ity of the ova would be properly inhibited but occasionally an ovum would fail to respond because of some peculiarity in its organization. Suppose that such peculiarities are due to local factors appearing with a frequency of $1/n$. Then the chance that two such independent local factors will act at the same time and thereby cause the simultaneous discharge of two supernumerary ova is $1/n^2$.

2. *Monozygotic Twins and Triplets.*—Normally a single embryonic area appears in the blastodermic vesicle and through some coordinating mechanism inhibits the formation of additional embryonic areas. Suppose that once in n cases a cell or group of cells acquires physiological independence as the result of an intrinsic factor and forms a second embryonic area. The chance that two such cells or groups of cells will arise at the same time is once in n squared if it is supposed as in the previous case that the two events are independent of each other.

In order that the stated numerical relations may ensue, the important consideration in either mode of origin of multiple births is the independence of the two events which give rise to triplets. If, in the fluctuations of the general physiological state of the mother, the condition is sometimes such as to result in twins and sometimes in triplets, it is hard to see why the " square " relation should exist. For instance if it is postulated that additional ova are stimulated to complete the maturation process as a result of an unusual amount of an internal secretion and that the number of extra ova depends on the quantity of the secretion there is no reason for expecting the observed relation between one extra and two extra embryos. This difficulty seems to apply to all general agents that may be postulated as acting upon the ovaries as a whole in the cases of multiple ovulation or upon the developing embryo as a whole in the case of monozygotic twins and triplets. If, however, each supernumerary ovum is due to an independent local action and such local actions have a certain average frequency the coincidence of two such actions would give the observed numerical relation of triplets to twins.

If the explanation as stated applies to the relation between triplet and twin births it is to be expected that it will apply to quadruplets as well. In that case the expected number of quadruplets is one in n^3. Unfortunately the numbers are too small for a reliable conclusion. In the largest available collection of data, the one mentioned above, there are 36 quadruplets in 13,360,557 births or one in $(71.9)^3$ which is somewhat greater than the expected number, one in $(89.1)^3$.

As in other statistical relations the biological significance in the present instance can not be proved directly from the mass of data. When one considers the vicissitudes of fertilization, the chances of death of individual embryos, the demonstrated influence of the spermatozoon in certain cases of twinning and numerous other biological factors, to say nothing of faulty registration statistics, it is hard to believe that the simple numerical relation of triplets to twins can be more than the result of the combination of numerous and as yet unanalyzed forces. A knowledge of the fact may, however, aid in the analysis.

CHARLES ZELENY

UNIVERSITY OF ILLINOIS

THE AMERICAN CHEMICAL SOCIETY

SECTION OF SUGAR CHEMISTRY

C. A. Browne, *chairman*

Fred. J. Bates, *secretary*

(*Concluded*)

The sugar industry of Peru: CHAS. A. GAMBLE.

Electric oven for rapid moisture tests: G. L. SPENCER. This oven (patented August 3, 1920) is a convenient arrangement for passing a rapid current of heated air through a sample. The air is drawn over a heating element, composed of a spiraled nichrome wire coiled around a suitable core, and thence through the sample contained in a capsule, fitted with a gauze or metal filter-cloth bottom. The temperature of the air is controlled by a rheostat. Any substance through which a current of hot air may be passed, without melting, may be dried in this oven. Raw sugar may be approximately dried in 3 minutes and to constant weight in 10 minutes; 100 gram samples of cane bagasse are dried in less than 60 minutes; cotton saturated with water is dried in 10 minutes.

Refining raw sugars without boneblack: C. E. COATES. Raw sugars from the tropics have been refined off and on in Louisiana for a number of years. This was profitable on occasions when the margin between raws and granulated was high. During the past two years this margin has been so high as to offer exceptional profits to the refiner. A number of Louisiana sugar houses purchased raw sugars during the last six months and refined them by several different methods: Phosphoric acid and lime; sulphur-dioxide and lime; filtercel alone; activated wood charcoals. At the beginning of the campaign, the yields were several per cent. below those obtained in the standard bone black refinery process, but as the season went on this difference was diminished until at the present time the yield is about one per cent. short of good refinery practise. The yields by the various methods are nearly the same. There is no reason why melting tropical raw sugars can not become a part of the routine practise in both cane and beet sugar houses. The quality of the sugars obtained is excellent and in the case of the activated charcoals the sugars were beyond any criticism of any sort.

Recent advances in defecation: W. D. HORNE. The Dorr Clarifier has been devised to remove the insoluble impurities from cane juice. Hot limed juice continuously enters the central well of the superimposed settling compartment equipped with slowly revolving scraper mechanisms. Clear juice flows from the periphery, and a thick mud is constantly withdrawn from the bottom. The Williamson Clarifier aerates a warm defecated raw sugar solution and then passes it through a long shallow heating tank provided with suitable baffles, causing all insoluble matters to rise in a scum, which is mechanically skimmed off, while clear liquor is continuously syphoned out below.

Comparative analysis of refined sugars: FREDERICK BATES and associates at the Bureau of Standards. A résumé was given of the results of an elaborate and exhaustive study of about 250 samples of refined sugars produced in the United States. One of the principal objects of this work was to determine the feasibility of preparing accurate specifications and definitions of the refined sugars. The work included the determination of the direct polarization, invert sugar, moisture and ash. The acidity and alkalinity were determined by developing a new method, using the hydrogen ion concentration with gratifying results. The average acidity and alkalinity was found to be small and indications are that the departure from neutral is a powerful factor in determining the properties of the sugar. In addition, the sugars were screened to determine average size of grain. A preliminary report was given on the importance of improving and applying the so-called candy test to refined sugars.

A graphic method for estimating reducing sugars in presence of sucrose: C. A. BROWNE. The slight reducing action of sucrose upon Fehling's copper solution introduces a considerable error in determining reducing sugars in presence of large amounts of sucrose. The author proposes a general graphic method which consists of a chart containing the reduction curves for dextrose in amounts from 0 to 250 mgs. in presence of sucrose from 0 to 5gs. The correct amount of dextrose, corresponding to the amount found, is determined by finding the curve which passes through the intersection of the coordinates for grams sucrose present (as determined by Clerget) and mgs. dextrose found. The starting point of this curve on the base line indicates the correct amount of dextrose.

Commercial production of d-Mannite: W. B. NEWKIRK and C. F. SNYDER. At the request of the Army, the manufacture on a commercial scale of d-Mannite from manna was undertaken. The crude manna was dissolved in water in a melter heated by steam coils. The liquor was 17° Brix. It was heated to boiling and defecated. Three methods of defecation were employed. · *Method 1:* .005 per cent. phosphoric acid added to hot liquor and let stand for thirty minutes, neutralized with lime, allowed to settle and the clear liquid decanted and filtered. The filtered liquor was boiled in open pan to 30° Brix (hot), placed in tank and crystallized. The crystals were separated in a large centrifugal. *Method II.:* The raw liquor was treated with 0.10 per cent. Kieselghur and filtered and the filtrate concentrated as above. *Method III.:* The raw liquor was treated with 0.5 per cent. commercial vegetable carbon and filtered and the filtrate concentrated as above. Method I. was the most satisfactory. The mother liquors from the first crystallization were concentrated to 40° Brix and allowed to crystallize; the mother liquors from the second crystallization were concentrated at 60° Brix and a third crop of crystals obtained. The mother liquor from the third crystallization was concentrated at 80° Brix and a fourth crop of crystals obtained. The final mother liquors were concentrated to 80° Brix and a fifth crop of crystals obtained. A tabulation is given of the

melting points and rotations reported in the literature. The specific rotation was determined in water solution for the yellow-green mercury line and we find

$$[\alpha]_E^{02} = -0.255.$$

Preservation of bagasse in sugar cane mill control: GUILFORD L. SPENCER. Formaldehyde has been generally used in preserving sub-samples of cane bagasse in preparing a composite sample, representative of several hours grinding. This has been ascertained to be only moderately efficient under modern milling conditions. The late M. Henri Pellet, in Egypt, suggested and used ammonia in protecting the samples. The author found this usually efficient but occasionally there is loss of sugar. This suggested the addition of chloroform and preservation of the bagasse in an atmosphere of ammonia and chloroform. This mixture is apparently very efficient. Refinery press-cake holds its polarization during several weeks in the presence of this preservative. The solution for polarization must be acidulated with acetic acid before clarification with lead subacetate.

Glass vacuum pan for laboratory use: M. J. PROFFITT.

Changes in the polarizing constants of sugars during refining: A. F. BLAKE. The Clerget sucrose value for sugars, as pointed out by Browne at the Cleveland meeting, normally exceeds the polarization by about one third the percentage of invert. This is true of raw sugars as shown by numerous analyses, but in the products of a refinery, soft sugars and syrup, the value of the ratio (S–P)/I is very low. Analyses of sugars at all intermediary stages of refining are given, in order to determine where the change takes place. It is concluded that some change takes place during defecation and filtration of low test material and in the handling of the muds and scums due to action of lime on the invert sugar, but that by all means the principal cause of the reduction of the value of this ratio is bone-black filtration. The factor is strongly negative for the first material coming off the boneblack, but increases in following portions until in the last portion it is about equal or slightly exceeds material going on. The average value of the factor for all material going on is much higher than the average coming off. Since boneblack absorbs invert from first material and gives it up to later material it is supposed that by selective action it might absorb more

levulose than dextrose. This is proved by tests on invert sugar. Another cause is the molecular rearrangement of dextrose and levulose into glutose, etc. A high value of the ratio in refined products indicates inversion during refining. Losses of sucrose figured upon Clerget values exceed those figured on polarization, while losses of organic material are much less.

A report on the sugar industry of France since the war: T. H. MURPHY. The French sugar industry, born of the Napoleonic wars, almost perished in the World War, being 66 per cent. destroyed. Formerly, the 213 sugar factories supplied all French consumption and 78,739 tons per year for export. Now the 60 small factories remaining can supply only a small portion of the nation's requirements, and about 400,000 tons per year are imported. One hundred and forty-two factories were 85 per cent. destroyed, and all copper coils, bronze tubing, copper and brass screens, in fact everything made of copper, bronze or brass, and all electrical equipment, was stripped out of the war-wrecked factories and taken to Germany. The plants where sugar machinery and equipment was made, suffered the same fate. The damage to sugar factories was over $89,000,000. Reconstruction in France has made enormous strides, but on account of the highly specialized machinery and equipment required, the sugar industry, has, as yet, been able to accomplish very little. Photographs of destroyed sugar factories shown.

The composition and preparation of a sugar syrup of maximum solubility: R. F. JACKSON and C. L. GILLIS. One of the large branches of the sugar industry is the manufacture of syrups for direct consumption. If the syrup consists only of sucrose, the saturated solution may contain only 38.7 per cent. of the sugar. Such a solution is too thin for a desirable product and is susceptible to fermentation. If concentrated to a denser consistency, it becomes supersaturated and deposits sugar crystals. If, however, the sucrose is partially inverted, the density may be considerably increased, but if the inversion is carried too far, the relatively low solubility of dextrose limits the density to which the syrup may be concentrated. A study was made of the mutual solubilities of the three constituent sugars, namely, sucrose, dextrose and levulose in the presence of each other. The solubility of sucrose in varying proportions of invert sugar was determined to very high concentrations of the latter. Similarly the solubility of su-

crose in the presence of dextrose ,and of dextrose in the presence of sucrose, and finally of dextrose in the presence of levulose were measured. The results of this investigation have shown the maximum concentration which invert sugar may have without depositing crystals of dextrose, and similarly the maximum concentration which a mixture of sucrose and invert sugar may have without depositing either sucrose or dextrose. The syrup which contains 29 per cent. of sucrose and 52 per cent. of invert sugar, or a content with respect to total sugar of 81 per cent., has this maximum concentration. In general, it is practicable to increase this concentration even to a slight supersaturation without danger. Such a solution is sufficiently dense for a good syrup and resists the growth of microorganisms. A number of methods of inverting sugar have been devised. We add the suggestion that the partial inversion can be accomplished by the aid of an extremely dilute hydrochloric acid and subsequent neutralization with sodium carbonate. The net result is the addition of a minute quantity of common salt. Data are provided for controlling the method. During the investigation, the densities of invert sugar solutions, the contraction of volume accompanying inversion, and the change of viscosity were determined.

Some characteristics of imported cane sugars: C. A. BROWNE. The general trend in the manufacture of raw cane sugar during the past decade is shown to be towards the production of 96 test sugar, which during the past 5 years has made up about 75 per cent. of the total importations. This percentage could be increased considerably if care were taken to manufacture a drier sugar that would not deteriorate. Some of the chemical, physical, mycological and entomological characteristics of the different grades of imported raw cane sugars are discussed. During the past year, considerable plantation white sugar, testing between 98 and 100, has been imported for direct consumption. Some of this sugar is of very good quality and if care were taken always to make a clean white sugar of uniform character plantation white sugar might find a considerable demand even among the more discriminating class of users.

American progress in bacteriological sugars: EDMOND H. EITEL. The history of the rare sugars virtually commences with 1883. The sugars had become essential in bacteriology when in 1914 the German supply was cut off. The U. S. government found its work critically handicapped. Appeals of a patriotic nature established a rare sugar production in America. From the laboratory stage to the commercial represents a far greater achievement than is apparent. The following sugars are now manufactured commercially: l-arabinose, dulcitol, d-galactose, d-glucose, glycogen, inositol, inulin, invert sugar, lactose, d-levulose from invert sugar, d-levulose from inulin, levulose, syrupy, maltose, d-mannitol, d-mannose, melezitose, raffinose, rhamnose, sorbitol, sucrose, trehalose and d-kylose. A greater achievement than this list, however, is the surpassing of the old standards of Kahlbaum and the discrediting of another German superman theory. The polariscope with variable sensibility, a device of American invention, and the growing knowledge of how accurately bacteria can detect minute impurities has stimulated the new standard. The use of the rare sugars in America is being extended to physic-chemistry, chemical analysis, diet, intravenous injection, plant pathology, medicine and even to experimental explosives, as well as to advances in bacteriology. A specific example of the importance of the sugars to national health and epidemiology is the differentiation possible by their means of the paratyphoid, meat poisoning and hog cholera bacilli and the resulting possible knowledge of the source of an epidemic. The solution of the problem of the sugars calls for both the chemist and bacteriologist in combination, and in the answer light will be thrown upon morphism and bacteria, configuration of sugars, the asymmetric carbon atom, theory of life and evolution.

Results of sugar cane experiments in St. Croix: LONGFIELD SMITH.

Use of kieselguhr in the clarification of cane juice: H. S. PAINE and C. F. WALTON, JR. Results are reported of a comparative study of various types of kieselguhr, or diatomaceous earth, for the purpose of correlating physical properties and clarifying efficiency as a possible means of determining relative market values. The investigation of clarifying efficiency has led to a quantitative study of the colloids removed from cane juice by different methods of clarification. These experiments included a microscopic examination of the various kieselguhrs, tests of comparative rate of filtration, sedimentation, fineness by sieving, solubility in dilute acids and alkali, and the quantitative determination by dialysis of the colloids present in the juice before and after clarifi-

cation. The results so far obtained indicate that, provided a sufficient amount of kieselguhr is used to afford the minimum adsorbing surface required for the colloids present, there is little, if any, difference in clarifying efficiency when equal weights are used, even though the various kieselguhrs may differ considerably in physical properties. The dialysis experiments further proved, as has been indicated by the work of previous investigators, that heating and filtration with kieselguhr remove all colloids of such a degree of dispersion as to give a turbidity visible to the eye. Using active decolorizing carbon after preliminary treatment of the juice with kieselguhr, it was found that colloids of such dimensions as to be invisible to the eye were thereby removed.

Determination of the density of molasses: W. B. NEWKIRK. The picnometer suggested permits a greater accuracy in the determination of the density of molasses than has been possible heretofore. It is essential for commercial reasons that an accurate method of determining the density be used. The interfering obstacles in the determination of densities of molasses are due to the high viscosity, included gases and dissolved gases. The picnometer suggested is adaptable in the presence of these difficulties. It consists of a bottle fitted with an enlargement at the top ground optically flat and closed off by another optical flat. An expansion chamber is ground on to the bottle to permit the expansion of the included gas to permit of its easy removal and is fitted with a vacuum connection and stop cock in order to put the contents of the bottle under greatly reduced pressure and maintaining the same for a considerable length of time, without the loss of moisture. The evaporation is negligible. The change in temperature of the picnometer after closing is reduced by very thick walls over the neck of the flask. This reducing temperature changes on handling. Two methods of deaerating were studied—the application of heat to reduce its viscosity and the application of air to expand the entrained gas. The heating causes considerable decomposition and has a deleterious effect in the determination of the density. The vacuum method removes entrained gas and does not have the bad features of heating or dilution. The accidental errors are shown to be very small and the total error in any one direction is shown to be within .1 of 1° Brix, and the majority of determinations can be made within a few hundredths of 1° Brix. Densities with this apparatus can be determined with reasonable facility and with considerably more accuracy than the sample of molasses can be obtained.

CHARLES L. PARSONS,
Secretary

ASSOCIATION OF AMERICAN GEOGRAPHERS

THE annual meeting of the Association of American Geographers was held with the department of geography of the University of Chicago during Convocation Week. Five sessions were held at which forty-one papers were read, nine by title.

Especial interest centered in the joint meeting with the Ecological Society of America and the session devoted to invited papers on industrial geography. The papers given at the joint meeting were as follows:

Experimental animal climatology: V. E. SHELFORD.
Geography in zoological museums: A. G. RUTHVEN.
The relation of plants to new habitats: D. T. MAC-DOUGALL.
Ecology and geographic boundaries: H. C. COWLES.

Owing to the necessary absence of President Gregory, because of an emergency telegram, his presidential address on ''Geographic basis of the political problems of the Pacific'' was omitted. The following papers on Industrial Geography were given during the afternoon session of the same day.

The significance of vegetable oils in the economic development of the tropics: V. C. FINCH.
Geographical influences in marketing; illustrated by the meat industry: GUY C. SMITH.
Geographic factors in dairy farming in southern New England: RICHARD E. DODGE.

The papers presented at the remaining sessions were as follows:

Rainfall maps of Latin America: EUGENE VAN CLEEF.
The trade winds and anti-trades of Porto Rico: OLIVER L. FASSIG.
Progress in organization of the Climatological Service of the West Indies: OLIVER L. FASSIG.
Rise in temperature on mountain summits earlier than on valley floors: H. J. COX.
Cold surf with off shore winds: CHARLES F. BROOKS.
Vertical gradients of evaporation and soil moisture in desert and coastal mountains: FORREST SHREVE.
Stream and ocean terraces in relation to recent earth movements: R. S. HOLWAY.