

the amount of inorganic material is obtained, which, when subtracted from the total residue, gives the weight of aniline hydrochloride.

The accompanying table gives the results of analyses of mixtures of peanut oil and nitrobenzol of known strength, and also two of lard oil and nitrobenzol.

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THE DETERIORATION OF SODA WATER DUE TO MICRO-ORGANISMS

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Received June 2, 1913

During the last two years many letters have been received at this laboratory from soda water bottlers asking for information relative to the cause and prevention of the so-called "diseases" of soda water. In a few instances, at least, bottling works have been forced to close down their business, owing to the fact that the product put out by them continually "went bad." As it is of economic importance to the various soda water manufacturers throughout the country and indirectly of interest to the consumer, an invitation was extended to various bottling works in the state to send in to the laboratory samples of spoiled soda water whenever found. Accordingly, a large number of samples were received and examined. It was found that the spoiled beverages may be classified into three groups, namely: *First*, stringy pop; *Second*, pop with sediment and turbidity; and *Third*, pop in which sufficient fermentation had developed to blow off the caps or break the bottles. The authors have been unable to find records of any previous work on this subject.

A microscopical examination of several samples revealed the fact that stringy pop, in these particular cases, was caused by the presence of a one-celled algae, "Tetraspora." Data on file in the water laboratories showed that the water supply used in the manufacture of the soda water was infested with an excessive growth of this algae. The stringiness was due to the mucilaginous nature of the cell walls which hold the cells together in large colonies. It can readily be seen that any algae-infested water, used directly, will give the manufacturer trouble. The use of distilled water is the best and easiest solution of this difficulty. Filters will not protect the bottler from this trouble entirely as the algae grow through the filters.

Those samples of soda water, showing only sediment and turbidity or in many cases sediment alone, were shaken, carefully opened and portions of the contents plated out on agar and other portions were inoculated into saccharose and dextrose broth fermentation tubes. Microscopical examinations were also made of the sediment settling to the bottom of the bottle. The agar plates showed the presence of 30,000 to 45,000 yeasts per cubic centimeter while the microscopical examination of the sediment established the fact that it was made up, in every case, of yeasts. Several strains of bacteria were isolated along with the yeasts and kept for further study as will be described presently.

While many bottlers reported losses due to blowing off of caps to bottles no samples thus affected were obtained, but instead a successful attempt was made to

produce this effect by inoculating various kinds of soda water under normal conditions, with three laboratory strains of saccharose fermenting colon organisms, which had been isolated from polluted water and sewage. The yeasts and bacteria isolated from samples showing sediment and in some cases marked turbidity were separately inoculated each into a respective set of samples to check up the cultural and microscopical findings mentioned above. A set of controls was also carried. Two varieties of soda water were used in these experiments, Cocoa Cola and Cream. These were inoculated in sets of four bottles each with the following organisms:

Set Lab. No.

1	101	Saccharose fermenting colon organism.
2	102	Saccharose fermenting colon organism.
3	107	Saccharose fermenting colon organism.
4	5428	Yeast (from ginger ale).
5	5429	Saccharose fermenting bacillus. Acid. No gas (from cream pop).
6	5432	Yeast (from lemon soda).
7	5426	Saccharose fermenting bacillus. Acid. No gas (from ginger ale).
8	5427	Saccharose fermenting bacillus. Acid. No gas (from ginger ale).
9		Controls.

NOTE: These experimental samples were bottled under normal factory conditions, with the exception that all bottles were sterilized.

When soda "goes bad" it does so almost invariably in hot weather, hence these bottles were placed in an incubator and kept at 37° C. for a week and then placed at room temperature and kept for several months with the following results:

SET ACTION

1	Developed slight turbidity only.
2	Developed slight turbidity only.
3	Developed slight turbidity and sufficient gas produced to lift caps.
4	Heavy sediment produced, made up of yeast and cap from one bottle lifted.
5	Turbidity only.
6	Sediment yeast.
7	Turbidity only.
8	Contaminated with yeasts, probably from bottling machine.
9	Normal pop. No sediment or turbidity.

NOTE: Active-gas producing colon organisms and yeast were found.

It would seem from the above that while not all strains of saccharose fermenting colon organisms will produce sufficient gas to lift the caps on the bottles, yet an extremely good gas-producing strain may bring this about and also that some strains of yeast will produce this result. Hence the use of polluted water might, in addition to endangering the health of the consumer, render the produce unsalable owing to presence of large numbers of colon organisms.¹ In a previous paper by the authors, it was noted that when a certain strain of *B. coli* was inoculated into pop it rapidly died out; this, however, was a non-saccharose fermenting organism and did not produce turbidity in the pop.

It is also evident from these experiments that sediment may be produced in pop owing to presence of certain wild yeasts, and also that any bacteria which ferment saccharose with the production of acid but no gas may render the pop turbid and unsalable.

Inasmuch as it is an established fact that algae grows only in the light it is important that all distilled

¹ THIS JOURNAL, 3, 495.

water stored in the bottling plants should be kept in the dark.

We wish to suggest to bottlers that they discard wooden kegs as they have been found to be carriers of yeasts and undesirable bacteria even after attempts have been made to sterilize them with hot water. Salt-glazed pottery, where substituted for wooden

receptacles, are very easily sterilized and have given excellent results in practice. Every effort should be made to keep all materials covered to prevent the entrance of these organisms from the air.

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SOME PROJECTION EXPERIMENTS WITH SPECTRA¹

By H. E. HOWE

Received May 3, 1913

The development of projection apparatus within the last few years, producing forms with which work of precision can be done, naturally led to the use of such instruments in fields where projection heretofore has not entered. The mention of projection apparatus recalls to the minds of most people simply the process of projecting lantern slides, but the physicist has for a long while used projection in lecture experiments and laboratory work. Of late the biologist has found it most useful for lantern slides, opaque ob-

A lecture given by Dr. C. E. Kenneth Mees on the "Nature of Color" before the Rochester section of the American Chemical Society suggested these simple experiments, for in that address Dr. Mees used the Zeiss complementary color projection apparatus, the principles of which are used in the instrument I have here.

However, the Zeiss instrument is too difficult to set up and has other objections which made a simplification very desirable for our purposes. Mr. W. L. Patterson, of the Bausch & Lomb Optical Co., therefore undertook the construction of a complementary color apparatus which would have the form of a con-

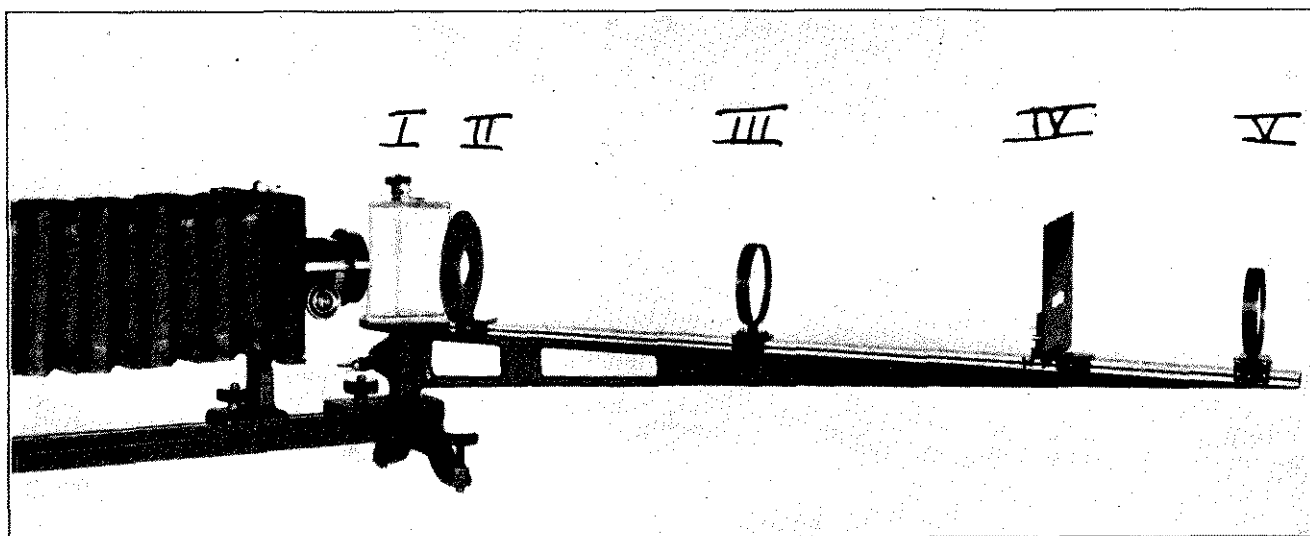


FIG. 1

jects, and for microscopical projection, not to replace the table microscope but as an accessory. It has always seemed to me that the chemist could use projection (more especially in lectures) profitably and to a large extent if he would but work out a few experiments as a beginning, and add to them as his familiarity with the projection suggests other experiments. The first of these chemical experiments with the aid of projection were given by Dr. Frank B. Kenrick, of the University of Toronto, and myself, at the general meeting of this Society at the Washington meeting, and the few experiments I now have to offer are more in the line of physics but have an application to the teaching of chemistry especially in qualitative analysis where the spectroscope is used for the identification of certain elements.

¹ Paper presented at the general session of the Milwaukee meeting of the American Chemical Society, March 25, 1913.

venient attachment which can be used on any of the well-known Balopticons possessing a lathe bed. The result was a light and easily adjustable apparatus which is shown in Fig. 1.

The projection apparatus consists of a Balopticon set up for lantern slide projection but with an extra standard, upon which the adjustable slit is carried, placed between the condenser system and the projection lens and to the bed of this Balopticon, the complementary color apparatus is attached as illustrated. This instrument consists of a short optical bench which may be adjusted to any angle with reference to the bed to which it is attached and which supports the following accessories:

- I. A bottle prism for holding carbon bisulfide or any other liquid.
- II. An Iris diaphragm and light shield.