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WILLIAM LLOYD EVANS

DECEMBER 22, 1870–OCTOBER 18, 1954

William Lloyd Evans was born December 22, 1870, in Columbus, Ohio, the son of Welsh immigrants. He went to the old Columbus High School and for two years to the Preparatory Department located on the rapidly growing Ohio State University campus. As a lad his affectionate nature, boyish enthusiasms and bright and searching mind had endeared him to his father and mother and there was nothing they would not do by way of sacrifice and home economy to ensure that William should have all the advantages of a university education. Their school boy was destined to become a distinguished chemist and President of the American Chemical Society.

So he entered the University; and there he took an active part in student affairs. He was concertmaster of the first orchestra and member of the Glee Club. In the prize drill of the Battalion of Cadets in 1891, his junior year, it was Captain W. L. Evans who received the prize sword for the excellent performance of his Company C; and in his senior year his classmates knew him as Lieutenant Colonel of the Battalion, as well as treasurer of the class. He was graduated with a B.Sc. degree in the Class of 1892.

Note should be taken of the activities of his undergraduate and graduate student days as related to his later life:

His devotion to music lasted throughout his long life. He was early a violinist in the Columbus Symphony Orchestra, and later a member of the Board of Directors of the Columbus Philharmonic Orchestra; he was chairman of the University's Song Book committee and organizer of the Choral Union. He married Cora Ruth Roberts in 1911. Many students and old friends will recall the delightful evenings spent in the Evans' home—with Dr. Evans playing the violin, and with Mrs. Evans and the three children joining in the singing.

In college days he made many warm and fast friends; and always he had a great capacity for friendship, and a willingness to share himself with friends. Someone who knew him well once said: "Professor Billy is as Welsh as his name in his endowment of a rare, intuitive understanding of the fine, secret alchemy of the human spirit."

From Professor Sydney A. Norton, the first professor of chemistry and a member of the founding faculty of the Ohio State University, William Evans received much of the inspiration that was to lead him into chemistry. After graduation he first made an excursion into ceramics as assistant chemist for the American Encaustic Tile Company at Zanesville; but was back on the campus in 1895, first on a fellowship, working for a Master's degree (1896) under Professor William McPherson on a topic concerned with the chemistry of quinones; and then on an assistantship with his friend Professor Edward Orton, Jr., who had just established at Ohio State the country's first department of ceramic engineering. But Evans decided that he wanted to teach chemistry, and he soon accepted a post in the high school at Colorado Springs. The four years there were nourishing years for the maturing young teacher.

In 1903 he won a fellowship at the University of Chicago and in the following year the Lowenthal Fellowship, enabling him to work out his Ph.D. degree (1905) with the brilliant John Ulrich Nef, who had recently been added to the Chicago faculty. The topic of the research was "On the Behavior of Benzoyl Carbinol Towards Alkaline and Oxidizing Agents."

Then, in 1905, he was called back to his alma mater as an assistant professor; was promoted to an associate professorship in 1908, and to a professorship in 1911; and thus was well launched on his career. It was to be a career remarkable for the quality and diversity of accomplishment and achievement.

Over the period of his active teaching he lectured to more than 45,000 freshmen; and the zest with which he gave his lectures and the profound impression that he made upon the students in their first year at the university were widely known. One of his admirers remarked: "His lectures in freshman chemistry have been a joy and inspiration to literally thousands of students at Ohio State. With contagious enthusiasm and splendid vigor he paints a vision of science not as something separate from life, but as part and parcel thereof, vitally important in its relationship to the thought and destiny of modern men." Dr. Evans usually gave, in addition, a course in organic chemistry or a seminar. Over the years he directed the researches of more than fifty doctoral students and many masters; and even while he was carrying the heavy load of the chairmanship, during the period of 13 years from 1928 to the time of his retirement in 1941, he still continued his researches actively.

His election to the Presidency of the American Chemical Society, in 1941, was the crowning honor of his outstanding career. He had been chairman and councillor for the Columbus Section, and in 1928 he had been chairman of the Organic Division and during the years 1933–1939 a councilor-at-large for the society. During the same years he was a member of the Committee on Chemistry and Chemical Technology of the National Research Council. Many other honors came to Dr. Evans, including the Nichols Medal in 1929 and the Medal of the American Institute of Chemists in 1942. He was president of the Ohio Academy of Sciences (1940), and a Fellow of the American Academy of Arts and Sciences of Boston; and he received honorary degrees, LL.D. from Ohio State University in 1948, and D.Sc. from Capital University in 1950. He was a delegate to the International Union of Chemistry, meeting in Liège in 1930.

His university colleagues and friends in town honored him with the presidency of the Faculty Club and the Torch Club; and the undergraduates elected him, in an honor granted to few of the faculty, to their Society of the Sphinx. He became a member of Sigma Chi and held memberships in Phi Beta Kappa and Phi Eta Sigma; he was president of the Ohio State Chapter of Sigma Xi, and member of Gamma Alpha, Phi Lambda Upsilon and Alpha Chi Sigma. At various times he was a member of the Athletic Board and the Graduate Council as well as of many of the University's important committees.

During the First World War he served for two years, first as Captain and then as Major, in the Chemical Warfare Service, and was Director of the Chemical Laboratories at Edgewood Arsenal. At one time he was a consultant for the U. S. Public Health Service; and he consulted for many years for Lowe Brothers of Dayton and for the Columbus Coated Fabrics Corporation. His services in his capacity as consultant were very helpful and stimulating; and he, in turn, used the contacts with the industrial research laboratory as one means of keeping his interest in chemistry at a high pitch, especially after his retirement from active participation in university work—and, in fact, right up to the time of his death.

He was one of Ohio States' greatest and most beloved professors. He was loved and admired by all of the many who knew him and loved most by those who knew him best.

We quote from an editorial in the *Columbus Dispatch*, October 19, the day following Dr. Evans' death:

"When a man has written his record of accomplishment over as long a time and as clearly as Professor William Lloyd Evans did there remains little to say about him, except to point out, again, that it is men like this who give our community character and who inspire others to confident and consistent endeavor.

"Professor 'Billy' Evans was one of the immortals who over the years have now and then emerged on the campus, and it is a tribute to him that in his passing more people will be directly affected by the happy memories of their association with him than will consider his death simply as the demise of a scholarly leader in his field."

From the *Ohio State Journal*, Columbus, October 19:

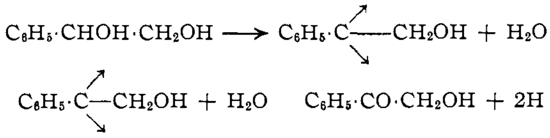
" 'Billy' Evans was one of the adornments of Ohio State University whose usefulness and influence will be reflected far beyond the generation of his youngest former student. His personality teamed up with his learning to make an inspiration for all who were fortunate enough to come into his presence."

All three of the Evans children were graduated from Ohio State University. Dr. Lloyd Robert Evans, who studied and received his M.D. degree at the Harvard Medical School, practices in Laramie, Wyoming. Jane Anne, Mrs. Alvin Nielsen, lives in Knoxville. William Arthur, the youngest, a brave and gentle-hearted gentleman, gave his life in the Great War, as a lieutenant, j.g., in the Navy. He was lost in the submarine Tullabee in the Pacific.

In the scientific work of Evans we can note the influence of his early training in precise analysis and of his association with Nef in studies on the reactivity of carbonyl and hydroxyl functions toward alkali and oxidizing agents. The personality of Nef was tremendous and he impressed his ideas of divalent carbon dissociation upon the minds of his students in no uncertain fashion. These students took a leading part in the development of graduate work in chemistry in the rising universities of the American midwest and in this Evans was no exception. Evans possessed a highly inspirational personality and was a great developer of young men. He held them to exacting standards in their experimental work.

With his first graduate student, Benjamin T. Brooks, Evans extended his Ph.D. dissertation work to *m*-nitrobenzoylcarbinol[2] noting that the introduction of the nitro group caused a greater sensitivity toward alkaline oxidizing agents. The predicated intermediate, *m*-nitrobenzoylformaldehyde, was prepared and its behavior toward alkali and alkaline oxidizing agents was studied with Witzemann.[3] Lou Helen Morgan[5] prepared phenyl-2,3-

ethanediol or styrolene alcohol and observed its behavior toward alkaline oxidizing agents. The results were interpreted on the basis of the methylene dissociation theory of Nef.



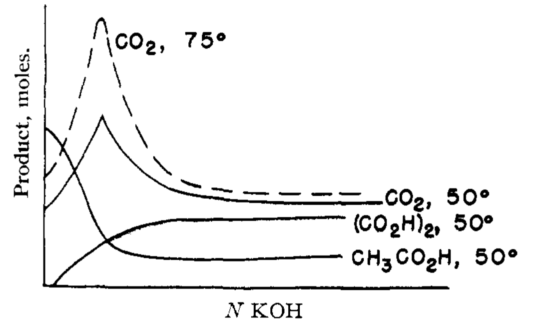
$$C_6H_5\cdot CHOH\cdot CH_2OH \longrightarrow C_6H_5\cdot\overset{\nearrow}{\underset{\searrow}{C}}—CH_2OH + H_2O$$

$$C_6H_5\cdot\overset{\nearrow}{\underset{\searrow}{C}}—CH_2OH + H_2O \quad C_6H_5\cdot CO\cdot CH_2OH + 2H$$

The possible intermediate oxidation product, mandelic aldehyde (C_6H_5–CHOH–CHO), was prepared, with C. R. Parkinson,[6] as its diethyl acetal but the aldehyde itself was shown to rearrange in water to benzoylcarbinol.

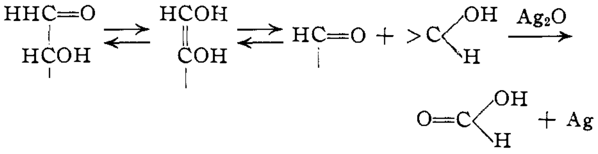
$$C_6H_5—CHOH—CHO \longrightarrow C_6H_5—CO—CH_2OH$$

In an attempt to prepare lactaldehyde by the oxidation of 2,3-propanediol with alkaline permanganate, Evans and Witzemann[4] found that the products were always carbonic, acetic and oxalic acids and that their relative amounts, accurately determined, were a function of the concentration of alkali. Pyruvic and lactic acids also were shown to yield these same final oxidation products. The results were again interpreted on the basis of the Nef methylene dissociation theory. This research was the first of a series of analytical studies on the distribution of the above three oxidation products as a function of alkali concentration and temperature. The methods were established with Jesse E. Day[7,9] and Homer Adkins[10] and the results were plotted in characteristic curves. Adkins also added an extensive, 2-page table—the first of many others to be found in the later publications of this distinguished investigator. The relatively simple substances so investigated were ethanol,[7,9] acetaldehyde, glycol, glycolaldehyde, glyoxal, glycolic and glyoxylic acids,[10] acetol (CH_3–CO–CH_2OH),[13] isopropyl alcohol,[14] acetone[15] and propylene glycol.[16] Potassium acetate was shown to be convertible, in small part, to potassium oxalate by alkaline permanganate.[12] In 1925, Evans published his first work concerned in its entirety with members of the carbohydrate group—which substances were to hold his first interests for the remainder of his active university career. These researches consisted of an extension to a number of the reducing sugars[18,19] and alditols[20] of the exact oxidation techniques mentioned above.



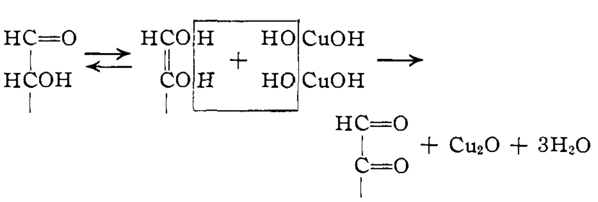
Oxidation of acetylethanol (acetol) with $KMnO_4$ (13).

Another oxidizing agent studied with the sugars and alditols was alkaline silver oxide.[39] With this reagent, its action in *N* alkali at 50° was selected as yielding the most reproducible results; the products determined as a function of time, were carbonic, oxalic, formic and glycolic acids. The reagent is unusual in that it does not attack a primary alcohol group. The formic acid production was correlated with oxidation at the 1,2-enediol.



$$\begin{matrix}HHC{=}O\\ |\\ HCOH\\ |\end{matrix} \rightleftarrows \begin{matrix}HCOH\\ \|\\ COH\\ |\end{matrix} \rightleftarrows \begin{matrix}HC{=}O\\ |\end{matrix} + {>}C\begin{matrix}\diagup OH\\ \diagdown H\end{matrix} \xrightarrow{Ag_2O} O{=}C\begin{matrix}\diagup OH\\ \diagdown H\end{matrix} + Ag$$

An excursion into the use of a mildly acid oxidizing agent was made by subjecting D-glucose, D-fructose and D-galactose to the action of a saturated solution of cupric acetate at 50° for long periods of time.[28] Here the product first formed was the hexosone which underwent further oxidation to yield carbonic, oxalic, formic and glyoxylic acids. With D-galactose, only the final products were obtained. The hexose 1,2-enediols were considered the source of the hexosones.

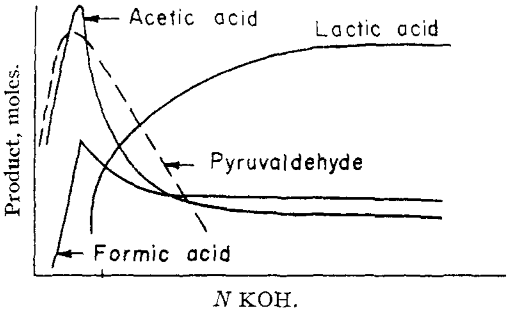


$$\begin{matrix}HC{=}O\\ |\\ HCOH\\ |\end{matrix} \rightleftarrows \boxed{\begin{matrix}HCO\\ \|\\ CO\\ |\end{matrix}\begin{matrix}H\\ \\ H\end{matrix} + \begin{matrix}HO\\ \\ HO\end{matrix}}\begin{matrix}CuOH\\ \\ CuOH\end{matrix} \longrightarrow \begin{matrix}HC{=}O\\ |\\ C{=}O\\ |\end{matrix} + Cu_2O + 3H_2O$$

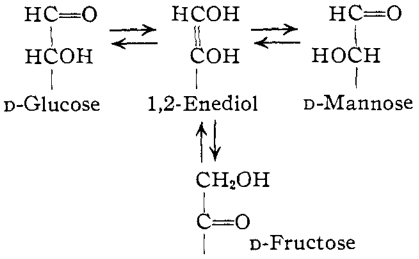
Evans[1] had shown that cupric acetate oxidized benzoylcarbinol to benzoylformaldehyde. This reaction was then extended[22] (C. E. Waring) to dihydroxyacetone and the triosone was isolated as a crystalline product considered to be a trimer.

Evans next turned his attention to an analytical study of the major products obtained by the action of strong alkali alone upon the reducing sugars. Classical work of a qualitative nature had been carried out previously along these lines by Lobry de Bruyn, Kiliani and Nef. These products were interpreted by the Nef postulations of intermediary enediols and their fragmentation. Earlier work along these lines with acetaldehyde[11] (C. D. Looker) and acetone[17] had been effected through studying their enolization in alkali by determining the amounts of products obtained, as a function of alkali concentration, on complexing the enols with mercuric salts, following an earlier observation of Nef, *Ann.*, **298**, 315 (1897), on the nature of these mercuric compounds. An initial critical alkalinity was required before the complex formed. With the sugars, the methods were established by Miss Rachel Edgar and G. Preston Hoff.[21] Pyruvaldehyde and lactic, acetic and formic acids were determined as a function of alkali concentration and temperature. Pyruvaldehyde was considered to originate in the scission of the hexose 3,4-enediol and was established as a precursor of lactic acid which was formed from it by a rearrangement of the benzilic acid type. The pyruvaldehyde was considered also to undergo scission to yield formic and acetic acids. The sugar 1,2-enediols were believed to be further sources of formic acid. These techniques were extended to DL-glyceraldehyde[23] (H. B.

Hass), dihydroxyacetone,[26] L-arabinose and D-xylose[31] (R. F. Conaway), D-fructose,[27] D-mannose,[29] D-fructose diphosphate[33] (R. C. Hockett), L-rhamnose.[36] Hydrazones of mono-*O*-acetyldihydroxyacetone were shown to be converted into osazones of pyruvaldehyde by merely refluxing in ethanol[46] (C. L. Bernier). At 75° the yields of products from D-glucose, D-mannose and D-fructose were essentially identical, a finding interpreted on the basis of their common alkaline interconversion.[27]

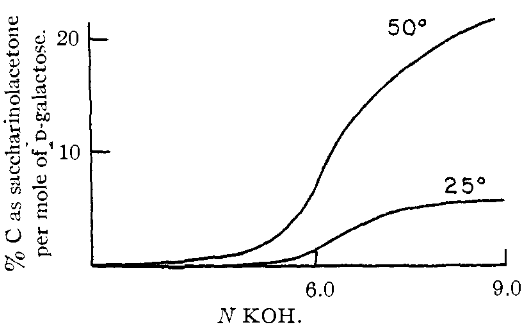


Dihydroxyacetone at 50° (26).



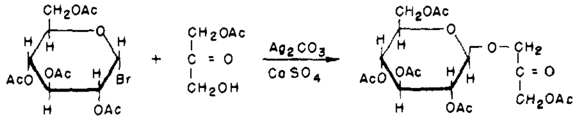
Interesting results were obtained with the disaccharides[30,34,35,44]; a (1 → 6)-linked disaccharide yielded twice as much lactic acid as did those linked (1 → 4). Some synthetic trisaccharides containing both types of linkages also were evaluated.[44,52] In strong alkali, the pentaacetates of *aldehydo*-D-glucose and *aldehydo*-D-galactose exhibited significantly higher lactic acid maxima than did their equivalent mixtures of hydrolytic components[48] (R. J. Plunkett).

Saccharinic acid formation was present in all of these alkali-treated sugar solutions. D-Galacto-α-metasaccharinolactone was isolated and determined in the D-galactose studies.[21] Evans and Benoy[21] postulated a correlation between saccharinic acid structure and enediol location wherein the 1,2-enediols would give rise to the "saccharinic" acids, the 2,3 to the *m*- and *p*-saccharinic acids, and the 3,4 to the iso-saccharinic acids. Evans and Hockett[33] pointed out that acetic acid could be considered as the saccharinic acid of glycolaldehyde and probably arose in part from this source in the alkaline solutions of the sugars.

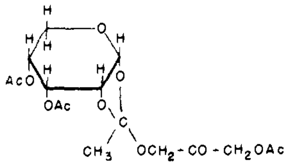


Saccharinic acid formation from D-galactose (21).

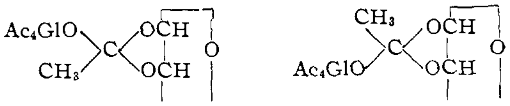
In considering the possible degradation products formed from the reducing disaccharides by strong alkali, Evans postulated a number of products which he synthesized in order to verify his postulations concerning their reactivity. Dihydroxyacetone monoacetate (H. O. L. Fischer, E. Baer and L. Feldman, *Ber.*, **63**, 1732 (1930)) was condensed with tetra-*O*-acetyl-α-D-glucopyranosyl bromide to form penta-*O*-acetyl-β-D-glucopyranosyl-(1→1)-dihydroxyacetone[38,41] (L. C. Kreider). Employment of an internal desiccant in this Königs–Knorr reaction considerably improved the yield. The corresponding acetates were prepared wherein the D-glucose unit was replaced by cellobiose and gentiobiose.[41] The lactic acid yields obtained from these substances and alkali[44] were found to be in agreement with the postulations predicated on the formation of double amounts of lactic acid from the (1 → 6)-linkages over those formed from the (1 → 4)-glycosidic unions.



The above work with Kreider,[38,41] an unusually fine experimentalist, initiated the phase of Evans' work wherein he was concerned with the synthesis of carbohydrate derivatives, mainly acetates of oligosaccharides. The synthesis of the pentose derivative described above was developed[40] to include the enantiomorphous forms of arabinose and xylose in its components and to thus produce the first, and still presently the only, known pairs of enantiomorphous disaccharide derivatives, one of which (containing arabinose) was described in its racemic form. When tetra-*O*-acetyl-β-D-ribopyranosyl bromide, or its enantiomorph, was employed in the reaction, an orthoester structure was produced.[50]



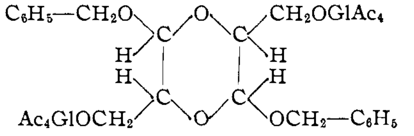
A new type of carbohydrate orthoester, in two diastereoisomeric forms ([α]D +17° and −28° in chloroform), was recorded by Talley, Reynolds and Evans[57] on treating penta-*O*-acetyl-α-D-mannopyranosyl bromide with β-D-glucopyranose 1,2,3,4-tetraacetate. The normal glycosidic derivative

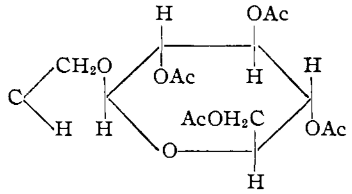


also was described as was the corresponding normal octaacetate containing two D-mannopyranose units.

The classical gentiobiose synthesis of Helferich and Klein, *Ann.*, **450**, 219 (1926), was improved[47] and its 2-epimer was prepared in crystalline form[45] (Hyp J. Dauben, Jr.) through the glycol oxidation method of Bergmann and Schotte (*Ber.*, **54**, 440 (1921)) and by the reaction between tetra-*O*-acetyl-α-D-glucopyranosyl bromide and α- and β-D-mannopyranose 1,2,3,4-tetraacetate.[51] A series of seven trisaccharide hendecaacetates was synthesized by the reaction of a disaccharide (cellobiose, maltose, gentiobiose, 2-epigentiobiose) acetohalogen compound with the 1,2,3,4-tetraacetates of D-glucopyranose and D-mannopyranose.[51,52,56]

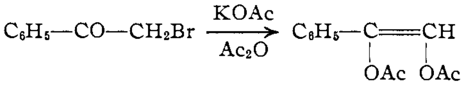
Dimeric DL-glyceraldehyde benzyl glycoside was treated with tetra-*O*-acetyl-α-D-glucopyranosyl bromide and with tri-*O*-β-L-arabinopyranosyl bromide to yield the crystalline acetates of the corresponding disaccharide glycosides[42] (H. W. Arnold). They[43] also recorded the diethyl thioacetal of DL-glyceraldehyde, characterized as the crystalline triphenylmethyl ether and triphenylmethyl ether monoacetate. The thioacetal diacetate then was converted to the sirupy *aldehydo*-DL-glyceraldehyde diacetate.





Ruff (*Ber.*, **35**, 2362 (1902)) had recorded the isolation, as its crystalline diethyl thioacetal, of the methyltetrose obtained on the degradation of calcium L-rhamnonate with hydrogen peroxide and ferrous ion. This substance was prepared by Swan[37] and converted to the methyl α-L-glycoside with mercuric chloride in methanol (general method of E. Pacsu, *Ber.*, **58**, 511 (1925)). The furanoside nature of the glycoside was established by methylation and oxidation to dimethoxy-L-(+)-succinic acid (diamide) according to the technique of Hirst (*J. Chem. Soc.*, 350 (1926)). The anomeric furanose forms of β-D-glucopyranosyl-(1→5)-D-arabinose heptaacetate were obtained[55] (MacDonald) by the Wohl degradation of gentiobiose. The dimorphous nature of sucrose octaacetate was detailed.[53]

An interesting return of Evans to his first interest, benzoylcarbinol,[1] was the synthesis of its enediol diacetate from ω-bromoacetophenone[54] (with William G. Dauben and R. I. Meltzer) through the general reaction established by Barnes and Tulane (THIS JOURNAL, **62**, 894 (1940)).



$$C_6H_5—CO—CH_2Br \xrightarrow[Ac_2O]{KOAc} C_6H_5—\underset{OAc}{C}=\underset{OAc}{CH}$$

b.p. 119°/(2 mm.)

An interest of Evans in the paint industry, in which he held a continuous consultantship since 1924, is reflected in four research publications on drying oils.[24,25,32,49]

MELVILLE L. WOLFROM
EDWARD MACK, JR.

PUBLICATIONS OF WILLIAM LLOYD EVANS

(1) On the Behavior of Benzoyl Carbinol Towards Alkalies and Oxidizing Agents, *Am. Chem. J.*, **35**, 115 (1906).

(2) On the Oxidation of Meta-Nitrobenzoyl Carbinol, with Benjamin T. Brooks, THIS JOURNAL, **30**, 404 (1908).

(3) The Oxidation of Meta-Nitrobenzoylformaldehyde, with E. J. Witzemann, THIS JOURNAL, **33**, 1772 (1911).

(4) The Oxidation of Propyleneglycol. I. The Action of Alkaline Potassium Permanganate Giving Carbonic, Acetic and Oxalic Acids, with E. J. Witzemann, THIS JOURNAL, **34**, 1086 (1912).

(5) The Preparation and the Oxidation of Styrolene Alcohol, with Lou Helen Morgan, THIS JOURNAL, **35**, 54 (1913).

(6) The Existence of Mandelic Aldehyde in Aqueous Solution, with C. R. Parkinson, THIS JOURNAL, **35**, 1770 (1913).

(7) The Oxidation of Ethyl Alcohol by Means of Potassium Permanganate, with J. E. Day, THIS JOURNAL, **38**, 375 (1916).

(8) A Comparison of Phenylhydrazine Oxalate with Mesoxalic Acid Phenylhydrazone, with W. L. Mong and F. L. Sinks, THIS JOURNAL, **39**, 1724 (1917).

(9) The Oxidation of Ethyl Alcohol by Means of Potassium Permanganate, with J. E. Day, THIS JOURNAL, **41**, 1267 (1919).

(10) The Oxidation of Organic Compounds with Alkaline Potassium Permanganate, with H. Adkins, THIS JOURNAL, **41**, 1385 (1919).

(11) The Influence of Potassium Hydroxide on the Formation of Vinyl Alcohol from Acetaldehyde, with C. D. Looker, THIS JOURNAL, **43**, 1925 (1921).

(12) The Oxidation of Potassium Acetate to Potassium Oxalate, with P. R. Hines, THIS JOURNAL, **44**, 1543 (1922).

(13) The Oxidation of Acetol with Potassium Permanganate, with O. L. Hoover, THIS JOURNAL, **44**, 1730 (1922).

(14) The Oxidation of Isopropyl Alcohol with Potassium Permanganate, with Lily Bell Sefton, THIS JOURNAL, **44**, 2271 (1922).

(15) The Oxidation of Acetone with Potassium Permanganate, with Lily Bell Sefton, THIS JOURNAL, **44**, 2276 (1922).

(16) The Oxidation of Propylene Glycol with Potassium Permanganate, THIS JOURNAL, **45**, 171 (1923).

(17) The Acetone–Isoacetone Equilibrium, with W. D. Nicoll, THIS JOURNAL, **47**, 2789 (1925).

(18) The Mechanism of Carbohydrate Oxidation. I. *d*-Glucose, *d*-Mannose, *d*-Fructose, *d*- and *l*-Arabinose and *dl*-Glyceric Aldehyde, with C. A. Buehler, C. D. Looker, R. A. Crawford and C. W. Holl, THIS JOURNAL, **47**, 3085 (1925).

(19) The Mechanism of Carbohydrate Oxidation. II. The Oxidation of *d*-Galactose, with C. A. Buehler, THIS JOURNAL, **47**, 3098 (1925).

(20) The Mechanism of Carbohydrate Oxidation. III. The Oxidation of the Hexitols *d*-Mannitol, *d*-Sorbitol and Dulcitol, with C. W. Holl, THIS JOURNAL, **47**, 3102 (1925).

(21) The Mechanism of Carbohydrate Oxidation. IV. The Action of Potassium Hydroxide on *d*-Glucose and *d*-Galactose, with Rachel H. Edgar and G. P. Hoff, THIS JOURNAL, **48**, 2665 (1926).

(22) The Mechanism of Carbohydrate Oxidation. V. The Oxidation of Dihydroxyacetone to Hydroxypyruvic Aldehyde, with C. E. Waring, THIS JOURNAL, **48**, 2678 (1926).

(23) The Mechanism of Carbohydrate Oxidation. VI. The Action of Potassium Hydroxide on *dl*-Glyceric Aldehyde, with H. B. Hass, This Journal, **48**, 2703 (1926).

(24) Relationship during Drying between the Acid Value of Linseed Oil and the Concentration of Cobalt Acetate, with P. E. Marling and S. E. Lower, *Ind. Eng. Chem.*, **18**, 1229 (1926).

(25) Chemical Mechanism of Linseed Oil Drying, with P. E. Marling and S. E. Lower, *Ind. Eng. Chem.*, **19**, 640 (1927).

(26) The Mechanism of Carbohydrate Oxidation. VII. The Action of Potassium Hydroxide on Dihydroxyacetone, with W. R. Cornthwaite, This Journal, **50**, 485 (1928).

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