

the "oblique arc." In the last two publications by the Coast and Geodetic Survey on investigations of the figure of the earth (entitled, "The Figure of the Earth and Isostasy from Measurements in the United States" and "A Supplementary Investigation in 1909 of the Figure of the Earth and Isostasy") the method was adopted of using the entire connected network of triangulation.

WILLIAM BOWIE,
Inspector of Geodetic Work
COAST AND GEODETIC SURVEY

THE ITHACA MEETING OF THE SOCIETY
OF AMERICAN BACTERIOLOGISTS,
DECEMBER 28-30, 1910

Bacteriology in General Education (president's address): V. A. MOORE.

This address is printed in full in SCIENCE, February 24, 1911. (Secretary.)

A Bacteriological Museum and Bureau for the Exchange of Bacterial Cultures at the American Museum of Natural History, New York: C. E. A. WINSLOW.

The Department of Public Health at the American Museum of Natural History has equipped a laboratory to serve as a central bureau for the preservation and distribution of bacterial cultures of both pathogenic and non-pathogenic organisms, and particularly of types of new forms and varieties. It is hoped that the laboratories of medical schools, colleges, boards of health, agricultural experiment stations, etc., and those engaged in biochemical work of all sorts, will furnish the museum with cultures at present in their possession, and the laboratory is now ready to receive and care for all such cultures. It is desired to have the history of the organisms in as full detail as possible and the museum will be glad, where necessary, to pay for the expense of transferring cultures and transcribing records. Types of new species and varieties are particularly desired at the present time and as they may be isolated in the future.

The laboratory plans also to keep on file descriptions of bacterial species in print or arranged in the form of the standard card and will be grateful for copies of any such descriptions.

Descriptions filed in the department will be carefully preserved and living cultures will be kept in good condition, so far as possible, and will be supplied to corresponding laboratories and

schools and other institutions which may desire cultures. The laboratory, of course, can not undertake to keep on hand difficultly-cultivable organisms, such as can only be maintained for a few weeks after isolation from the body; neither can it at present supply virulent cultures of organisms which rapidly lose their virulence under laboratory conditions. It should, however, be able to furnish cultures of organisms of all the ordinary types, which can be maintained under cultivation. Pathogenic forms will only be sent to properly qualified persons.

It is hoped, further, that the laboratory may offer opportunities for work in systematic bacteriology, and facilities will be offered to properly trained workers who may desire to conduct such work at the museum or to obtain cultures for carrying it on elsewhere.

The Proposed Microbiological Central Station in Berlin: OTTO RAHN.

This paper consisted of a review of the efforts put forth in Germany to establish a central station for investigations and distribution of microbiological cultures. It was in line with the preceding paper, but indicates that the German policies are more extensive and complete. (Secretary.)

The Fermenting Capacity of the Average Individual Cell (Bacterium lactis acidi): OTTO RAHN.

It is possible to compute approximately the amount of metabolic products formed by one bacterial cell in one hour. This unit is called "fermenting capacity." Object of this computation is the separation of the two vital factors of microbial activity, the growth and the fermentation. At present, this separation can be accomplished only by a mathematical calculation. The fermenting capacity of the average cell is approximately given by the equation:

$$X = \frac{S \log b/a}{t(b-a) \log 2},$$

where S is the amount of products formed during the time t , a is the number of cells in the beginning, b the number after t hours. The fermenting capacity of the average cell of *Bacterium lactis acidi* is about 0.000,000,001 to 0.000,000,004 mg. of lactic acid per hour. This amount is of the same order of magnitude as the weight of the cell.

Old cultures of *Bacterium lactis acidi*, if transferred into fresh milk, ferment very slowly because the power of multiplication as well as the

fermenting capacity are greatly reduced, both in about the same ratio. Increase of temperature stimulates growth and fermenting capacity. The comparison of a milk culture and a lactose broth culture showed a higher rate of growth in milk, a higher fermenting capacity in broth. Oxygen reduced the total amount of acid produced and in the two strains under study, the fermenting capacity is more influenced than the growth. It was found that transferring in sugar-free broth for 32 days in succession did not influence the fermenting capacity at all.

The frequent statement that in young cultures growth takes place without fermentation is not based on actual experiments. The amount of products formed by a small number of cells must necessarily be so insignificant that it can not possibly be detected by chemical analysis. From the time when a chemical proof is possible, the parallelism is evident. There is no indication of a discontinuity. This is proved, however, only for true products of fermentation. Toxins may be essential products and follow other laws.

A Halophytic Diplococcus: T. D. BECKWITH.

During the summers of 1907 and 1910 the principal cause of the reddening during preparation for market of salted codfish and other gadoid fish appeared to be a diplococcus which could not be isolated by use of standard media. Special media were devised, the first being an infusion of ordinary salted and unpreserved shredded cod flesh (100 parts) with distilled or rain water (1,000 parts) with the addition of 2 per cent. agar-agar. The second medium was made by using pickle from the butts diluted once with distilled or rain water and with 2 per cent. agar-agar added. The

easily with all common formulæ such as carbol-fuchsin and methylene blue. It is Gram positive; non-motile, although having a very marked brownian motion. No capsule could be demonstrated, although the colony on immersion in water showed slight zoogloea-like characteristics. It is an obligatory aerobe. Colony is 1-2 mm. in diameter with edge slightly raised. In chromogenesis the colony is salmon pink but color is somewhat lessened after repeated transfer, becoming pinkish white. In pure culture feeble growth appears on standard neutral beef agar but is not fostered by the other common media in vogue.

No description could be found of this diplococcus and it is thought to be a new species. As it appears on the salt flesh of practically all members of that family, the name of *Diplococcus gadidarum* n. s. is proposed.

Later it was demonstrated that sometimes the form may be isolated on A.P.H.A. standard beef agar plus 7-10 per cent. NaCl. Such a method is not at all certain in result, however.

On account of the fact that fish acted upon by this form undergo rapid decomposition due to its effects, and its characteristics are so halophytic tests were made to compare its growth in a saline medium with two most common forms of albuminous disintegration, *B. subtilis* and *B. fluorescens liquefaciens*. The sets of media were prepared by the addition of various per cents. of NaCl to A.P.H.A. standard beef agar with neutral reaction. Plates were incubated 96 hours at 30° C. The following table shows the points of repression of growth of these microorganisms upon such media and demonstrates the strong halophytism of this diplococcus.

Per cent. of NaCl	0	1	2	3	4	5	6	7	10	12.5	15	20
<i>Diplococcus gadidarum</i>	+	+	+	+	+	+	+	+	+	+	+	0
<i>Bacillus subtilis</i>	+	+	+	+	+	0	0	0	0	0	0	0
<i>Bacillus fluorescens liquefaciens</i>	+	+	+	+	+	0	0	0	0	0	0	0

NaCl content of these media averaged 5.25 per cent.

Upon these media at 30° C. in 96 hours salmon-pink colonies appeared upon plating out pinkened fish flesh. The predominant colony form was a diplococcus. This coccus is 0.4-0.5 μ in diameter in freshly isolated cultures; later upon repeated transfer during two years' time, it showed swollen involutionary forms sometimes 1.0 μ in size. The adjacent sides of the units of the diplococcus are slightly flattened like the gonococcus. It stains

Optimum condition for *Diplococcus gadidarum* n. s. is indicated to be 5-10 NaCl, for *B. subtilis* and *B. fluorescens liquefaciens* 0-1 per cent.

At Gloucester and afterwards in our laboratories, repeated smear preparations made from particles of fish flesh taken from the most reddened portions along the vertebræ where the coloring is most prominent and generally makes its first appearance, showed this diplococcus to be the most prominent form. It seems likely then that this diplococcus is one of the most destructive

agencies in the reddening of prepared salted fish. During the seasons of 1907 it was predominant on the samples examined, although it is possible to conceive that varying seasonal conditions of different summers may change the predominant form so that some other one of the various microorganisms as the causal factors of "red fish" may become the most destructive ones. This question is worthy of further study.

Bacterial Flora in Milk: H. W. CONN.

A general résumé of the present status of dairy bacteriology was furnished by this paper; and it also touched upon the significance of bacteriology in the control of municipal milk supplies. (Secretary.)

Relation of Form of Milk Pail to Germ Content of Milk: H. A. HARDING and J. K. WILSON.

The first important infection of milk occurs during the act of milking.

Ordinary milk pails have open tops, 12 or more inches in diameter. Many improved pails have been suggested, but few have been favorably received by dairymen.

The leading causes for rejection are the excessive height of the pails and the inconvenient size and shape of the opening for receiving the milk.

Tests of various pails indicated that a successful pail should not be over 12 inches high and should have an opening of approximately 25 square inches. An oval or elliptical opening is more convenient than a round one of the same area.

Stocking found that the use of cloths or mechanical strainers on pails was not desirable and that the relative efficiency of small-topped pails was greater under poor dairy conditions.

Under high-grade dairy conditions when a good small-topped pail was contrasted with an ordinary 18-inch open pail the reduction in germ content was more than 50 per cent. As such a pail is as convenient to use and practically as cheap as an ordinary pail, there seems to be no reason why it should not be generally adopted.

The Influence of the Products of Lactic Organisms upon Bacillus typhosus: Z. NORTHRUP.

This study was taken up first from the standpoint of the longevity of *B. typhosus* in sour milk. Previous investigations show that the typhoid bacteria in infected milk are generally all killed within twenty-four hours after the milk has reached 0.4 per cent. lactic acid.

Several widely varying types of lactic organisms were obtained from various sources for this study;

B. typhosus, from the laboratory stock culture. The typhoid bacteria and a lactic-acid producer were grown together in sterile milk after the milk had soured; the combined culture was plated at intervals. A special plating medium was used in two succeeding tests for differentiating the typhoid and lactic organisms; one lactic only was inhibited by the bile agar used as a differentiating medium.

Assuming that it is the products of the lactic bacteria and not the bacteria themselves which exert the inhibitive influence upon the typhoid bacteria, the plan was formulated of growing the typhoid bacilli in their products alone. The lactics were grown in lactose broth, allowed to produce an amount of acid, then filtered through a Chamberland "F" bougie. As a result of these experiments, it was found that a certain amount of the acid produced by the typical lactic organisms has greater germicidal properties than the same amount produced by any other type of lactic organism. The typical lactic kills *B. typhosus* at +37° acid or 0.3 per cent. lactic acid while the acid made by *B. bulgaricus* and another strong acid-producer reaches nearly twice 0.3 per cent. lactic acid in the lactose broth before the typhoid organisms are killed.

A comparison was made establishing the relative amount of acid produced in lactose broth and milk by lactic organisms. According to these results, +37° acid, the minimum inhibitive acidity, produced by No. 2 in lactose broth, corresponds to +80° acid or 0.72 per cent. acid in milk.

Summarizing, if strong lactic organisms are present in large numbers in infected milk, it may be definitely stated that all typhoid bacteria will be killed when the acidity in the milk reaches 0.72 per cent. lactic acid.

The Use of Fermentation Tests in the Study of the Lactic Bacteria: L. A. ROGERS.

It was found that the characters used in describing the lactic bacteria are not distinctive or are too variable to separate this group into subgroups.

The curdling of milk is especially variable and uncertain.

The fermentation of various test substances was found to be constant and, when properly correlated, to indicate natural grouping.

By means of these tests it was possible to separate the 150 cultures studied into three groups. Each of these groups was distinguished by fermenting or failing to ferment certain groups of test substances.

The Normal Number of Body Cells in Cow's Milk: R. S. BREED and I. READ STEDGER.

A report on some determinations made at Allegheny College and the University of Göttingen by the use of the direct method of counting these cells devised by Prescott and Breed.¹ A series of examinations was made of cream and skim milks obtained in a variety of ways to determine what became of these cells when the milk was separated or centrifuged. The results obtained were so variable that the final conclusion was that none of the methods using the centrifuge can be made satisfactory enough to give results of any value so far as determining the number of cells present is concerned. A necessary corollary of this conclusion is that all the deductions based on the use of these methods, careful and painstaking as much of this work has been, are worthless so far as they are based on the numerical factor alone. A daily examination of the milk of three normal cows extending over a period of six weeks indicates that there may be a cyclic variation in the number of these cells and showed variations in numbers ranging from 0 to 20,000,000 and more in milk which was apparently normal in every particular.

What is the Value of Quantitative Bacteriological Determinations in the Control of City Milk Supply: H. A. HARDING.

Their educational value is slight because dairymen are unable to translate quantitative results into terms of dairy processes and laboratory workers are also unable to do this until they have located the particular difficulty by other means.

As legal standards quantitative results have little value because they fluctuate so widely, dependent upon the technique used. A variation of 100 per cent. is frequently observed between the results of two equally accepted methods of determination.

They are not necessary, since the best results in improvement of city milk supply can be obtained without the aid of quantitative determinations.

They are useful as a check upon the work of dairy inspectors and in determining which dairies are most in need of close observation. Where the force of inspectors is not adequate to a close supervision of all the dairies, bacteriological determinations will indicate where the inspector's energy can be most wisely employed.

Their greatest value is in measuring the sources of infection. There is at present a lack of much

data and thousands of dollars are being wasted in present attempts at producing sanitary milk because the relative importance of various avenues of infection are not understood.

Apparatus for Collection of Deep-water Samples: PAYN B. PARSONS.

Description of a sampling apparatus for use in collecting samples of water for bacteriological examination, where the depth of water is very great and the currents are strong.

A single rope used for lowering and raising the lead pipe container and for breaking off the neck of the vacuum tube or releasing the stopper.

Also a description of an apparatus for the collection of chemical samples and one especially adapted for dissolved oxygen samples, where the samples must be taken in very deep water and the line kept plumb in the currents.

Bacteria in the Waters of New York Harbor: PAYN B. PARSONS.

Table giving the average number of bacteria in the water of New York harbor at the surface and at the bottom during 1909.

Table giving the average number of bacteria in the water of New York harbor during ebb and flood tides during 1909.

Averages of 1,082 examinations of water, made for the Metropolitan Sewerage Commission of New York, are included in the tables.

Discussion of present dangers to the health of the people from the vast quantity of sewage dumped into New York harbor, with special reference to bathing and the oyster industry.

Intensity of Pollution as shown by Numbers of Bacteria: PAYN B. PARSONS.

A consideration of numbers of bacteria in various sections of New York harbor, including a comparison of the numbers occurring in samples collected in the Atlantic Ocean and in those taken at points where there was a high degree of pollution.

Summary of the average number of bacteria in each distinct section of the harbor, during ebb and flood tides.

Table showing average numbers of bacteria as compared with the average per cent. of saturation with oxygen in the water of the various sections of New York harbor for all depths and tides during 1909. Eight hundred oxygen and 1,082 bacterial analyses, made for the Metropolitan Sewerage Commission of New York, are included in the averages.

¹ See *Journal of Infectious Diseases* for 1910.

Comparison of numbers of bacteria in mud deposits on the harbor bottom in samples collected from polluted and unpolluted sections.

Relation of channels and shoals to bottom deposits and bearing of this upon the oyster industry.

Biochemical Factors in Soil: M. X. SULLIVAN.

The soil is not an inert reservoir for plant food, but is the seat of physical, chemical and vital actions, the biochemical factors being especially prominent. Numerous bodies which occur in soils and arise either in the metabolic activities of microorganisms or are left in the soil after the decomposition of the plant and animal debris and perhaps occur also as a result of excretion from roots or from cell sloughing, play a considerable rôle in soil fertility. Some of these substances are harmful to plants, some beneficial. Fertilizers do work in soil in modifying the physiological functions of the microorganisms by bringing about suitable conditions for their development, in stimulating or retarding their digestion of inert bodies, and in furthering their enzymotic functions. Soils *per se* have oxidizing and catalyzing properties, while poor soils have these functions in a much lessened degree. Oxidation in subsoils which are of much poorer productivity than the surface soil is usually very slight.

Bacteria of Frozen Soil: H. J. CONN.

Results of work at Ithaca, N. Y., during 1909-10, showing a phenomenal increase in soil bacteria during the winter. Quantitative results already published.² Qualitative work includes the study of about 300 cultures.

Quantitative Results.—Increase from 7 millions per gram in November, 1909, to 33 millions in February, 1910, and from 8 in November, 1910, to 22 in December, 1910. These results are new, but are not disproved by previous work.

Possible Explanation.—There seem to be two different groups of organisms, one increasing in warm, the other in cold weather; the former requires so much organic food that a rapid increase is impossible.

Evidence in Support of this Explanation—

Relation to Moisture Content.—Germ content and moisture content are usually parallel; the exceptions to this rule are such as to suggest an alternation in predominating types.

Relative Numbers of Rapid Liquefiers, Actinomycetes and Slow Growers.—The last group increases in winter.

² *Centbl. f. Bakt.*, II. Ab., 28, pp. 422-434.

Qualitative Results.—There are certain organisms present throughout the year. The others appear only at times and show a tendency to reappear at the same season another year. Fall and winter show the greatest diversity of types.

Classification of the types studied in this work:

1. Higher filamentous bacteria. Actinomycetes.
2. Rapid liquefiers, producing spores. Mostly of the *B. subtilis* group.
3. Rapid liquefiers, without spores. All but one *Pseudomonas* forms.
4. Slow growers—without spores, producing punctiform colonies; partly show liquefiers, partly non-liquefiers.

Medium used in quantitative work: Gelatin, 12 per cent.; dextrose, 0.1 per cent.; soil extract, 20 per cent. Reaction adjusted with NaOH to 0.5 per cent. acid to phenolphthalein. Soil extract for this medium prepared by boiling 30 minutes with an equal weight of water, then filtering.

Incubation period in quantitative work: 7 days. Temperature of incubation: 19°.

Viability of P. radiculicola on Ash-maltose-agar: S. F. EDWARDS.

During the summer and autumn of 1906, cultures of *P. radiculicola* were isolated from the nodules of nineteen hosts, an ash-maltose-agar. Colonies were transferred to the same medium in Freudenreich flasks which were kept in a darkened cupboard at laboratory-room temperature. During the autumn of 1910, plates were made from these old cultures with the result that in fifteen of them the organism was still living. The results are shown in the following table:

In every case in which growth occurred, the colonies were typical, and stained preparations and hanging drops showed the typical characters of *P. radiculicola*.

Pot tests in sterile sand were started, using seeds of alfalfa, red clover, peas and beans. At the time of writing, only the peas were sufficiently developed to examine. Of six control plants, not inoculated, three showed no nodules, and three showed 1, 10 and 12 nodules, respectively. Six plants inoculated with the 1906 culture showed 18, 33, 20, 25, 64 and 25 nodules, respectively. Stains from the nodules showed rod and branched forms typical of *P. radiculicola*, and plates showed abundant growth in five days on ash-maltose-agar at room temperature. The work thus far shows evidence that *P. radiculicola* retains its virility as well as its vitality after considerable periods of time in stock cultures under laboratory conditions.

Viability of P. radicicola on Ash-maltose-agar

Host Plant	Alive after		
	Years	Months	Days
Siberian pea tree (<i>Caragana frutescens</i>).....	4	4	4
Red clover (<i>Trifolium pratense</i>)..	4	5	0
Soy bean (<i>Glycine hispida</i>).....	No colonies on ash-maltose-agar.		
Sweet pea (<i>Lathyrus odoratus</i>) ...	4	0	10
Garden pea (<i>Pisum sativum</i>).....	4	2	17
Alsike clover (<i>Trifolium hybridum</i>).....	4	3	21
Bitter vetch (<i>Lathyrus sativus</i>)...	4	4	16
Flat pea (<i>Lathyrus sylvestris</i>)....	No colonies on ash-maltose-agar.		
Red clover (<i>Trifolium pratense</i>), isolated from dried plants sent from Medicine Hat, Alta.....	3	10	16
Alfalfa (<i>Medicago sativa</i>).....	4	2	9
Black medick (<i>Medicago lupulina</i>).....	4	4	16
Horse bean (<i>Vicia faba</i>).....	4	0	29
Black locust (<i>Robinia pseudacacia</i>).....	No colonies on ash-maltose-agar.		
Honey locust (<i>Robinia viscosa</i>), medium dried to 7 mm. from 28 mm.....	4	4	12
Dutch white clover (<i>Trifolium repens</i>).....	4	3	20
Garden bean (<i>Phaseolus vulgaris</i>)	4	1	0
Scarlet runner bean (<i>Phaseolus multiflorus</i>).....	No colonies on ash-maltose-agar.		
Hairy vetch (<i>Vicia villosa</i>), medium dried to 4 mm. from 24 mm.....	3	11	22
Sweet white clover (<i>Melilotus alba</i>), medium dried to 4 mm. from 24 mm.....	4	4	14

Studies of Media for the Quantitative Estimation of Bacteria in Water, Sewage, etc.: STEPHEN DEM. GAGE.

The Variation in Composition of Beef Infusion.—In a former report, the writer called attention to the fact that the variation in the amount of solids in beef infusion made by the standard procedure was as great as or greater than the amount of pepton added in the process of making gelatin or agar media from that infusion. At that time (1904) it was suggested that this error might be considerably reduced if the beef infusion were made up to a constant specific gravity. The records at the Lawrence Experiment Station show that while the specific gravity of coagulated and filtered beef infusion prepared according to the standard procedure, may vary between 1.100 and 1.005, about one half of the samples have a specific gravity of about 1.006, and this value was selected as a standard. Analyses of a large number of samples of beef infusion adjusted to a

standard specific gravity of 1.006 show that the range of variation in the total nitrogen and in the total organic and mineral matters in solution has been fully as great as when no correction of the specific gravity was attempted. The error in reading specific gravity with a hydrometer may be as much as ten per cent. A careful analysis of the records shows that the proportion of samples in which the total solids did not vary more than 10 per cent. from the mean was increased from about 55 per cent. in the case of samples of the usual beef infusion to over 75 per cent. in the samples of infusion with a constant specific gravity, and a similar increase in uniformity is found in the total organic matters and in the total nitrogen. In other words, the use of beef infusion of a constant specific gravity is a step toward media of more uniform composition, and toward increased accuracy in bacterial counts.

The Influence of Quartz Sand upon Microbial Cultures: OTTO RAHN.

The object of this paper is to study the influence of soils upon microorganisms. The decomposition of liquid media (milk, peptone solution) was compared with that of the same liquid absorbed in quartz sand, and great differences were found. Naturally, aerobic processes were greatly increased and anaerobic processes greatly decreased when the liquid was mixed with sand in such proportion as to allow of abundant aeration. Both aerobic and anaerobic processes were favored, however, when just enough liquid was added to the sand to keep it entirely submerged. This indicates a peculiar influence of the quartz sand upon microbial action which is paralleled by the retardation or inhibition of poisonous effects upon plant roots by mere addition of quartz sand. Surface attraction of the microbial products by quartz sand does not account for this phenomenon.

Studies in Disinfection of Alfalfa Seeds: J. K. WILSON.

Sterile seeds are desirable if not necessary for the study of the relation of bacteria to plant life.

Sterile legume seeds may be obtained from ripening pods, but occasionally they are needed when such a supply is not at hand.

The utility of alcohol, corrosive sublimate and formaldehyde in providing such a supply has been tested on alfalfa seeds.

Sterility of seeds so treated was tested by incubating them in standard bouillon and examining them macro- and microscopically.

Seeds immersed in 70 per cent. alcohol for 105

minutes were not sterile. The effect of this treatment on germination was not tested.

Immersion in HgCl_2 1-1,000, for 2 minutes and washing eleven times in sterile water did not result in sterility. This treatment did not reduce the percentage of germination of the seeds.

Seeds immersed in 10 per cent. formaldehyde for 80 minutes were sterilized only in a few instances. The germination was reduced 3 per cent.

Seeds were first put into 95 per cent. alcohol for 10 minutes and then into 10 per cent. formaldehyde for periods ranging from 15 minutes to 6 hours. Only those treated 6 hours in formaldehyde were sterile. The germination of the seeds treated 6 hours was reduced 65 per cent. Ten minutes in alcohol did not reduce the percentage of germination.

Seeds were first put into water in a vacuum chamber and the pressure reduced to 3 mm. for 210 minutes. A portion of these seeds, after being placed for 30 minutes in 10 per cent. formaldehyde, was sterile, but the seeds did not germinate. The vacuum treatment alone did not reduce the percentage of germination.

Apparently the air in seeds prevents the entrance of disinfecting solutions and protects the bacteria.

Method of Keeping Bacteria from Growing Plants: J. K. WILSON and H. A. HARDING.

The main avenue of infection for experimental plants is through the air.

Of the many ways which have been suggested for preventing this infection none of them are simple and effective.

Harrison and Barlow have published on a method for growing legumes on agar in Erlenmeyer flasks. This method can be improved by growing plants in sterile Mason jars, using sterile seeds and earth. Exchange of gases is provided for by soldering a $\frac{1}{2}$ -inch tube into the metal jar top, plugging the tube with cotton and covering it with an inverted test tube to reduce the chances of contamination and to check evaporation.

Alfalfa planted in such jars, in sterile sandy soil to which 10 per cent. of water has been added, grew thriftily during four months without being watered or the jars being opened.

(The jars exhibited contain alfalfa planted August 13, 1910, and the jars have not been opened since that date.)

Bactericidal Properties and Variations in the Agglutinin Content of Antimeningococcic Sera: LAWRENCE T. CLARK.

Serum obtained from the horse which has received subcutaneous injections of first modified and later unmodified polyvalent suspensions of the meningococcus, acquires measurable quantities of agglutinin. Intraperitoneal injections of similar suspensions, either mono- or poly-valent, produce in the ram a serum of markedly greater agglutinating power.

Homologous sera produced from six cultures respectively, by intraperitoneal injections in the ram, gave distinctly specific agglutinative reactions with but one exception—sera 4 and 6 and cultures IV. and VI. being interchangeable with similar results.

Polyvalent antimeningococcic ram serum possesses decided bactericidal activity, as demonstrated by its effect in combination with complement on fresh living suspensions of the meningococcus.

Studies on Immunity in White Rats and Mice against Spirochæta duttonii: D. H. BERGEY.

White rats and mice that have recovered from a well-marked infection with *Spirochæta duttonii* have a high degree of acquired immunity against the organism. The serum of such immune rats and mice serves to protect normal animals against the infection.

The degree of immunity developed is not always absolute, though it is always sufficient to induce a pronounced alteration in the severity and course of the infection. If infection occurs, the onset is delayed, the number of organisms in the blood is relatively small, relapses are infrequent, and a fatal termination of the disease is prevented.

The protective substances in the blood of the immune animals consist of at least three types of antibody. Agglutinins are present early in the disease. Bacteriolytic substances are developed as shown by the degenerative changes in the organisms toward the close of the disease. Besides these tropic substances are undoubtedly of far greater importance in bringing about the very rapid diminution in the number of organisms in the blood.

The final elimination of the organisms from the blood of the infected animals rests upon their englobement by the free and fixed cells of the body through the influence of the tropic substances.

Agglutination of B. cholerae suis during the Production of the Dorset-Niles Serum: WARD GILTNER.

Purpose.—An effort has been made to throw some light upon the relation between *B. cholerae suis* and hog cholera. There has also been considered the possibility of a constant relationship between potency of serum and agglutinative power for *B. cholerae suis*.

Methods.—The macroscopic, test-tube method has been followed. Cultures were isolated from the spleen of virus hogs. At first a bacterial suspension was prepared by washing off surface growth from agar slants with carbol-salt solution, later bouillon cultures were diluted with a solution of formaldehyde. Blood samples were taken from the tail bleedings or at slaughter or death of pigs. Samples of "mixed sera" were preserved in .5 per cent. phenol generally.

Results.—Normal blood serum gave a maximum reaction at a dilution of 1-250 or less.

Blood of virus pigs gave a maximum reaction at a dilution of 1-800, but usually less.

Blood of pigs treated by the serum-simultaneous method gave a maximum reaction at a dilution of 1-500. These pigs were younger than the virus pigs and, other things being equal, young pigs generally possess a blood of less agglutinative power than old pigs.

The agglutination reaction appears to be a reaction of immunity since, as a rule, pigs treated by the serum-simultaneous method possess a blood of higher agglutinative power if they live (develop immunity) than if they die (fail to develop immunity).

During the process of hyperimmunization agglutinins for *B. cholerae suis* increase as the virus injections increase, but not necessarily simultaneously or in the same degree.

Of 51 samples of Dorset-Niles serum, only 11 gave an agglutination reaction at a maximum of 1-1,000 or less, while 7 agglutinated at 1-50,000.

The agglutinative power of a mixed serum may decrease more or less than 50 per cent. after 6 to 8 months in cold storage.

Potency of serum can not be measured by agglutinative power in all cases.

Sera of high agglutinative power, *i. e.*, agglutinating at 1-2,000 or above, were potent in 85.71 per cent. of cases and not potent in 14.28 per cent.; sera of low agglutinative power, *i. e.*, agglutinating at 1-1,000 or less, were potent in 45.45 per cent. of cases and not potent in 54.54 per cent.

Studies on the Filterable Virus of Hog Cholera:
CHAS. T. MCCLINTOCK, WALTER E. KING and
ROBT. H. WILSON. (From the Research Laboratories of Parke, Davis and Co., Detroit, Mich.)

Results of experiments indicate that a relatively short residence of hog-cholera serum in the circulatory system of the horse, in some way causes an activation of the virus. Horse serum, obtained one half to one hour after the animal has received approximately 140 c.c. of hog-cholera virus, is capable of producing more uniform results when injected into healthy hogs than corresponding dilutions of hog-cholera serum in normal horse blood, *in vitro*, and in physiological salt solution. The incubation period following the injection of horse-serum virus is relatively short.

The minimum fatal dose of virulent serum, as represented by a dilution of the virus in physiological salt solution, does not appear to indicate the minimum fatal dose where the dilution is maintained in the form of horse-serum virus.

From some analogous phenomena relative to the behavior of toxins, it is suggested that the filterable virus of hog cholera may contain a distinct toxin portion.

A Discussion of the Preparation and Distribution of Biologic Products: J. J. KINYOUN.

Founded upon the experiences of the author who has been intimately connected with the development in the production of biologic products in the United States, certain inductions of wide application were drawn pointing toward municipal and governmental manufacture and control. (Secretary.)

Intestinal Bacteriology: A Résumé: ARTHUR I. KENDALL.

By feeding experimental animals (cats and monkeys) alternately with protein and carbohydrate, respectively, it is possible to demonstrate definite alternations in the intestinal flora both by staining and by cultural methods.

These bacterial alternations consist essentially of a definite sequence of proteolytic and fermentative types of organisms. In addition to these changes in the type of the intestinal flora as the diet of the host is alternated, certain bacteria are able to accommodate their metabolism to a protein and a carbohydrate regimen, respectively. For example, *B. coli* possesses the power of accommodating its metabolism both to a protein and to a carbohydrate diet.

This accommodation of metabolism to dietary changes is a fundamental and extremely important property possessed by many bacteria, and it can be utilized therapeutically.

In lactic acid therapy it plays a prominent rôle: feeding carbohydrate and cutting down protein in patients suffering from the absorption of protein putrefaction products leads to a change in the metabolism in many of the prominent bacteria concerned in the morbid process. These organisms attack the sugar in preference to protein, since it has been shown by the writer that fermentation takes precedence over putrefaction in these bacteria.

In exogenous infections, such as bacillary dysentery, it also is an important feature, since it is possible to influence favorably the associated bacterial flora by feeding lactose in these cases. The lactose is hydrolyzed, and used by the dysentery bacilli and other organisms in the lumen of the alimentary canal. Under these conditions the dysentery flora becomes fermentative instead of putrefactive, that is to say, the flora (dysentery bacilli, *B. coli* and the streptococcus principally) form acid products instead of toxin and proteolytic products.

Some Quantitative Methods of Examining Fecal Bacteria: W. J. MACNEAL.

This paper is a summary of the methods employed in studying the fecal bacteria of healthy men already published in *The Journal of Infectious Diseases*, 1909, together with certain additions to the technic made since. The essential character in which the procedure is somewhat unique is in the plan of making every one of a large number of experimental results referable to a definite quantity of the mixed fecal flora, so that all the details of the comprehensive examination are quantitatively comparable with each other, and the results of one examination quantitatively comparable in detail with the results of another examination. The experimental observations fall under two heads: (1) the direct examination including (a) gravimetric determination of bacterial substance, (b) microscopic count of the bacterial cells by two methods and (c) differential count of Gram-stained fecal flora; (2) the culture tests including five different sets of plate cultures and one set of separation tube cultures of the mixed fecal flora, three different sets of plate cultures of the fecal spores and a variety of fermentation tube cultures devised not only to show differences in the fermentative activity of the mixed fecal flora, but also and more especially to bring to development and aid in the eventual isolation of various fecal bacteria which may not be found upon the plate cultures. For some of the results

obtained by these methods those interested are referred to the papers cited above.

Tests of the Virulence of Diphtheria Bacilli: B. L. ARMS, M.D., and E. MARION WADE, B.A.

The paper gives the technic of the isolation and test and shows:

1. The marked variation in the virulence of different strains of diphtheria bacilli isolated from the same culture, showing the necessity of testing several strains before releasing a case on a negative virulence.
2. That as a rule if a case is proved positive by the virulence test the organisms retain their virulence as long as they persist, even though the case has completely recovered clinically.
3. That where there is an outbreak of diphtheria the "carriers" often harbor organisms, even though no symptoms are present in the host.
4. That sometimes the virulence may become enhanced, although this is the exception and seems to be more frequently true of institutional cases.

Further Studies on Blackhead in Turkeys: PHILIP B. HADLEY.

This paper presents some of the results of work on the blackhead disease of turkeys conducted at the Rhode Island Agricultural Experiment Station since July 1, 1908. The further investigations indicate that blackhead can not be considered as a specific disease, but that it includes several distinct etiological factors. One of these, as first reported, is coccidiosis. Another is now found to be infected with a species of flagellated organism. These two factors (and perhaps others) may work either together or separately to produce the pathological appearances characteristic of blackhead. Multiplication of the flagellates by means of spore-formation has been observed in the tissues of the ceca and liver. At an early stage of development many of the parasites lose their flagella and become ameboid. In the motile stage the flagellates are characterized by the presence of two flagella, a membrane and a short "Achenstab." The length of the motile forms does not exceed 12 μ . Encysted forms 12 μ –16 μ were observed. A more detailed report of the investigation appears in the *Centralblatt für Bakteriologie*.

Bacillary White Diarrhea of Young Chicks: LEO F. RETTGER.

The epidemic type of diarrhea which is characterized in part by a whitish diarrheal discharge, and which is now known as "bacillary white diarrhea," is caused by a bacillus which belongs to the coli-typhi group of bacteria. It has many

points in common with the typhoid bacillus. It may be cultivated easily on the ordinary laboratory media, but its growth on slant or plate agar is delicate, and very much like that of the *Streptococcus pyogenes*. This peculiar appearance on agar is a great aid in the identification of the bacillus, and hence in the diagnosis of the disease.

This organism, which has been named *Bacterium pullorum*, is present in the intestine, liver, lung, spleen, kidney, heart and unabsorbed yolk of chicks suffering with the disease in question. It is to be obtained most easily from the liver and yolk, when the latter is present.

Feeding experiments conducted on a large scale demonstrated that the disease may be transmitted to young chickens under three days old through infected food and drinking water. Furthermore, chicks may be infected with *Bacterium pullorum* before hatching. These two facts furnish an easy explanation as to the rapid spread of the infection among chicks many of which were normal at the time of hatching.

The mother hen is the source of infection in the egg. The examination of hens from which it was almost impossible to raise chicks, on account of white diarrhea, revealed the fact that the ovaries were infected with *Bacterium pullorum*. The diseased ova were very abnormal. They were discolored, misshapen and of all degrees of consistency. Eggs from these hens had been found to contain the specific bacillus in question in all stages of incubation. Later, a method was devised for identifying the bacillus in fresh eggs which came from infected flocks. Numerous eggs were tested, and the organism was observed in many of them. Thus, a satisfactory method is at hand for determining, without injury to the birds, which hens are infected with *Bacterium pullorum*, and consequently are the source of infection, if their eggs are used for hatching purposes.

Quite recently a pullet which was less than eight months old, and which was one of the survivors of an infected flock, showed the presence of the specific bacillus in the ovary. This discovery completed the cycle of infection. The laying hen is a bacillus carrier. Her eggs harbor the bacillus, and the chicks which are hatched emerge with the organism planted within them. These chicks are the source of infection of other chicks which are normal at the time of hatching. The disease becomes epidemic. The female chicks which survive carry the infection in their body until they are mature laying hens, and the same cycle is begun again, unless intelligent steps are taken to eradi-

cate the infection by methods which are most apparent.

Carbolic Acid in Fowl Cholera: PHILIP B. HADLEY.

The prevalence of fowl cholera in many of the New England states is increasing. An attempt is being made at the Rhode Island Agricultural Experiment Station to devise methods for its prevention or control. Preliminary experiments have involved a study of the effects of subcutaneous inoculations of a 5 per cent. solution of carbolic acid upon fowls previously infected with the organism of fowl cholera, *Bacillus bipolaris septicus*. The results of this work to date have shown that repeated daily subcutaneous inoculations with 5 per cent. carbolic acid, in 3 c.c. amounts, have power to prevent the development of the disease in fowls infected from one to twenty-four hours previously with the cholera organism. The results were approximately the same whether the infections resulted from subcutaneous inoculation of the virus or from the ingestion of virulent material (feeding by glass pipettes). The possible manner of action of the carbolic acid was discussed. A more detailed report of this work appears in Rhode Island Agricultural Experiment Station Bulletin, No. 144.

The Etiology of Contagious Abortion of Cows: W. J. MACNEAL.

The existence of a contagious form of abortion in cattle has been recognized for a long time by practical husbandmen. Nocard (1886) made the first extensive bacteriological investigation of the disease, but failed to identify any microorganism as the cause. Bang (1896) found a small bacillus in the uterine exudate of aborting cows, grew it in pure culture, and produced abortion by injecting these cultures into cows and sheep. The peculiar oxygen requirement of the microorganism for growth in artificial culture was discovered and fully studied by Bang and Stribolt. Subsequently, the same organism has been isolated from cases of contagious abortion of cattle by Preisz (1902) in Budapest, Nowak (1908) in Krakau, McFadyean and Stockman (1909) in England, MacNeal and Kerr (1910) in Illinois, U. S. A., and by Zwick (1910) in Germany.

The microorganism is a very small rod, not motile and without spores. It is Gram-negative. Plate cultures are best obtained by streak inoculation on solidified serum-agar, the plates being incubated at 37° in a closed jar from which the oxygen is partly exhausted. This is conveniently accomplished by putting plates of *B. subtilis* in

the jar along with the cultures of the abortion bacillus. The appearance of the colonies is characteristic, and coupled with the behavior toward oxygen is almost sufficient for identification. Subcutaneous injection of active cultures into pregnant guinea-pigs causes abortion with great regularity.

Of the various names employed to designate the organism, *Bacillus* (or *Bacterium*) *abortus* Bang, is considered as the correct and appropriate one.

A Method for Determining the Germicidal Value and Penetrating Power of Liquid Disinfectants:

ARTHUR I. KENDALL and MARTIN R. EDWARDS.

The method consists essentially of infecting plain agar with 24-hour cultures of *B. coli*, hardening the agar in sterile tubes of 1.5 cm. inside diameter and about 1 meter long, then cutting cylinders from the hardened agar by running it out slowly and sectioning it transversely into cylinders of about 2 cm. long with a sterile knife. The cylinders so obtained are dropped directly into the disinfecting solutions which it is desired to examine, and into 5 per cent. carbolic acid as a standard for comparison. Cylinders from each solution of disinfectant are removed at the end of stated intervals, washed in distilled, sterile water, and then a core removed from the center of each cylinder along the long axis by means of sterile quill tubing (3 mm. in diameter).

These cores so removed are placed in lactose fermentation tubes and incubated at body temperature for several days, making daily examinations for gas formation.

By comparing the results obtained with the various disinfectants with those of the standard carbolic acid, it is possible to formulate a coefficient which expresses the combined germicidal and penetrating power of the disinfectant in question with that of carbolic acid.

All abstracts have been supplied by authors unless otherwise stated.

CHARLES E. MARSHALL,
Secretary

EAST LANSING, MICH.

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 690th meeting was held on February 25, 1911, President Day in the chair. Two papers were read:

Some Causes of Variations in the Polarization of Sky Light: Dr. H. H. KIMBALL, of the U. S. Weather Bureau.

The first part of this paper contained a brief résumé of the main features of sky polarization, together with references to some of the theories that have been advanced to account for them. Observations by different investigators were cited to illustrate the character of periodic variations in sky polarization, and a summary was given of observations by the author. These latter include measurements of the percentage of polarization at the point of maximum, *i. e.*, 90 degrees from the sun and in its vertical, as well as observations on the position of the neutral points of Arago and Babinet. They show (1) variations in sky polarization with place, apparently due principally to differences in the intensity of reflection from the surface of the earth, and (2) variations with meteorological conditions.

No connection is apparent between sky polarization and the pressure exerted by the aqueous vapor contained in the atmosphere. Dustiness, or any form of mechanical haze, decreases the percentage of polarization; but by far the most potent cause of such a decrease appears to be optical haze, or the diffusion of light by reflection from the boundary surfaces of non-homogeneous layers or currents of air.

All of the observations included in the above summary were obtained when the sky was practically cloudless. Of the ten days on which the lowest percentage of polarization was observed seven were followed by rain before midnight of the succeeding day.

The Nature of the Sun: Dr. C. G. ABBOT, of the Smithsonian Institution.

In the preparation of a forthcoming book on the sun the speaker had attempted to explain solar phenomena on the hypothesis that the sun is completely gaseous, and not possessing the shell of clouds generally assumed to constitute the photosphere. The temperature of the sun seems to be of the order of 6500° absolute centigrade, and the pressure in the iron reversing layer about five atmospheres. In these circumstances it seems highly improbable that matter other than gaseous exists. A continuous spectrum was held by the speaker to be the natural consequence of the immense thickness and considerable pressure of the radiating gas sphere. A sharp boundary exists because the molecular scattering of light prevents the view at the center of the sun's disc from penetrating more than perhaps one thousand kilometers. A view at the sun's edge will be oblique, and to furnish gas one thousand kilometers thick