An Einstein four-dimensional manifold, defining a permanent gravitational field, can never be regarded as immersed in a flat space of five dimensions.

This applies in particular to the solar field (defined say by the Schwarzschild form), in which the earth and the other planets are moving. The appropriate value of n must therefore be greater than 5 and less than 11. A brief discussion shows that actually $n = 6$. Therefore:

The solar gravitational field can be represented by a curved manifold of four dimensions situated in a flat space of six dimensions.

This manifold can be written in finite form and gives what may be called a *geometric model* of the field in which we are living.

The proofs of these theorems and the actual equation of this model are appearing in current numbers of the *American Journal of Mathematics,* together with the full discussion of the general results connecting light rays and orbits in any field stated in SCIENCE, October 29, 1920, pp. 413–414.

EDWARD KASNER

COLUMBIA UNIVERSITY

THE AMERICAN CHEMICAL SOCIETY

(Continued)

FERTILIZER DIVISION

F. B. Carpenter, *chairman*
H. C. Moore, *secretary*

Kelp as a basis of an American potash industry: J. W. TURRENTINE.

Relationships of chemistry and the fertilizer industry: C. H. MACDOWELL.

A perfect fertilizer law: E. G. PROULX.

Boron in relation to the fertilizer industry: J. E. BRECKENRIDGE.

The quantitative estimation of borax in mixed fertilizers: J. M. BARTLETT.

Note on the determination of nitrogen in fertilizers containing both organic and nitric nitrogen: F. B. CARPENTER. Notwithstanding the fact that the modified Kjeldahl and Gunning methods have been in use for a number of years, the results obtained by these methods in the hands of different analysts on samples containing mixtures of organic and nitric nitrogen are far from satisfactory. This is probably largely due to a wrong interpretation of the official method. From the standpoint of the manufacturer this is quite a serious matter and it seems desirable that the Association of Official Agricultural Chemists should take such action as is necessary to modify or at least change the reading of the modified methods so that there may be no misunderstanding of how they should be carried out.

Dicyanodiamide. A rapid, direct method for its determination in cyanamid and mixed fertilizers: ROLLA N. HARGER, presented by Oswald Schreiner. The method depends upon the fact that when a solution of silver picrate is added to a solution of dicyanodiamide, the latter is quantitatively precipitated as a double compound of silver picrate and dicyanodiamide, $C_6H_2(NO_2)_3OAG$, $C_2H_4N_4$. This new double compound we have named silver picrate-mono-cyanoguanidine. It forms in small crystals which quickly settle out of the solution and can be separated upon a Gooch crucible very rapidly, so that the analysis can be carried out in a very short time. Neither cyanide nor urea give any precipitate when their solutions are treated with silver picrate, and determinations of dicyanodiamide carried out in the presence of these compounds showed that they have no effect upon the analysis. The molar weight of the compound is 420.22, five (4.991) times that of dicyanodiamide, a fact which greatly enhances the accuracy of the method, since an error of 1 mg. in the precipitate weighed will mean an error of only 0.2 mg. of dicyanodiamide or 0.13+ mg. of nitrogen.

The changes taking place in cyanamid when used in mixed fertilizers: ROLLA N. HARGER, presented by Oswald Schreiner. (1) When cyanamid is placed in a mixed fertilizer containing acid phosphate and 5–10 per cent. of moisture, the cyanamide content decreases with great rapidity. (2) This change is represented principally by, and in many cases quantitatively by, the formation of dicyanodiamide. (3) A given quantity of moist acid phosphate is able to transform a limited amount of calcium cyanamid. (4) Cyanamid is not affected by dry acid phosphate. (5) Moisture alone is able to cause the conversion of cyanamid to dicyanodiamid, but the change is much slower than when acid phosphate is present. Since it has been repeatedly shown that dicyanodiamid is valueless as a fertilizer material and, moreover, is toxic to many plants, the formation of this compound in fertilizer materials seems undesirable. From the results of this study it would seem that the method of applying cyanamid, commonly employed, which consists in adding the cyanamid to fertilizer mixtures containing acid phosphate, which mixtures almost always contain several per cent. of moisture, is a very questionable practise. Moreover, the use of cyanamid as a "conditioner" for "green" acid phosphate is very probably at the expense of most of the nitrogen in the cyanamid. On first thought it would appear that this conversion of cyanamid into dicyanodiamide could be avoided by simply employing dry fertilizer mixtures, but this overlooks the fact that when such mixtures are added to the soil moisture conditions are at once provided and the transformation may possibly then take place. Preliminary experiments carried out in this laboratory indicate that under certain conditions at least this is the case.

Some results of the determination of potash by the Lindo-Gladding method, using alcohol of various strengths in the presence of sodium salts: R. D. Caldwell and H. C. Moore. When potash is determined by the official method of the A. O. A. C. but slightly lower results are obtained when 80 per cent. alcohol is used than when 92 or 95 per cent. is used in case of sample of pure potassium chloride, but when sodium chloride or sulfate is added the results with 80 per cent. alcohol are lower. Tests with a sample of potassium platinic chloride showed it to be but slightly soluble in 80 per cent. alcohol alone, but the solubility increases with the increase of sodium salts added but with 95 per cent. alcohol sodium salts have no effect.

Injurious effects of borax on field crops: F. B. Carpenter. It has long been known that certain chemical substances are poisonous to plant life. While certain compounds of copper, zinc and arsenic are exceedingly poisonous, compounds of manganese and boron are far less deleterious. Most of the experiments which have been made with these compounds have been made on plants grown in pots or water cultures; in case of borax, however, considerable knowledge has been gained during the past few years on field crops from the use of Searles Lake potash, which contained an excessive amount of this compound. The first large scale borax poisoning in this country occurred in Indiana in 1917 on corn. In 1919 considerable damage was reported on potatoes and tobacco in different localities. Many conflicting reports were made in regard to amount of borax required to produce injury. While in some instances as little as two pounds per acre has been reported to have slightly injurious effects, one report was noted where as much as 400 pounds per acre was used with apparently no bad results. Experiments made by the writer on corn, beans, cotton, Irish potatoes, sweet potatoes and tobacco showed no bad effects where 8 pounds anhydrous borax per acre were used, but there was slight injury with sixteen pounds. It is evident, therefore, that the character of soil, amount and time of rainfall, the manner of application, etc., influence to a large degree the amount of borax which can be used without poisonous effect.

The "blank" in the Kjeldahl process; its analytical and commercial significance: B. F. Robertson.

Potash shales of Illinois: M. M. Austin and S. W. Parr. (1) Shales occur in at least two localities in Illinois which contain five per cent. or more of potash. (2) Shale outcropping in several places near Jonesboro in Union County which contain five per cent. of potash would be suitable, so far as can be determined from its chemical composition and physical character, for use in the manufacture of Portland cement. (3) By using this material in the manufacture of cement and by applying the known methods of potash recovery, a yield of 5.3 pounds of potash, representing a value of 70 to 80 cents per barrel of cement could be obtained. (4) The constitution of the southern Illinois shale is complex. The shale contains free oil, bituminous matter, pyrite, undecomposed potassium bearing rock, feldspathic in character and potassium bearing material of the nature of glauconite or greensand. (5) Shale from Dixon, Lee County, contains 5.8 per cent. of potash which is held for the most part in a more stable condition than that in the southern Illinois shale. (6) Extraction of the potassium from shale of either the southern Illinois or Dixon type by means of solid or liquid reagents would seem to be impracticable, because of the incomplete reaction of these reagents on the shale and because of the cost of leaching and recovering potash from material where it is present in such small amounts. (7) The plant availability of the potash in the southern Illinois shale is probably characteristic of all of the material of this type outcropping in that locality. (8) That part of the potassium in the southern Illinois shale which is soluble in sulphuric acid, is shown to be in a combination of the glauconite type. (9) In southern Illinois shale having a potash content of 5.0 per cent. in the raw condition or 5.6 per cent. when ignited, 62 per cent. of the total potash is glauconitic in character and is available as plant food.

Potash situation in Germany: H. A. Huston.

RUBBER DIVISION

W. K. Lewis, *chairman*

Arnold H. Smith, *secretary*

Reports.

Discussion: Shall the Rubber Division publish an annual volume of reprints and lengthy abstracts of everything of interest to the rubber chemist made public during the year?

Election of officers.

Rubber energy: W. B. WIEGAND. (Lantern.)

The aging of some rubber compounds: New Jersey Zinc Co. Research Laboratories. (Lantern.)

Some microsections cut from vulcanized rubber articles: New Jersey Zinc Co. Research Laboratories. (Lantern.)

The action of certain organic accelerators in the vulcanization of rubber. II.: G. D. KRATZ, A. H. FLOWER and B. J. SHAPIRO. The relative activities of molecularly equivalent amounts of aniline and diphenylthiourea in the acceleration of vulcanization were compared in rubber-sulfur mixtures and in mixtures which contained zinc oxide. In a rubber-sulfur mixture the activity of aniline was found to be much greater than that of diphenylthiourea. In mixtures which contained zinc oxide, the reverse was true. With aniline as the accelerator, either in the presence or absence of zinc oxide, the same maximum tensile strength was obtained, accompanied by a higher sulfur coefficient in the absence of zinc oxide than when this substance was present. The mixtures which contained zinc oxide, attained the same maximum tensile strengths at approximately the same sulfur coefficients, irrespective of whether aniline or diphenylthiourea was employed as the accelerator. It is evident that there is apparently no general relation between the physical properties and sulfur coefficients of accelerated mixtures.

The action of certain organic accelerators in the vulcanization of rubber. (*II.*): G. D. KRATZ, A. H. FLOWER and B. J. SHAPIRO. The activities of certain synthetic, nitrogenous organic accelerators, in a mixture of rubber and sulfur, were compared with the dissociation constants of the original substances. With the exception of members of a closely related series, no definite relation was found to exist between the activities of the substances as accelerators and their dissociation constants. Substances which decompose, or react, with other components of the mixture to form substances of acid character do not accelerate unless a neutralizing base, or salt, is present. The results obtained, and the conclusions drawn from them, compare favorably with other results obtained with ammonium salts.

Method for the determination of free sulfur and antimony tri- and penta-sulfides in golden antimony: J. F. SCHUFTER.

The action of heat and light on vulcanized rubber: J. B. TUTTLE. The action of heat and light on vulcanized rubber is frequently spoken of as being identical and oxidation is said to be the cause of the deterioration. From published and unpublished tests it is shown that the action of heat is one of change in the rate of the chemical reaction between rubber and sulfur and goes on throughout the entire mass, whereas the action of light is one of oxidation, taking place on the surface. Heat produces no change in the solubility of the rubber substance in solvents such as acetone and alcohol, whereas light breaks up the rubber molecule forming decomposition products which are readily soluble in acetone.

A theory of vulcanization based on the formation of polysulphides during vulcanization: WINFIELD SCOTT and C. W. BEDFORD. All organic accelerators and a number of inorganic accelerators function as catalysts of vulcanization through the formation of polysulphides. These accelerators may be placed into two classes: (1) Hydrogen sulphide polysulphide accelerators. Organic bases are believed to form polysulphides by the aid of hydrogen sulphide. Examples are piperidene and dimethylamine which form polysulphides in the presence of hydrogen sulphide and sulphur. Inorganic bases, such as sodium hydroxide, calcium hydrate, magnesium oxide and basic magnesium carbonate, function in the same manner as the above. (2) Carbo-sulph-hydrol polysulphide accelerators. Thio ureas and dithiocarbamates are believed to form some type of polysulphides through the grouping C-SH. Differentiated from the above two classes of accelerators are such accelerators as zinc oxide and litharge which do not form polysulphides. These are termed "secondary accelerators" owing to the fact that they decompose polysulphides to give active sulphur.

DIVISION OF WATER, SEWAGE AND SANITATION

J. W. Ellms, *chairman*

W. W. Skinner, *secretary*

Water softening for the manufacture of raw water ice: A. S. BEHRMAN. The manufacture of ice from distilled water is rapidly being replaced by production of ice from raw water, due principally to cheap dependable power and water softening. The requisite characteristics of first quality ice are clearness, firmness and freedom from discoloration. In freezing water, by far the greatest part of the substances dissolved in it freeze out in the ice produced. Ice made from impure water is opaque, discolored and brittle, depending on the nature of the impurities. Lime-soda softening, followed by sand filtration, is the most efficient purification of raw water to be frozen. The most objectionable impurities are compounds of magnesium, calcium and iron, organic matter, silica and alumina, and sodium salts. Softening with lime eliminates temporary hardness, magnesium and iron, and reduces organic matter, silica and alumina. Recent investigations indicate that soda may be omitted from treatment, as removal of permanent hardness appears to be unimportant if all of magnesium is replaced by calcium. Temporary hardness is particularly objectionable, causing gritty white sediments in center of cake, white deposits in clear ice, weak structure, and probably crackings and also necessitates one or more core pumpings. Zeolite softening of the raw water has been shown to be unsuitable for ice making, due to the relatively large quantity of sodium salts which it leaves in the treated water to retard freezing and form deposits, to the fact that bicarbonates, which are in some manner connected with cracking, are not removed, and to the nonremoval of iron, organic matter, alumina and silica.

Specifications for glassware for waterworks laboratories: Harry E. Jordan.

Hardness of surface waters in the United States: W. D. Collins.

The new sewage testing station of the Illinois State Water Survey Division: Edward Bartow. With the cooperation and assistance of the Sanitary Districts in Illinois, The State Water Survey Division has started again the sewage testing station that was operated from 1914–17 and in which work was practically discontinued during the war. It is proposed to test all processes of sewage disposal that may be applicable to Illinois conditions, as time and funds permit. The first test will be of the Dorr-Peck modification of the activated sludge process, which will be tested from raw sewage to clarified effluent and to dried sludge.

Charles L. Parsons,
Secretary

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SECTION E—GEOLOGY AND GEOGRAPHY

Section E of the American Association for the Advancement of Science held its sessions this year in conjunction with the Geological Society of America and the Association of American Geographers, in Rosenwald Hall of the University of Chicago, from December 28 to January 1. In accordance with the agreement whereby the affiliated societies take charge of the program whenever they meet jointly with Section E, the Section had no program of its own. The address of the retiring vice-president, Dr. Charles Kenneth Leith, of the University of Wisconsin, upon the subject, "The structural failure of the lithosphere," was delivered on the evening of December 28 at the annual smoker of the Geological Society of America. It has been published in Science. The papers of the general sessions will appear in the *Bulletin of the Geological Society of America,* Vol. 32, and in the *Annals of the Association of American Geographers,* Vol. 11.

At the regular meeting of the Sectional Committee the following were nominated for sectional officers:

Vice-president and Chairman of the Section, Dr. Willet G. Miller, director of the Ontario Bureau of Mines.

Secretary for 4 Years, Dr. Elwood S. Moore, Pennsylvania State College.

The election of a committee member was not required this year.

Rollin T. Chamberlin,
Secretary

SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter