

CONTENTS

TECHNOLOGY

14. Occurrence and Mining, by <i>J. R. Van Wazer</i>	
Amount of Phosphorus in the Earth and in the Universe.....	955
Mineralogy of Phosphorus.....	957
Genesis of Phosphate Deposits.....	958
Occurrence of Phosphorus in the Air and in Natural Waters.....	960
Principal Types of Deposits.....	961
Ore Reserves and Production Figures.....	967
Possible Depletion and Ore Analyses.....	970
History of Phosphate Mining in the U.S.A.....	973
The Florida Fields.....	974
The Tennessee Fields.....	979
Western Fields.....	980
French North African Fields.....	982
Russian Phosphates.....	982
By-Product Uranium.....	983
By-Product Fluorine.....	984
By-Product Vanadium.....	985
15. Utilization and Economics of Phosphorus and Its Compounds, by <i>P. Logue</i>	
History.....	987
General Survey.....	989
Phosphorus-Based Products in Commerce.....	989
Applications in Various Industries.....	1006
Functional Properties.....	1018
16. Wet-Process Phosphoric Acid, by <i>H. M. Stevens</i>	
Introduction.....	1025
History.....	1026
Wet-Acid Process Details.....	1028
Sodium Phosphates from Wet Acid.....	1052
Use of Leached-Zone (Aluminum Phosphate) Ore.....	1056
Novel Processes for Phosphates and Pure Acid.....	1058
Economics.....	1066
17. Fertilizer Manufacture, by <i>J. H. Payne, Jr.</i>	
History.....	1071
Fertilizer Terminology.....	1073
Superphosphate Manufacture.....	1076
High-Temperature Phosphates.....	1088
Ammonium Phosphates.....	1098
Mixed Dry Fertilizers.....	1105

Nitric Phosphates.....	1130
Liquid Fertilizers.....	1134
Weight and Freight.....	1144
18. Manufacture of Elemental Phosphorus and Its Major Inorganic Derivatives, by <i>T. L. Hurst</i>	
History of Elemental Phosphorus.....	1149
Electric-Furnace Process for Phosphorus.....	1160
Manufacture of Phosphoric Acid from Phosphorus.....	1209
Manufacture of Phosphate Salts.....	1213
19. Manufacture of Phosphate Esters and Organic Phosphorus Compounds, by <i>D. H. Chadwick and R. S. Watt</i>	
History.....	1221
Alkyl and Aryl Phosphoryl Chlorides.....	1223
Partial Esters of Phosphoric Acid.....	1226
Triaryl Phosphates.....	1231
Alkyl Aryl Phosphates.....	1239
Trialkyl Phosphates.....	1243
Other Phosphate Derivatives.....	1252
Thiophosphates.....	1257
Dithiophosphates.....	1262
Esters of Phosphorous Acid.....	1267
Products Containing a Carbon-to-Phosphorus Bond.....	1272
BIOLOGICAL FUNCTIONS	
20. Phosphates in Life Processes, by <i>B. J. Katchman</i>	
Brief History.....	1282
Phosphorus in Nature.....	1283
Photosynthesis and Metabolism.....	1296
21. Phosphates in Biological Macromolecular Syntheses and Energy Mechanisms, by <i>B. J. Katchman</i>	
Phosphates in Genetic Materials and Replication.....	1345
Group-Transfer Agents.....	1383
Energy Processes in Biological Systems.....	1400
General Rationale.....	1418
22. Mineralized Tissues, by <i>A. S. Posner</i>	
Bone and Tooth Morphology.....	1430
Structure Studies.....	1435
Mechanism of Mineralization.....	1442
Pathology of Mineral Tissue.....	1453

APPLICATIONS

23. Plant Nutrition and the Utilization of Fertilizer Phosphorus, by <i>K. Lawton</i>	
Phosphorus in Plant Tissues.....	1462
Foliar Absorption and Desorption.....	1467
Phosphorus Uptake.....	1470
Symptoms of Phosphorus Deficiency.....	1481
Phosphorus in the Soil.....	1487
Various Phosphorus Fertilizers.....	1496
Factors Affecting Fertilizer Availability.....	1518
Methods of Fertilizer Placement.....	1525
Effects of Nitrogen, Lime, and Soil on Phosphate Fertilizers.....	1534
Long-Term Fertilizer Effects.....	1541
Future Developments.....	1542
24. Animal Nutrition and Phosphates in Feeds, by <i>J. Kastelic and R. M. Forbes</i>	
Introduction.....	1547
The Availability of Phosphorus in Plant Materials to Various Species of Animals.....	1549
Phosphorus Requirements and Utilization by Farm Animals.....	1560
Phosphorus Requirements of Other Animals.....	1580
Concluding Remarks on Requirement and Availability Studies.....	1592
Commercial Considerations.....	1597
25. Food and Dentifrice Applications, by <i>J. R. Van Wazer</i>	
History.....	1601
Phosphates in Foods.....	1604
Chemical Leavening.....	1604
Other Food Applications.....	1631
Dentifrice Polishing Agents.....	1644
26. Action of Phosphates on Finely Divided Solids, by <i>J. W. Lyons</i>	
Considerations from Colloid Theory.....	1656
Theory for Kaolin and the Phosphate Deflocculants.....	1674
Industrial Applications.....	1685
Deflocculation of Raw Slurry in Cement Manufacture.....	1689
Phosphates in Kaolin Processing and Use.....	1698
Oil Well Drilling Muds.....	1709
Pigments.....	1715
Soils and Mineral Ores.....	1720
Other Promising Areas.....	1728
27. Detergent Building, by <i>J. C. Harris and J. R. Van Wazer</i>	
The Cleaning Process.....	1732
The Building Function.....	1744
Building of Synthetic Actives.....	1759
Built Soaps.....	1763
Miscellaneous Applications.....	1771

28. Hard-Surface Cleaning and Water Treatment, by <i>J. C. Harris</i>	
Hard-Surface Cleaning.....	1775
Abrasive Cleaners.....	1787
Dairy Cleaning.....	1788
Dish and Bottle Washing.....	1790
Cleaning of Floors and Walls.....	1795
Miscellaneous Hard-Surface Cleaners and Water Softeners.....	1796
Water Softening.....	1797
Phosphates for Water Softening.....	1803
Threshold Treatment and Water Conditioning.....	1809
Miscellaneous Related Applications.....	1816
29. Phosphorus in Metallurgy, by <i>J. W. Spretnak</i>	
Alloying Characteristics of Phosphorus with Metals.....	1823
Phosphorus in Copper and Copper Alloys.....	1826
Phosphorus in Iron and Steel.....	1834
30. Surface Treatment of Metals, by <i>J. R. Van Wazer</i>	
History.....	1857
Phosphatizing Metal Surfaces.....	1859
Chemical Polishing and Brightening.....	1880
Electropolishing.....	1885
"Electroless" Plating of Nickel.....	1888
31. Uses of Organic Phosphorus Compounds, by <i>E. B. Fisher</i> (deceased) and <i>J. R. Van Wazer</i>	
Plastics Applications.....	1897
Petroleum Additives and Functional Fluids.....	1909
Biocidal Applications.....	1918
Miscellaneous Uses.....	1929
32. Miscellaneous Applications, by <i>J. R. Van Wazer</i>	
Phosphate Parting Agents.....	1937
Pyrotechnics and Incendiaries.....	1941
Phosphorus Compounds as Catalysts (including Fireproofing).....	1945
Phosphates as Phosphors.....	1956
Appendix A. Patents on Water Softening and Conditioning.....	1962
Appendix B. Patents on Phosphates in Detergents.....	1970
Appendix C. Patents on Phosphates in Cleaning Compositions.....	1990
Appendix D. Patents on Phosphates in Bleaches and Sanitizers.....	2007
Index.....	2013