst *19,* 121-3 (1894)
A description of a simple heat-vacuum method of extracting gases.

130 HASLAM, R. T., HERSHEY, R. L. and KEAN, R. H. Study of the Mechanism of Absorption.
Paper read at the Ithaca meeting, Am. Chem. Soc. (1924); J. Ind. Eng. Chem. *16,* 1224.

131 HATTON, T. C. Conclusions on Activated Sludge Process at Milwaukee.
Eng. News-Record *J9,* 840-4 (1917).
98% removal of suspended matter required 0.5 cu. ft. of air per gallon for 1 hour, but complete nitrification required 0.75 to 1.1 cu. ft. per gallon for 4 to 6 hours.

132 HAWORTH, J. . Experimental Work on Sewage' Purification.
Water & Water Eng. *18,* 265-7 (1916).
Various aeration devices and methods of purification are compared. Tests indicate that mechanical aeration may replace aeration by compressed air.

133 HAWORTH, J. Activated Sludge Experiences at Sheffield, England.
Sanitary Record *63,* 228-9 (1919).
Fill and draw experiments with surface aeration, with a circulating velocity of 1.5 to 2 feet per second, gave encouraging results.

134 HAWORTH, J. and HODGKINSON, F. W. Bio-aeration Method of Sewage Treatment.
Inst. Munic. County Eng., 1922; Can. Eng. *44,* 103-7 (1923).
Mechanical agitation of activated sludge by paddle wheels, using velocities of 1.5 feet per second or greater, are described.

135 HAYES, A. Oxygen at Great Depths.
Am. J. Sci. (2), 11, 241 (1851).
More oxygen was found at the surface than at 100 to 200 feet depth.

136 HEINRICH, R. Einfluss der Temperature und des Lichts auf die Kohlensäureabscheidung bei Wasserpflauzen. (Influence of Temperature and Light on Evolution of Oxygen by Water Plants.)
Landw. Vers. Sta. 13, 136 (1870).
Evolved bubbles were counted from submerged leaves; about 3° to about 55° were the temperature limits; artificial light was tried; see also Prillieux, Compt. rend. 69, 408 and *70,* 521. (See No. 6).

137 HELM, O. Ueber die quantitative Ermittelung des im Wasser gelösten Stickstoff-und Sauerstoffgas. (The Quantitative Determination of Dissolved Nitrogen and Oxygen in Water.)
Z. anal. Chem. 5, 58-60 (1866).
Quantitative evolution by the vacuum method is advocated.

138 HENDRICK, C. W. Activated Sludge Experiments at the Sewage Disposal Plant, Baltimore.
J. Ind. Eng. Chem. *8,* 645-6 (1916).
Data on the experimental plant and some discussion of suitable air diffusers.

139 HENRY, W. Experiments on the Quantity of Gases Absorbed by Water under Different Conditions of Temperature and Pressure.
Phil. Trans. Roy. Soc. London 93, 29-42, 274-6 (1803).
Early experiments describing apparatus and results.

140 HOOVER, C. B. A Method for Determining the Parts per Million of Dissolved Oxygen Consumed by Sewage Effluents: Columbus Sewage Works.
Eng. News *65,* 311-12 (1911).
A combination of oxygen consumed from permanganate and dissolved oxygen consumed is üsed, since the ratio between these was found practically constant for each kind of sample.

141 HOPPE-SEYLER, F. Apparat zur Gewinnung der in Wasser absorbirten Gase. (Apparatus for Obtaining the Gases Absorbed by Water.)
Z. anal. Chem. *31,* 368 (1892).
A mercury pump and heat are used.

142 HÜFNER, G. Ueber die Bestimmung der Diffusionscoefficienten einiger Gase für Wasser. (The Determination of the Diffusion Coefficient for some Gases in Water.)
Ann. Phys. Chem. *60,* 134-68 (1897); Z. physik. Chem. 27, 227-49 (1898).
Apparatus described; diffusion determined for carbon dioxide, nitrous öxide, and gas mixtures; rates check those of Stefan (see No. 273) especially for carbon dioxide and oxygen through hydrophane.

143 HÜFNER, G. Untersuchungen über die Absorption von Stickgas und Wasserstoff durch wässerige Lösungen. (Investigations on the Absorption of Nitrogen and Hydrogen by Water Solutions.)
Z. physik. Chem. 57, 611-25 (1907).
Experimental determination using salt Solutions.

144 HUIZINGA, A. De Bepaling van Stikstof in Drain—en Regen—wasser volgens de Methode van Schlösing. (Determination of Nitrogen in Well and Rain Water by the Method of von Schlösing.)
Chem. Weekblad *8*, 882-995 (1911).
Improvements in the method are given to overcome sources of error and render it accurate for. 0.1 milligram of nitrogen.

145 HUNTER, J. Analysis of Sea Water Performed on Board H. M. S Porcupine.
J. Chem. Soc. *23*, 16-22 (1870).
Carbon dioxide, oxygen, and nitrogen were determined at the surface and down to 2090 fathoms.

146 HUTCHINSON, C. C. Schützenberger's Process for the Volumetric Estimation of Oxygen in Water.
Chem. News 38, 184-7 (1879); J- Chem. Soc. 36, A, 77 (1879).
Method of determination and standardization of Solutions are given.

147 IPAT'EV, V. and ANDRYUSCHENKO, A. Absorption of Carbon Dioxide by Salt Solutions under High Pressure.
Bull. acad. sei. russie *1917*, 851-62.
Review of literature; from a study of concentration, temperature, and pressure in chemical absorption, attempts are made to find the relation between carbon dioxide chemically united with, and dissolved by, salt Solutions using salts of calcium, barium, copper, cadmium, zinc, lead, nickel, and iron.

148 JACKSON, D. H. Testing for Dissolved Oxygen.
Power 55, 644-6 (1922); 59, 261-2 (1924).
A field method is described; deGraaf's method (see No. 80) is criticised on the basis that the oil used to exclude air absorbs some iodine.

149 JACOBSON, O. Ueber die Luft des Meerwassers. (The Air in Sea Water.)
Ann. Chem. Pharm. *167*, 1-38 (1873).
A method is given for determining carbon dioxide in sea water and extensive data on the North Sea for surface and deep layers.

150 JAKOWKIN, A. A. Solubility of Chlorine in Water.
J. Russ. Phys. Chem. Soc. *32*, 673 (1900); Z. physik. Chem. *29*, 613-57 (1899).

A discussion is given of hydrate formation by dissolved chlorine.

151 JORISSEN, W. P. Ietsoverde Bepaling van de Zuurstof in Water. (Note on the Determination of Oxygen in Water.)
Chem. Weekblad *6*, 123-5 (1909).
Winkler's and.Romijn's procedures using alkaline manganous salts are compared.

152 JORISSEN, W. P. and RINGER, W. E. De Bepaling van de opgeloste Zuurstof in Zeewater. (The Determination of Dissolved Oxygen in Sea Water.)
Chem. Weekblad *2*, 781-91 (1905).
The various modifications of Winkler's method are discussed, and data given on the North Sea and Zuiderzee.

153 JUST, G. Löslichkeit von Gasen in organischen Lösungsmitteln. (Solubility of Gases in Organic Solvents.)
Z. physik. Chem. 37, 342-67 (1901).
At 15°, 20°, and 25° the solubilities of carbon dioxide in 44 solvents, and of hydrogen, nitrogen, and carbon monoxide in 17 solvents, were determined.

154 KAISER, A. Zur Bestimmung des in Wasser gelösten Sauerstoffs. (Determination of Dissolved Oxygen in Water.)
Chem. Ztg. *27*, 663 (1903).
A method using freshly precipitated iron hydroxide is suggested.

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Third Report on Colloid Chem., Brit. Assoc, (1920).
A suggestive review with special reference to physiology and brewing.

156 KISCH, W. Zur Bestimmung des im Wasser gelösten Sauerstoffs. (The Determination of Dissolved Oxygen in Water.)
Z. angew. Chem. *1891*, 105-8.
A comparison is given of the various methods to date.

157 KISTIAKOWSKI, W. A. Laws of Solutions.
J. Russ. Phys. Chem. Soc. *30*, 576-85 (1898); Chem. Zentr. (i), 1899, 89, 91; Chem. Soc. Abstr. (2), *76*, 730 (1899).
. Adifferential diffusion apparatus for gases is described, and a theoretical discussion of the results given.

158 KLUT, H. Die freie Kohlensäure im Trinkwasser und ihre Bestimmung an Ort und Stelle. (Free Carbon Dioxide in Potable Water and its Determination in situ.)
Ber. pharm. Ges. 29, 344-59 (1919).
Methods of determination are given and a good bibliography appended.

159 KNOPP, W. Uber die Löslichkeitsbeeinflussung von Wasserstoff und Stickoxydul in wässerigen Lösungen verschieden dissoziierte Stoffe. (Solubility Relations of Hydrogen and Nitrous Oxide in Water Solutions of Differently Dissociated Solutes.)
Z. physjk. Chem. *48,* 97-108 (1904).
The absorption coefficient of hydrogen in chloral hydrate Solution and of nitrous oxide in propionic acid and various salt Solutions, with a discussion of the departures from the theoretical.

160 KNOX, W. F. Ueber das Leitungs'vermögen wässeriger Lösungen der Kohlensäure. (The Conductivity of Aqueous Carbon Dioxide Solutions.)
Ann. Phys. Chem. 54, 44-57 (1895).
Data on conductivity measurements is given.

161 KOLTHOFF, I. M. De Titratie van Koolzuur en zijn Zouten.. (The Titration of Carbonic Acid and its Salts.)
Chem. Weekblad *14,* 781-93 (1917).
Review of methods; Phenolphthalein or neutral red is advocated; hydrogen ion exponent is briefly discussed both as to determination and significance in establishing the equilibria in Solution.

162 KOLTHOFF, I. M. Determination of Carbon Dioxide and Reactions of its Various Forms to Indicators in Potable Waters. Active Carbon Dioxide.
Pharm. Weekblad *54,* 982-92 (1917).
A comparison of methods given in the "Codex alimentarius" with others in use, with a discussion of their principles, technic, relative accuracy, etc.

163 KÖNIG, J. Die Schützenberger'sche Methode der Sauerstoffbestimmung. (The Schützenberger Method of Oxygen Determination.)
Z. angew. Chem. *1891,* 108-10; Ber. *13,* 154 (1880).
The precautions necessary are pointed out with special emphasis on the quality of indigotin used.

164 KÖNIG, J. and KRAUCH, C. Ueber die Bestimmung des freien, in Wasser gelösten Sauerstoffs. (Determination of the free Oxygen Dissolved in Water.)
Z. anal. Chem. *19,* 259-82 (1880).
Bunsen's, Mohr's, and Schützenberger's methods are compared.

165 KÖNIG, J. and MUTSCHLER, L. Ueber die Bestimmung des im Wasser gelösten freien Sauerstoffs und den Sauerstoffgehalt des Brunnenwassers. (Determination of free Dissolved Oxygen in Water, and the Oxygen Content of Well Waters.)
Ber. *10,* 2017-22 (1877).

A comparison between Schützenberger's and Mohr's methods is made.

166 KREIDER, D. A. Bestimmung von Sauerstoff" in der Luft und in wässerigen Lösungen. (Determination of Oxygen in the Air and in Water Solutions.)
Z. anorg. allgem. Chem. 13, 418-26 (1897); Am. J. Sci. *2*, 312 (1901).
A special bulb to contain both the sample and reagents is described.

167 KUENEN, —. Change of Absorption Goefficient of Gases with Temperature.
Proc. Roy. Soc. Edinb. *23*, 312 (1901).
Experimental determinations are reported.

168 LANDOLT & BÖRNSTEIN. Löslichkeit von Gasen in Wasser. (Solubility of Gases in Water.)
Physikalisch-Chemische Tabellen, III, 599-605 (1905).
Compilation of the available solubility data.

169 LEDERER, A. Relation of Dissolved Oxygen in Water to the Quality of the Water.
Eng. News *64*, 289 (1910).
Abstract of a paper read at the Amer. Pub. Health Convention; precautions to be observed in interpreting the oxygen demand of waters are discussed.

170 LEDERER, A. The Biochemical Oxygen Demand of Sewages.
J. Ind. Eng. Chem. *6*, 882-8 (1914).
An extensive study of the dilution method is reported.

171 LEDERER, A. Determination of Biochemical Oxygen Demand by the Saltpeter Method in Stockyards, Tannery, and Corn Products Wastes.
J. Ind. Eng. Chem. 7, 514-6 (1915).
Application of the sodium nitrate method is shown to give more consistent results than the dilution method.

172 LEDIG, P. G. Absorption of Carbon Dioxide and Ammonia from Gas Bubbles.
Paper read at the Ithaca meeting, Am. Chem. Soc, (1924); J. Ind. Eng. Chem. *16*, 1231.

173 LEDIG, P. G. and WEAVER, E. R. Method for Studying the Rapid Absorption of Gases by Liquids.
J. Am. Chem. Soc. *46*, 650-7 (1924).
An accurate Photographie apparatus is described for the detailed study of the rate of absorption from small bubbles; the Solution of carbon dioxide by alkalis is given as an illustration.

174 LETTS, E. A. and ADENEY, W. E. Report on Pollution of Estuaries and Tidal Waters.
Fifth Rept., Roy. Commiss. on Sewage Disposal, App. VI, Part X.

Data oh pollution as determined by dissolved oxygen results is given.

175 LETTS, E. A. and BLAKE, R. F. Method of Determination of Oxygen in Fresh Water, Sea Water, Sewage, etc.
Sci. Proc. Roy. Dublin Soc. 9, 454 (1900); Chem. News *82*, 163-4 (1900).
Ferrous sulphate is used in alkaline Solution, the excess being titrated with dichromate or permanganate.

176 LEVIN, M. Beiträge zur Theorie der Löslichkeitsbeeinflussung. (Contributions to the Theory of Solubility Relations.)
Z. physik. Chem. 55, 513-36 (1906).
A discussion of collected solubility data in the light of the hydrate theory is presented.

177 LÉVY, A. Ammoniakgehalt der Luft und der Meteorischen Wässer. (The Ammonia Content of the Air and of Rain Water.)
Compt. rend. *84*, 273 (1877).
The method of determination is described and results tabulated over a period of time.

178 LÉVY, A. and MARBOUTIN, F. Dosage de l'Oxygène dissous dans l'Eau de Mer. (Quantity of Oxygen Dissolved in Sea Water.)
Compt. rend. *124*, 959-61 (1897); Bull. soc. chim. 19, 149 (1898). . . .
Oxygen is determined by dichromate titration of excess ferrous iron in alkaline Solution; chlorine of sea water is found to be without effect on the results.

179 LEWIS, W. K. and WHITMAN, W. G. Principles of Gas Absorption.
Paper read at the Ithaca meeting, Am. Chem. Soc, (1924); J. Ind. Eng. Chem. *16*, 1215.
Presenting a discussion of the twö-phase theory of the absorption process at a gas-liquid boundary, with a mathematical treatment of the different cases.

180 LEWY, B. Untersuchung über die Zusammensetzung des Gases welches das Meerwasser in verschiedenen Tageszeiten enthält. (Investigation of the Composition.of the Dissolved Gases in Sea Water at Different Hours of the Day.)
Ann. Phys. Chem. *58*, 326-35 (1846).
Tabulated analyses of the gases are given from sea.water and from the vicinity of green and brown algae.

181 LUBARSCH, O. Ueber die Absorption von Gasen in Gemischen von Alkohol und Wasser. (The Absorption of Gases by Water-alcohol Mixtures.)
Ann. Phys. Chem. *37*, 524-5 (1889).
Solubilities were determined for oxygen, hydrogen and carbon dioxide in mixtures containing from o to 80% alcohol. (See No. 205.)

182 MACARTHUR, C. G. Solubility of Oxygen in Salt Solutions and the Hydrates of these Salts.
J. Phys. Chem. *20,* 495-502 (1916).
Solutions of the chlorides of Li, Na, K, Rb, Cs, NH4, Ba, Ca, Mg, and of KBr, NaBr, KNO3, KI, Na2 $S0_4$, and sucrose of various concentrations were saturated with air and the dissolved oxygen determined by the Winkler method. Irregularities in solubility are discussed in terms of ion potentials and hydrate formation.

183 MACHE, H. Uber die Diffusion von Luft durch Wasser. (The Diffusion of Air through Water.)
Physik. Z. 7, 316-8 (1906).
Diffusion calculated as 1.7 cubic centimeters per day per centimeter at one atmosphere pressure.

184 MACKENZIE, J. J. Ueber die Absorption der Gase durch Salzlösungen. (The Absorption of Gases by Salt Solutions.)
Ann. Phys. Chem. 1, 438-51 (1877).
The solubility of carbon dioxide in Solutions of potassium, sodium, ammonium, barium, Strontium, and calcium chlorides is determined.

185 MACKENZIE, J. J. and NICHOLS, E. L. Ueber die Volumenvermehrung der Flüssigkeiten durch Absorption von Gasen. (The Increase in Volume of Liquids due to Gas Absorption.)
Ann. Phys. Chem. *239,* 134-42 (1878).
An accurate determination of the volume change resulting from dissolved gases is made.

186 MACKEY, W. M. and MIDDLETON, R. E. Colorimetric Estimation of Oxygen Dissolved in Water.
J. Soc. Chem. Ind.//, 1127-8 (1898).
The color change in alkaline pyrogallol is utilized.

187 MACTAGGART, H. A. Electrification at the Boundary between a Liquid and a Gas.
Phil. Mag. *27,* 297-314; *28,* 367-78; *44,* 386-95 (1922).
Cataphoresis experiments show that the migration velocity of gas bubbles is influenced by changes in surface tension of the liquid; the electrical charge on the bubble can be changed by varying the concentration of the dissolved salts; a bubble may change its sign while decreasing in size due to absorption.

188 MARCHAND, H. Campaign against Corrosion of Boiler Plates by Removing Gases from Water.
Genie civil *82,* 423-5 (1923).
The dissolved oxygen content of water varies with its origin, temperature, exposure to air, agitation, etc. The harmful effect of oxygen increases with higher temperatures; water containing 1 cubic centimeter of oxygen per

liter may be used below 60°; water containing half this amount, at 75-80°; or one-fifth of the amount, at 150°. Processes of deactivation are discussed.

189 MARTIN, A. J. TWO Sludge Problems: Aeration and Setding.
Surveyor 54, 195-6 (1918).
The activated sludge process requires 20 to 70 times the amount of air necessary to supply the oxygen needed by the organic matter; mixing by mechanical means to conserve air is considered.

190 MARTIN, A. J. The Bio-aeration of Sewage.
Contract Record *37*, 1081-3 (1923); Surveyor *64*, 287 (1923); Water and Water Eng. 25, 373-4 (1923); Engineering *116*, 681-2 (1923).
Brief historical review of the use of air in sewage purification, together with recentdevelopments and the need for research, are discussed.

191 MCDERMET, J. R. Degasification of Water.
J. Am. Water Works Assoc. 11, 118-27 (1924).
The Elliott process,.its theory, Operation and results are given.

192 MCLAUGHLIN, T. A. Cataphoresis of Air Bubbles in Various Liquids.
Sic. Proc. Roy. Dublin Soc. *17*, 13-17 (1922).
Using MacTaggart's apparatus (see No. 187), no cataphoresis of air bubbles was found in 16 different organic liquids; in distilled water the bubble moved toward the positive pole; in impure benzene, toward the negative.

193 MCLELLAN, B. G. A Note on Boiler Corrosion.
J. Soc. Chem. Ind.*36*, 853-6 (1917).
A case of corrosion due to dissolved oxygen is described.

194 MCLEOD, H. Apparatus for Determining the Quantities of Gases Existing in Solution in Natural Waters.
J. Chem. Soc. 11, 307-13 (1869).
A vacuum extraction apparatus is advocated.

195 MCLEOD, H. Observations on the Solution of Gases in Water.
J. Chem. Soc. *23*, 36-41 (1870).
The author discusses the results of different workers to date.

196 MEYER, J. Uber die Geschwindigkeit der Abgabe und der Aufnahme von Kohlendioxyd durch Wasser. . (The Velocity of Escape and of Absorption of Carbon Dioxide in Water.)
Z. Elektrochem. 15, 249-52 (1909).
Calculations of the velöcity are made on the basis of Knox's data (see No. 160).

197 MICHAUD, F. Solutions of Gas in Liquids.
Ann. phys. p, 203-32, 233-58 (1918).
A comprehensive thermodynamical treatment of Solutions of gas in liquids, especially as regards vapor pressure, the cryometric effect, entropy of Solution, and coefficient of solubility.

198 MOHLMAN, F. W. Deoxidizing Effect of Effluent from Miles Acid Process.
J. Ind. Eng. Chem. 11, 325-7 (1919).
Experiments are reported on the decrease in the oxygen of sea water in New Haven harbor caused by the sulphur dioxide in the Miles acid process effluent.

199 MORREN, M. Recherches sur les Gaz que l'Eau de Mer peut tenir en Dissolution en differents Moments de la Journee, etc. (Investigation of the Dissolved Gases in Sea Water at Different Times of the Day, etc.)
Ann. chim. phys. (3), *12*, 5-56 (1844).
Considerable data is collected.

200 MOUREU, C. Recherches sur les Gaz Rares des Sources Thermales. (Investigations on the Rare Gases of Thermal Springs.)
Bull. soc. chim., (4), p, I-XXV (1911).
Over 50 determinations are given of Ar, He, Kr, Xe, and Ne in various French thermal Springs; no relation was found between the He and the radioactivity of the spring.

201 MOUREU, C. and LEPAPE, A. Sur les Gaz des Sources Thermales; Présence du Crypton et du Xenon. (The Gases of Thermal Springs; Presence of Krypton and Xenon.)
Compt. rend. 149, 1171-4 (1910).
These gases were detected in 26 French Springs by the spectroscope after concentrating by carbon absorption.

202 MÜLLER, A. R. Relation of Oxygen Loss in Natural Waters and Artificial Nutrient Solutions to Bacterial Growth.
Arb. kais. Gesundh. *38*, 294-326 (1912).
The growth and loss of oxygen are not exactly proportional, but are casually connected.

203 MÜLLER, C. Die Absorption von Sauerstoff, Stickstoff, und Wasserstoff in wässerigen Lösungen von Nichtelektrolyten. (Absorption of Oxygen, Nitrogen, and Hydrogen by Aqueous Solutions of Non-electrolytes.)
Z. physik. Chem. *81*, 483-503 (1913).
Studies were made on the absorption of these gases in Solutions of cane sugar, grape sugar, glycerol, and chloral hydrate. The absorption coefficients decrease with increasing concentration of solute, but with cane sugar a minimum is reached, after which the solubility increases again.

204 MÜLLER, F. G. C. Apparat zur Bestimmung der Wassergase. (Apparatus for Determining the Gases in Water.)
Z. angew. Chem. *1899*, 253-5.
A boiling-out apparatus is described.

205 MÜLLER, 0. Ueber Absorption yon Kohlensäure in Gemischen von Alkohol und Wasser. (Absorption of Carbon Dioxide in Water-alcohol Mixtures.)
Ann. Phys. Chem. *37*, 24-43 (1889).
Determinations'of the solubility in various strengths of alcohol are reported, together with a.discussion of hydrate formation. (See also No. 181.)

206 MUSAIO, G. Observations ort the Methods in Use for the Determination of the Quantity of Gas Dissolved in Potable Waters.
Staz. sper. agrar. ital. *23*, 113-4 (1893); Analyst *18*, 67-8 (1893)-
Errors in the methods to date are discussed, and a new apparatus is proposed to avoid them.

207 MUTSCHLER, L. Bestimmung des Sauerstoffs im Wasser. (Determination of Oxygen in Water.)
Z. Nahr. Genussm. *2*, 481-4 (1899).
The alkaline ferrous sulphate method is described.

208 NACCARI, A. and PAGLIANI, S. Sull 'Assorbimento die Gas nei Liquidi e in Particolare sulla Legge di Henry. (The Solubility of Gases in Liquids, especially with Reference to the Law of Henry.)
Nuovo cimento (3), 7, 71-91 (1880).
The data of Chanikow & Luginin is worked up and their absorption coefficient for oxygen in water found to be 10.5% greater than that found b'y Bunsen.

209 NAYLOR, W. A Method of Determining Oxygen in Water.
Chem. News *83*, 259 (1902).
The indigo-hyposulphite method as used by Gerland (see No. 114) is described.

210 NERNST, W. Theorie der Reaktionsgeschwindigkeit in heterogenen Systemen. (Theory of Reaction Velocity in Heterogeneous Systems.)
Z. physik. Chem. *47*, 52-5 (1904).
Diffusion is pointed out as the limiting factor in reaction velocity; see also Klein, Z. anorg. allgem. Chem. 137, 56-65 (1924).

211 NOLL, H. Modifikation der Sauerstoffbestimmung im Wasser nach W. Winkler. (Modification of Winkler's Method for Oxygen in Water.)
Z. angew. Chem. *18*, (2), 1767-8 (1905).
The accuracy of the method in the presence of organic matter is investigated and a correction suggested.

212 NOLL, H. Beitrag zur Bestimmung des im Wasser gelösten Sauerstoffs bei Gegenwart von Nitriten und organischer Substanz. (The Determination of Dissolved Oxygcn in Water in Presence of Nitrites and Organic Matter.)
Z. angew. Chem. *30,* (1), 105-8 (1917); J. Chem. Soc. *112,* 502 (1917).
A discussion of Lehman & Fitzau's procedure in which the nitrites are destroyed by Carbamide (urea) and sulphuric acid; the accuracy of other methods is compared and discussed.

213 NORDELL, C. H. Aeration by Mechanical Agitation of Sewage Proved Unsuccessful.
Eng News-Record 76, 856 (1916).
A combination of mechanical stirring with aeration is claimed to be less efficient and economical than aeration alone.

214 NORDELL, C. H. Milwaukee Air Diffusion Studies in Activated Sludge.
Eng. News-Record *78,* 628-9 (1917).
Contact of air with sewage is prolonged by fine subdivision of the air, because small bubbles ascend slowly; 25-50% of tank area must be diffusion area or bubbles will coalesce.

215 PATON, J. W[7]. C. The Amount of Air Contained in Water.
J. Soc. Chem. Ind. *15,* 419, 863 (1896).
Dissolved gases destroy the vacuum in steam engine condensers; air pumps necessary to allow for this are discussed.

216 PERMAN, E. P. Rate of Escape of Cer-tain Gases from Solutions of Varying Concentration.
J. Chem. Soc. *67,* 868-80 (1895).
Results of experiments are given using water Solutions of ammonia, carbon dioxide, bromine, hydrochloric acid, sulphur dioxide, and hydrogen sulphide.

217 PETTERSSON, O. and SONDEN, K. Syrets och Qväfvets Absorb-tion uti Vatten. (Oxygen and Nitrogen Absorbed by Water.)
Svensk Kern. Tid. 1, 17 (1889); Ber 22, 1434, 1439 (1889); J. Soc Chem. Ind. 8, 726 (1889).
Data is given on the dissolved gases in the Baltic and Stockholm water; Bunsen's work on absorption coefficients is repeated.

218 PHELPS, E. B. Putrescibility and Stability of Sewage Effluents.
U. S. Geol. Survey, Water-Supply Paper *229,* 74-88 (1909).
The significance and methods of stability determination are discussed.

219 PHELPS, E. B. New York Harbor Pollution
N. Y. Harbor Report, Mass. Inst. Techn., 1911.
A mathematical formula is derived for calculating the quantity of oxygen absorbed from the air by natural bodies of water.

220 PHELPS, E. B. The Chemical Measure of Stream Pollution and Specifications for Sewage Effluents.
Am. J. Pub. Health *3,* 524-34 (1913).
The quantity of organic matter present is best measured by its oxygen requirement.

221 PHELPS, E. B. Absorption of Oxygen by De-aerated Water.
Trans..Am, S.oc..-Ciyil_Eng. 76, 1624 (1913).
A comprehensive study of the distribution and importance of oxygen in New York harbor pollution problem; the effect of time, depth, and initial Saturation are expressed mathematically.

222 PHELPS, E. B. Studies on the Self-Purification of Streams.
U. S. Pub. Health Repts.. 29, 2128-32 (1914).
Re-aeration is very important since oxygen is constantly used up by the bacteria and organic matter; the latter is a mono-molecular reaction, hence the degree of pollution can be determined.

223 PHELPS, E. B. Chemical Studies of Pollution of the Ohio River.
J. Ind. Eng. Chem. *6,* 682-4 (1914).
The importance of re-aeration and dissolved oxygen are stressed.

224 PHELPS, E. B. Re-aeration in Self-Purification of Streams.
Eng. Record *74,* 617-8 (1916); J. Ind. Eng. Chem. 9, 403-5 *(1917).* . . .
Re-aeration is a better criterion of capacity to receive sewage than the dilution ratio; dams and rapids are important, not for exposing the water, but for mixing it.

225 PHELPS, E. B. Potomac River Investigation.
U. S. Hygenic Lab. Bull. *104,* 124 (1916).
Data on the re-aeration of the Potomac river and its capacity for Washington sewage as determined by dissolved oxygen content are given.

226 PHILIP, J. C. Influence of Non-electrolytes and Electrolytes on Solubility of Sparingly Soluble Gases in Water.
J. Chem. Soc. *91,* 711-7 (1907).
The author discusses previous work and its relation to the determination of hydration by solubility. .

227 PIRNIE, M. Function of Aeration in Water Purification.
Eng. Contr. *61,* 573-6 (1924); Public Works 55, 251-2 (1924).
The effects of aeration on a number of water supplies are described and the function of aeration in removing tastes, iron, and in aiding soda ash coagulation is discussed.

228 PRYTZ, K. and HOLST, H. Die Absorptionscoefficienten der Kohlensäure und des Schwefelwasserstoffs in Wasser bei dessen Gefrierpunkt. (The Absorption Coefficients of Carbon Dioxide and Hydrogen Sulphide in Water at its Freezing Point.)
Ann. Phys. Chem. 54, 130-8 (1895).
The absorption coefficients and the freezing point lowering are determined in water at o°.

229 RAMSAY, W. and HOMFRAY, I. Colorimetric Method for Determining Oxygen Dissolved in Water.
J. Soc. Chem. Ind. *20,* 1071-75 (1901).
The use of ammoniacal cuprous chloride in a special portable apparatus is recommended.

230 RAOULT, F. M. Recherches sur 1'Absorption de l'Ammoniaque par les Dissolutions Salines. (Absorption of Amraonia by Salt Solutions.)
Ann. chim. phys. 1, 262-74 (1874).
A determination is made of the solubility in alkalis and in alkali salt Solutions.

231 RAOULT, F. M. Ueber Präzisions Kryoskopic, Anwendungen derselben auf wässerige Lösungen. (The Accuracycy of Cryoscopic Methods and their application to Water Solutions.)
Z. physik. Chem. 27, 617-61 (1898).
The paper includes a determination of the freezing point lowering for dissolved air in water.

232 RAYLEIGH, LORD and RAMSAY, W. Argon, a New Constituent of the Atmosphere.
Phil. Trans. Roy. Soc. London *186* A, 187-241 (1895).
The solubility in water is included in a discussion of its properties.

233 REBENSTORFF, H. Einfache Gewinnung der in Wasser gelösten Luft. (Simple Extraction of the Air Dissolved in Water.)
Z. physik. Chem. Unterricht *18,* 222 (1905).
An apparatus for the vacuum-heat extraction method is described.

234 REICHERT, E. Apparat zur Bestimmung von Gasen in Flüssigkeilen (Apparatus for Determining Gases in Liquids.)
Z. anal. Chem. 11, 271 (1872).
A boiling out method is proposed.

235 RICHARDS, E. H. Dissolved Oxygen in Rain Water.
J. Agr. Sci. *8,* 331-7 (1917).
The dissolved oxygen content of rain water collected below paraffin oil is a little below Saturation; rain water can become strongly supersaturated.

236 RICHARDSON, F. W. Ready Method for Extraction and Estimation of Dissolved Gases in Water.
J. Soc. Chem. Ind. *38*, 32-3 (1919).
Gases are extracted by a vacuum bulb attached to the sample bottle; warming the sample to 40^0 is advised; carbbn dioxide requires repeated extractions.

237 RICHARDSON, W. D. Oxygen is the Prime Factor in Corrosion.
Chem. Met. Eng. *23*, 23-8 (1920).
A discussion of the various theories of corrosion, with emphasis on the importance of oxygen and oxygen carriers.

238 RICHTER, R. Uber den Einfluss einer kleinen Kläranlage auf den Sauerstoffgehalt eines kleinen Baches. (Influence of a Small Settling Tank on the Dissolved Oxygen Content of a Brook.)
Pharm. Zentralhalle *34*, 471-5 (1913).
The effect of emptying the dregs of a bleachery tank on the dissolved oxygen content of a brook is noted.

239 RIDEAL, S. The Aeration Test for Sewage Effluents.
Analyst *26*, 197-202 (1901).
The rates of absorption of oxygen by water and sewage are determined and discussed.

240 RIDEAL, S. and BURGESS, W. T. The New Standards for Sewage Effluents.
Analyst *34*, 193-205 (1909).
A discussion of dissolved oxygen and methods for its determination.

241 RIDEAL, S. and STEWART, C. G. Determination of Dissolved Oxygen in Water in Presence of Nitrites and of Organic Matter.
Analyst *26*, 141-7 (1901).
An excellent review of previous methods is given; oxygen absorption by quiescent cylinders of water containing ammonio-cuprous chloride to simulate sewage absorption is determined.

242 RISCHBIETH, P. Die Löslichkeit von Kohlendioxyd in Wasser. (Solubility of Carbon Dioxide in Water.)
Z. physik. Chem. Unterricht *36*, 120 (1923).
A rough gas buret method for measuring solubility, especially for demonstration purposes, is described.

243 RITZEL, A. Gaslöslichkeit, Kompressibilität und Oberflächenspannung. (Gas Solubility, Compressibility and Surface Tension.)
Z. physik. Chem. *60*, 319-58 (1807).
The solubility of carbon monoxide is determined in mixtures of organic solvents, and the properties of these mixtures are discussed.

244 ROMIJN, G. De Bepaling van de in Water opgeloste Zuurstof. (Determination of Dissolved Oxygen in Water.)
Dissertation, Leiden, 1893; Rec. trav. chim. *12*,241-7 (1893); 75, 76-8 (1896); J. Soc. Chem. Ind. *15*, 674 (1896).
A method of determination using alkaline manganous chloride is suggested.

245 ROMIJN, G. Apparat zur Bestimmung von Sauerstoff in Wasser. (Apparatus for Determining Oxygen in Water.)
Z. angew. Chem. *1897*, 658.
The author described a vacuum bulb to serve for both collection and analysis of the sample.

246 ROSCOE, H. E. On the Absorption of Chlorine by Water.
Quart. J. Chem. Soc. *8*, 14-26 (1856).
The absorption coefficient is determined and compared with the solubility of hydrogen and carbon dioxide under similar conditions to test the validity of Henry's law.

247 ROSCOE, H. E. and DITTMAR, W. On the Absorption of Hydrochloric Acid and Ammonia.in Water.
Quart. J. Chem. Soc. *12*, 128-51 (1860).
The absorption of these gases by water is measured at o°, and their departures from Henry's law are discussed.

248 ROSCOE, H. E. and LUNT, J. On Schützenberger's Process for the Estimation of Dissolved Oxygen in Water.
J. Chem. Soc. *55*, 552-76 (1889); Ber. *22*, 2717-23 (1889); J. Soc. Chem. Ind. *8*, 729 (1889). (Note: The % oxygen at o° should be 34.88, not 38.88 as in this abstract.)
A careful critical examination of the method is made to determine its reliability.

249 ROTH, W. A. Ueber die Absorption des Stickoxyduls in wässerigen Lösungen verschieden dissociierte Stoffe. (The Absorption of Nitrous Oxide by Water Solutions of Differently Dissociated Solutes.)
Z. physik. Chem. *24*, 114-51 (1897).
The solubility. is determined in d fferent organic solvents at different temperatures, with a discussion of the mathematical relationships. (See No. 38.)

250 ROTH, W. A. Uber die Lösungsgeschwindigkeit von Gasen in Wasser. (The Rate of Solution of Gases in Water.)
Z. Elektrochem. 15, 328-31 (1909).
The rate of absorption of nitrous oxide and carbon dioxide by water, and the rate of escape of nitrous oxide by a current of hydrogen, are calculated from the rate of temperature change of solubility and by cryoscopy.

251 ROULE, L. Sur l'Influence exercée sur la Migration de Montee du Saumon par la Proportion d'Oxygène dissous dans l'Eau

des Fleuves. (The Influence of Dissolved Oxygen in River Waters on the Migration of Salmon.)
Compt. rend. *158*, 1364-6 (1914).
Salmon favor waters high in dissolved oxygen; analyses are given of the samples studied.

252 ROULE, L. Observations on the Proportion of Oxygen in Water of a Littoral Pond and in Littoral Sea.
Compt. rend. soc. biol. 79, 434-6 (1916).
The oxygen content was determined at the surface and at 6 meters depth; hourly, daily and seasonal variations were found; the significance of the results with respect to fish migration is discussed.

253 RUPPIN, E. Bestimmung der im Meerwasser gelösten Gase. (Determination of Dissolved Gases in Sea Water.)
Z. anorg. allgem. Chem. *38*, 117-20 (1904).
A vacuum-heat method of extraction is described.

254 RUTH, J. P., JR. Aerating and Activating Sewage.
U. S. Pat. No. 1491277, April 22, 1924.
Pine oil or other soluble oil is added to cause the air introduced to break up into fine bubbles.

255 SACHS, J. H. Comparison of Permanganate Methods for Determination of Required Oxygen.
J. Ind. Eng. Chem. *8*, 404-5 (1916).
A comparison is made of four permanganate methods in both acid and alkaline Solution; the acid Solution at 37° (the procedure of Thresh) is advocated.

256 SALE, J. W. and SKINNER, W. W. Vertical Distribution of Dissolved Oxygen and Precipitation by Salt Water in Certain Tidal Areas.
J. Franklin Inst. *184*, 837-48 (1917).
Lower layers contain less dissolved oxygen than upper, due to (a) stratification of the water produced by the specific gravity of the under-run of sea water which cuts off vertical circulation, and (b) depletion by natural agencies which was greatest in September.

257 SCHIEDT & STOCKMANN. Determination of Carbon Dioxide and Oxygen in Steam from Various Softening Processes.
Arch. Wärmewirtschaft *4*, 7-10, 24-6 (1923).
Data is given on the analysis of feed water and steam for four plants. Typical values for carbon dioxide and oxygen respectively in g. per ton of steam, are: Lime-soda, 12 and 5; Lime-soda with blow-off water returned to feed, 37 and 4; Permutit followed by degasifying, 62 and 1; no softening, 68 and 4.

258 SCHLEIERMACHER, A. Specifisches Gewicht von Wasser bei Absorption von Luft. (Specific Gravity of Water containing Absorbed Air.)
Ann. Phys. Chem. *8*, 53-83 (1879).
The correction for absorbed air is determined in some accurate work on specific gravides.

259 SCHULZ, B. Aeration of the North Sea and the Baltic Sea.
Naturwissenschaften *12*, 105-13, 126-33 (1924).
Extensive data and analyses obtained by recent expeditions are given; approximate equilibrium is found to exist between the air and the dissolved gases; the absorption coefficients are a function of temperature and salt content; the gas content varies with depth, the oxygen being at a maximum at .20-30 meters due to carbon dioxide assimilation by plants; at greater depths oxygen decreases, carbon dioxide increases, and salts and alkalinity increase.

260 SCHÜTZENBERGER, P. and RISLER, C. Memoire sur l'Emploi de l'Hydrosulphite de Soude comme Moyen de Titrage de l'Oxygène, etc. (The Use of Sodium Hyposulphite in the Titration of Oxygen, etc.)
Bull. soc. chim. *19*, 152-6 (1873); *20*, 145-59 (1873); Compt. rend. 75, 879 (1872).
Details of the method and preparation of the reagents are described.

261 SCOTT, G. G. Oxygen Utilization by Fishes and other Aquatic Animals.
Proc. Soc. Exptl. Biol. Med. 13, 146-7 (1916).
The effect of temperature, light, and type of animal on the oxygen consumption is determined.

262 SETCHENOW, J. Uber die Konstitution der Salzlösungen auf Grund ihres Verhaltens zu Kohlensäure. (The Constitution of Salt Solutions on the Basis of their Carbon Dioxide Content.)
Z. physik. Chem. *4*, 117-25 (1889).
Conclusions drawn from three years work on the subject and a discussion of the correlation with Dalton's Law.

263 SEYLER, C. A. Supersaturation of Solutions of Oxygen in Water.
Chem. News *67*, 87 (1893).
Rise in temperature may cause supersaturation in water, but shaking is necessary to cause loss of oxygen.

264 SHOUB, H. L. Note on a New Apparatus for Use with the Winkler Method for Dissolved Oxygen in Water.
U. S. Hyg. Lab. Bull. *96*, 83-5 (1914).
A convenient device for measuring out a portion of the bottle mixture for titration is suggested.

265 SIMONS, G. W., JR. Aeration of Sulphur Water in Florida.
Eng. Contr. *48,* 31 (1917);
Flowing well discharges in thin sheets over two discs, thus removing the hydrogen sulphide.

266 SKIRROW, F. W. Uber die Löslichkeit von Kohlenoxyd in binären organischen Gemischen. (Solubility of Carbon Monoxide in Binary Orgänic Mixtures.)
Z. physik. Chem. *41,* 139-60 (1902).
Solubility is determined in a number of organic mixtures and the deviations discussed.

267 SMIT, J. Enkele Opmerkingen over de Zuurstofbepaling in Water. (The Determination of Oxygen in Water.)
Chem. Weekblad *12,* 476-81, 819-22 (1915).
A discussion is given of the method adopted by the Dutch "Codex alimentarius"; modifications are investigated.

268 SPELLER, F. N. The Deactivator System for Elimination of Corrosion in Hot Water Supply Pipes.
Eng. Contr. *50,* 297-9 (1918); 51, 221-2 (1919).
Construction of a deactivator and tests on it are described.

269 SPELLER, F. N. Deoxidizing Water to Prevent Pipe Corrosion.
Eng. Mining J. *107,* 480 (1919).
A report of tests of corrosion by deoxidized water used for heating purposes; Speller's deoxidizer does not entirely remove oxygen, but hydrogen present inhibits corrosion.

270 SPELLER, F. N. Control of Corrosion by Deactivation of Water.
J. Franklin Inst. 193, 515-42 (1922).
The author gives a good review of factors influencing corrosion and methods for its elimination.

271 SPELLER, F. N. Water Deactivation.
Proc. Eng. Soc. Western Penn. 59, 189-201 (1923).
Several methods of treatment are described.

272 SPERR, F. W., JR. Absorption of Hydrogen Sulphide.
Paper read at the Ithaca meeting, Am. Chem. Soc. (1924).

273 STEFAN, J. Diffusion der Kohlensäure durch Wasser und Alkohol. (Diffusion of Carbon Dioxide through Water and Alcohol.)
Wien. Acad. Ber. *77,* 371-409 (1878); Jahresber. Chem. *1878,* 46-50
Experimental determination of diffusion velocities using a narrow tube (less than 1 mm) to prevent mixing by sinking of the heavier saturated layers; the process is shown to follow Fick's law. - . . .

274 STEINER, P. Uber die Absorption des Wasserstoffs im Wasser und in wässerigen Lösungen. (The Absorption of Hydrogen by Water and Aqueous Solutions.)
Ann. Phys. Chem. 52, 275-99 (1894).
The solubility is determined in thirteen different solvents and the results discussed in terms of Solution composition.

275 STEPHENSON, H. F. Effect of a Film of Oil on the Aeration o Water.
Analyst *44,* 288 (1919).
Samples of water boiled then cooled showed nearly the same dissolved oxygen content whether covered with kerosene or not during the cooling.

276 STINSON, E. S. and SHIVE, J. W.' An Effective Absorption Apparatus.
Science 59, 193-4 (1924).
An absorption bottle is described in which the gas ascends in a spiral path.

277 STOOFF, H. Role of Atmospheric Oxygen in the Purification of Sewage.
Naturwissenschaften 11, 389-95 (1923).
Review of development of various aeration processes for purifying sewage, with an extensive survey of the chemical and biological reactions occurring during the decay of organic substances, the fermentation of carbohydrates, and the putrefaction of nitrogeneous substances.

278 SUGDEN, S. Determinatiin of Surface Tension from the Maximum Pressure in Bubbles.
J. Chem. Soc. *121,* 858-66 (1922); 125, 27-31 (1924).
The theory of the method has been extended and the surface tension of water and benzene determined.

279 TALBOT, A. N. Removal of Iron from Drift Well Water.
Proc. 111. Water Supply Assoc. 3, 151 (1911).
The rate of aeration and the amount of dissolved oxygen necessary for deferrization are discussed.

280 TALBOT, A. N. and STROMQUIST, W[7]. G. Experiments in the Removal of Iron from the Water Supply of the University of Illinois.
111. State Water Survey, Bull. 9, 121-6 (1911).
The role of aeration in iron removal is discussed on the basis of experiments conducted by the authors.

281 TAYLOR, N. W. and HILDEBRAND, J. H. Solubility Relations of Certain Gases.
J. Am. Chem. Soc. *45,* 682-94 (1923).
The solubility of chlorine in some organic solvents has been determined; the solubility data for various gases is summarized, and the theoretical relations discussed.

282 TEXTER, C. R. Prevention of Corrosion in Hot Water Supply Systems and Boiler Economizer Tubes.
J. Am. Water Works Assoc. *10,* 764-72 (1923).
Chemical and mechanical methods of oxygen removal, and deactivation with steel scrap are referred to; soluble Silicates for forming a self-healing impervious film are also mentioned.

283 THERIAULT, E. J. and HOMMON, H. B. Determination of Biochemical Oxygen Demand of Industrial Wastes and Sewage.
U. S. Pub. Health Bull. *97,* 71-86 (1918).
An intensive study is made of the excess oxygen method for determining biochemical oxygen demand.

284 THOMAS, V. Action de l'Oxyde Nitrique sur quelques Chlorures Mètallique; Chlorure Ferreux, Chlorures de Bismuth et d'Aluminium. (Action of Nitric Oxide on Metal Chlorides: Chlorides of Iron, Bismuth and Aluminium.)
Compt. rend. *121,* 128-30 (1895); (also ibid. *120,* 190-2 (1895).
Giving a discussion of the Compounds formed in the absorption by these salts.

285 THOMAS, V. Sur l'Absorption de l'Oxyde Nitrique par le Bromure Ferreux. (The Absorption of Nitric Oxide by Ferrous Bromide.)
Compt. rend. *123,* 943-5 (1896); *124,* 366-8 (1897).
An experimental determination and discussion of the results; the later paper extends the work to include also ferrous chloride Solutions.

286 THOMAS, V. Sur 1'Absorption de l'Oxyde Nitrique par les Sels Ferreux. (The Absorption of Nitric Oxide by Ferrous Salts.)
Bull, soc' chim. (iii), /p, 343-7 (1898); also ibid. *13,* 229-31 (1895).
A determination of the amounts of nitric oxide absorbed at different temperatures by Solutions of ferrous salts in water and in alcohol.

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After discussing previous apparatuses, the author describe a device of his own design.

293 URSPRUNG, A. Demonstration of B.ubble Formation in Water of Variable Air Content.
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J. Chem. Soc. 97, 66-78 (1910).
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The theory of Donnan & Masson is extended. (See No. 87).

297 VANDEVENTER, C. N. and JÜRGENS, B. H. Uber die Bestimmung von in Wasser gelösten Sauerstoff. (The Determination of Dissolved Oxygen in Water.)
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A general discussion; a dissolved oxygen determination on a fresh sample is no test of pollution; the sample should be incubated 5-15 days after dilution with distilled water containing oxygen.

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Proc. Natl. Acad. Sci. 7, 229-31 (1921).
A Volumetric extraction apparatus.

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Proc. Roy. Soc. London *79*, 366-71 (1907).
The solubilities of oxygen, nitrogen and carbon dioxide are determined in olive oil, cod-liver oil, lard, and human fat; at body temperature the fats dissolve over five times as much nitrogen as water or blood plasma does.

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A mathematical discussion of the shape is given, from which the author concludes that the meridian section of liquid drop or gas bubble cannot be represented by a finite equation by means of known funetions; the determination of surface tension is also discussed.

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Activated sludge experiments are described.

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The role of oxygen is discussed.

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The prevention of corrosion by the removal of oxygen is outlined.

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The fairly constant relation between these gases points to a common origin from the air; data on 28 wells is given.

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Z. farben textil Chem. 1, 439-42 (1902); J.Soc. Chem. Ind. *21*, 1156 (1902).
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A case is described in which dissolved oxygen was so reduced in a lake by the discharge of ferrous sulphate industrial wastes that fish were unable to live.

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J. Ind. Eng. Chem. *8,* 647-8 (1916).
A description of experiments on trickling filters and aeration tanks.

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A table is given of the solubilities of atmospheric oxygen in water in milligrams per liter for temperatures from 5° to 30° at 1° intervals, and pressures from o to 760 mm.

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J. Chem. Met. Mining Soc, S. Africa, *27,* 105-11 (1921).
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The authors determined the rate of absorption of oxygen, sulphur dioxide, ammonia, and hydrochloric acid through the free surface of the liquid, and the rate of escape of sulphur dioxide from aqueous Solutions by air, to substantiate the two-film theory of Lewis & Whitman (see No. 179).

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Including a good review of methods and a discussion of the accuracy of Schützenberger's method.

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J. Ind. Eng. Chem. *16,* 1157-61 (1924).
In commercial produetion scarcely half the carbon dioxide can be economically saved; factors Controlling the rate of absorption are studied to increase the efficiency. The rate in potassium carbonate is independent of concentration and increases up to 70° if the Saturation does not exceed 65%. Methods for determining the equilibria in Solution are given.

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Ber. *21,* 2843-54 (1888).
The original Winkler method using manganous sulphate and potassium iodide is described.

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Ber. *22,* 1764-74 (1889); J. Soc. Chem. Ind. *8,* 727 (1889).
The iodometric method is used for determining the solubilities at different temperatures.

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Z. physik. Chem. *9,* 171-5 (1892).
A discussion of the change of absorption coefficient with temperature and viscosity of the solvent.

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Ber. *24,* 89-101, 3602 (1891); 34, 1408 (1901).
In the two papers are determined the solubilities of hydrogen, nitrogen, oxygen, air, nitric oxide, carbon monoxide, methane, and ethane in water.

319 WINKLER, L. W. Bestimmung der in natürlichen Wässern gelösten Gase. (Determination of the Gases Dissolved in Natural Water.)
Z. anal. Chem. *40,* 523 (1901).
A method is suggested for determining the gases and a table of solubilities given.

320 WINKLER, L. W. Ueber die Bestimmung der Kohlensäure in natürlischen Wässern. (Determination of Carbon Dioxide in Natural Waters.)
Z. anal. Chem. *42,* 735 (1904).
A titration method is advocated.

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Z. angew. Chem. 25, 1563 (1912).
A special flask adapted to dissolved oxygen determination by the Winkler method is-described.

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Z. anal. Chem. 53, 665-72 (1914).
A method is described for waters high in organic matter and nitrites.

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Z. Nahr. Genussm. 29, 121-8 (1915).
A modification of the original procedure is recommended.

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Z. angew. Chem. *28, 22* (1915); *29,* 44 (1916).
The second paper describes the determination of dissolved gases.

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Z. Nahr. Genussm. *47, 257-9* (1924).
The application of Winkler's method to small samples of water.

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Techn. Quart. *20,* 406 (1907).
Trickling filter experiments are described, together with a discussion of oxygen utilization.

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Dé Ingenieur 37, 444-6 (1922).
A method for dissolved oxygen determination is given; the oxygen may increase up to 183% by falling a distance of a few centimeters in the air; water meters may increase the oxygen content unless entirely air-tight.

328 WROBLEWSKI, S. v. Ueber die Gesetze, nach welchen die Gase sich in flüssigen, festflüssigen und festen Körpern verbreiten. (Laws Governing the Diffusion of Gases in liquid, semi-liquid and solid bodies.)
Ann. Phys. Chem. *238,* 481-513 (1877).
The diffusion of carbon dioxide is measured in water, sodium chloride Solution, some vegetable oils,. gelatine of different water contents, and rubber; the change in specific gravity of water due to gas absorption is determined; an expression is derived following the Biot-Fourier theorem to represent the gas diffusion.

329 WROBLEWSKI, S. V. Constante der Verbreitung der Kohlensäure in reinem Wasser. (Diffusion Constant of Carbon Dioxide in Pure Water.)
Ann. Phys. Chem. *4,* 268-77 (1878).
Further work on gas diffusion; carbon dioxide does not follow the Biot-Fourier law, since diffusion is interfered with by sinking of the saturated upper layers (see No. 273).

330 WROBLEWSKI, S. V. Ueber die Abhängigkeit der Constante der Verbreitung der Gase in einer Flüssigkeit von der Zähigkeit der letztern. (On the Dependence of the Diffusion Constant of Gases in a Liquid upon the Viscosity of the Latter.)
Ann. Phys. Chem. 7, 11-23 (J879).
Experimental determination and discussion of results.

331 WROBLEWSKI, S. V— Ueber die Natur der Absorption der Gase. (The Mechanism of Gas Absorption.)
Ann. Phys. Chem. *8, 29-52* (1879).
Theory of absorption is discussed; experiments show that Henry's law can be applied to the Solution of gases in rubber.

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Sanitary Record *61,* 38, 68, 90, 122 (1918).
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Z. Nahr. Genussm. *2,* 696 (1899).
Mutschler's procedure is contrasted experimentally with Winkler's.