

# The "Poison Squad" and the Advent of Food and Drug Regulation

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*"O, they may get over it but they'll never look the  
same,  
That kind of bill of fare would drive most men insane.  
same."*

Chorus from "Song of the Poison Squad" Lew  
Dockstader's Minstrels, October 1903

A century ago, 12 men sat down to a plate of food laced with poison and came back for more. Blessed by Congress, the dinner was the first in a series of meals containing steadily increasing doses of suspected toxic chemicals. What better animal to test toxicity in humans, than a human?

The infamous five-year human feeding experiment took place in the basement of the Agriculture Department's former Bureau of Chemistry, located on what is now Independence Ave., in Washington, D.C.

Complete with kitchen and dining room and backed by a government laboratory, the project was the brainchild of scientists from the Bureau of Chemistry (now the Food and Drug Administration). Chief chemist Harvey W. Wiley, M.D., considered by many to be the founding father of the FDA, spearheaded the effort to such tests himself. Wiley hoped to learn "whether preservatives should ever be used or not, and if so, what preservatives and in what quantities." Ultimately, if Wiley could prove from his studies that food adulteration went beyond flagrant cheating to obvious harm, then both the public and Congress would likely support a national policy.

## 'None But the Brave Can Eat the Fare'

Three years after Wiley's initial request, Congress enacted new controls over imported foods, including provisions for the inspection and rejection of adulterated shipments. Historians write that greater knowledge about the safety of common preservatives, it was believed, would serve to strengthen enforcement of these new laws. Therefore, Congress included funding in the chemical division's 1902 budget

*Next week he'll give them mothballs, a la Newburgh or  
else plain;*

*O, they may get over it but they'll never look the* separate scientific facts on food safety from the recurrent food safety scares that had fast become the subject of growing public mistrust, inflammatory publications, and Congressional hearings. Wiley's earliest concerns stemmed from the widespread use of borax as a food preservative. And, in fact, fraud was so widespread that even products labeled "pure" were often counterfeits, such as purported "pure Vermont maple syrup" that was little more than colored and flavored Iowa corn syrup.

At the same time, however, manufacturers argued that certain preservatives, such as sulfur, were indispensable in processing products such as wines and raisins. Nevertheless, the public was becoming increasingly concerned about all kinds of toxic substances reportedly found in foods.

Although Wiley believed the burden of proving the safety of preservatives should fall on the manufacturers of such additives, still, he boldly asked Congress during Senate hearings on food adulteration in 1899 for money to conduct appropriations to carry out the proposed "hygienic table trials."

Wiley and other scientists quickly assembled the first dozen young, able-bodied Department of Agriculture volunteers--dubbed the "Poison Squad" by newspapers--and fed them wholesome meals containing potentially harmful substances. The initial five preservatives studied were borax, salicylic acid, sulfuric acid, sodium benzoate, and formaldehyde. Dosages ranged from one-half gram daily to four grams by the end of the five-year study. Each subsequent group of a dozen men tested one preservative, and in all of the five years, there was never a shortage of volunteers.

The squad pledged to eat all their meals at the "hygienic table." They agreed not to consume any outside foods or beverages, except water. Even that had to be measured and reported. Each participant recorded his weight, temperature and pulse rate before each meal, and what he ate.

Every week, physicians from the Public Health and Marine Hospital Service examined the squad members. Any symptoms noted were reported.

From the men's point of view, perhaps the most annoying aspect of the study was submitting all their urine and feces to government chemists for daily analysis. Additionally, a portion of the study was devoted to determining whether any preservative was eliminated through perspiration and respiration.

The men, of course, knew they were eating potential poisons. They didn't know, however, which foods contained the substances. At first borax was added to butter, to which the men developed a sudden distaste. Wiley then tried it in milk, meat, and coffee. Evidently, as the men determined which food contained the substances, they began eating less of it and eventually avoided that food altogether. Therefore, early on in the trials, Wiley decided he would no longer hide the preservatives and began putting them inside gelatin capsules instead. Previous tests showed that when taken in the middle of a meal, the capsules would quickly dissolve into digesting food, and in the case of borax, without discomfort. For the remainder of the five years, capsules were used for the study.

As daring as it was to submit to such testing in the first place, the men--who responded to Wiley's appeal to promote scientific knowledge while getting free meals--agreed to do so for at least six months. They also agreed to not hold the government responsible for any illness or injury that might result. The meals, which were prepared from high-quality ingredients by a certified Civil Service Commission chef, represented but a small reward for the hardships borne by the volunteers, including the possibility of long-term harm.

### **Bad Publicity for a Good Cause**

Overnight, the Poison Squad became a national sensation. Wiley worried, however, that humorous banter about the squad would discredit the seriousness of his scientific project. But he also knew the importance of winning over the public--not only for the policy he was beginning to envision on chemicals in foods, but also for the progress of the pending federal food and drug law, then under debate in Congress.

After learning that reporters had taken to interviewing the Poison Squad's chef through a basement window, Wiley bowed to the inevitable interest and took reporters into his confidence. He reported to newspapers every detail of the experiment and its effects on the men, and also had the nerve to join the group for most of his own meals.

Wiley stopped the experiments only when the chemicals made several of the diners so sick that they couldn't function--nausea, vomiting, stomachaches, and the inability to perform work of any kind. By this time, though, stories of the men's indigestion had run rampant and were being followed by fascinated readers all over the United States. The table trials even made the minstrel shows. In the end, the publicity helped Wiley gain a Congressional hearing, as well as support for his contention that chemical preservatives had no place in food.

### **The Science Behind Food Additive Regulation**

Wiley's findings on borax were not impressive. The results reported in 1904 showed that borax was one of the least toxic of the preservatives studied. More impressive, however, were the symptoms reported in the individual case histories as dosages of borax and other preservatives were increased: diminished appetite, feelings of fullness and discomfort in the stomach, dull and persistent headache, and in some instances, abdominal pain.

The amounts of preservatives eliminated in feces were found to be insignificant. The amount recovered from perspiration was not enough for a quantitative determination by the methods used back then. The respiration study came back without significant results.

For the sake of the food industry, which wielded a powerful influence over lawmakers, Wiley eventually admitted that very small amounts of preservatives might be harmless, and might even protect consumers from more serious dangers of food spoilage. But he argued that the accumulation of such additives was a danger to public health since he couldn't determine, much less control, quantities of a given substance that a person might ingest over time. Wiley was convinced that any kind of regulation would have to treat all preservatives alike--ruling out

discrimination between food chemicals according to their risks and benefits.

Wiley didn't win all of his fights, and not many federal court cases were aimed directly at the chemicals fed to the Poison Squad. But four of the preservatives tasted by the Squad are long gone from the food additive market--borax, salicylic acid, formaldehyde, and copper sulfate. In the end, the Poison Squad, and all that they ate, helped pave the way for federal regulation of foods and drugs in the United States--the Pure Food and Drug Act of 1906, also called the "Wiley Act" and later its successor, the 1938 Federal Food, Drug, and Cosmetic Act.

Although Wiley's dining experiment was quite politicized, highly controversial, and remains scientifically contentious today, his efforts led to the scientific regulation of food additives, with rational limitations. The result?

Preservatives found safe could be legally added to foods, but not to cover up the use of ingredients unfit for human consumption.

As scientists learn more about the action of certain chemicals in our bodies, the FDA can use this information to re-evaluate further uses of preservatives.

Although no formal long-term follow-up was done on members of the Poison Squad, anecdotal reports indicate that none were harmed. According to William O. Robinson of Falls Church, Va., the human guinea pigs suffered no permanent illness or injury. Robinson, a member of the Poison Squad, was 94 years old when he died in 1979.

*Suzanne White Junod, Ph.D., FDA historian, contributed to this story.*

## CHAPTER II

### THE POISON SQUAD

*Vulneratus, non victus.*-- Proverb

#### PROLOGUE

Confucius says:

*"The commander of the forces of a large state may be carried off, but the will of even a common man can not be taken from him."*

In the foregoing pages attention was called to the experiments making on healthy young men to determine the influence of preservatives and coloring matters on health and digestion. The general method of conducting these investigations was discussed. Altogether nearly five years were devoted to these experimental determinations, beginning in 1902 and lasting until 1907.

The total number of substances studied was seven, namely, boric acid and borax, salicylic acid and salicylates, benzoic acid and benzoates, sulphur dioxide and sulphites, formaldehyde, sulphate of copper, and saltpeter.

Reports of these investigations were published, with the exception of sulphate of copper and saltpeter, which were denied publication. In 1908 further investigations of this kind were allotted to the Remsen Board whose activities will be described in the following pages. The Bureau of Chemistry was "grievously wounded but not conquered" by this transfer of its activities.

#### ANOTHER THREATENING STORM

Anyone who has observed the occurrence of tornados, cyclones, and thunder storms, especially in the spring, has noticed their tendency to occur in groups. This is especially true of any particular locality and generally of those parts of our country in which these

visitations, often destructive to life and property, are common. The storms which threatened the integrity of the food law were of this kind. They were different, however, from the caprices of the weather in the time of the year they occurred. The most threatening of them arose, not in the spring, but in the winter of 1907. The transfer of authority to execute the law from the Bureau of Chemistry to the Board of Food and Drug Inspection, and from that Board to the Solicitor, was a very good introduction to what occurred soon after January 1st, 1907. Even after the Bureau of Chemistry was deprived of its power of autonomy, it still retained intact its function of judging what was a threat to health.

#### WISE FORESIGHT

Prior to the enactment of the food and drugs law it was evident from the increase in popular interest in this matter that the enlistment of organized bodies of men and women interested in securing this legislation would sooner or later become effective. It was considered the part of wisdom to prepare for this much wished-for consummation. Numerous attempts had been made before the Congress of the United States to change the wording of the proposed bill in such a way as to eliminate the Bureau of Chemistry as the active executive organization of the law when passed. All of these attempts had been almost unanimously negated by the Congress as often as they were offered. It seemed, therefore, quite certain that when the law finally was secured the Bureau of Chemistry would be retained as its executive agent. As early as 1902 authority was obtained from Congress to carry on feeding experiments on healthy young men. The language of the law follows:

"To enable the Secretary of Agriculture to investigate the character of food preservatives, coloring matters, and other substances added to foods, to determine their relation to digestion and

to health, and to establish the principles which should guide their use."

The object was to see if the preservatives and coloring matters added to foods would have any effect upon the digestion and health of these young men. Young men as a rule are more resistant to effects of this kind than children or older persons. They represent the maximum of resistance to deleterious foods. The deduction from this theory is that if the young men thus selected showed signs of injury other citizens of the country less resistant would be more seriously injured. Having received authority from Congress to proceed in this matter, a small kitchen and dining room were provided in the basement of the Bureau and a call issued for volunteers to join this experimental class. We asked chiefly employees of the Bureau. We had no difficulty in securing twelve healthy young men who volunteered their services and took an

oath to obey all rules and regulations which should be prescribed for the experimental dining table. Their term of enlistment was made for one year. Up to this time no such extensive experiment on human beings had been planned anywhere in the world. It was not necessary to ask any publicity to this matter. It was a problem which interested not only newspaper reporters and editors, but the public at large. One reporter who was most constant in his attendance, and this was the beginning of his reportorial work, had the happy faculty of presenting the progress of the experiment in terms which appealed to the public imagination. He early designated this band of devoted young men as "The Poison Squad." There was rarely a day in which he did not visit the experimental table and write some interesting item in regard thereto. This cub reporter is now the celebrated author of the "Post-Scripts" in the Washington Post, George Rothwell Brown.



The Dining Room of "The Poison Squad"

## **LENGTH AND PURPOSE OF THE EXPERIMENT**

For five years these experiments continued and investigations of an extensive character were carried on with the preservatives which were in most common use. The chemical and

physiological data accumulated were vast in extent and presented great difficulties in interpretation. Following the rule adopted by the Bureau, every doubtful problem was resolved in favor of the American consumer. This appeared the only safe ethical ground to occupy. Decisions against the manufacturers who used these bodies could be reviewed in the courts when the food

law became established, whereas if these doubtful problems had been resolved in favor of the manufacturers the consumer would have had no redress. Without going into further detail in regard to these experiments it may be said that one of the common colors and all the common preservatives used in foods were banned from use by a unanimous verdict against them.

## **DATA PUBLISHED**

The greater part of these data was published as parts of Bulletin 84, Bureau of Chemistry. They comprise: Part I--Boric Acid and Borax; Part II--Salicylic Acid and Salicylates; Part III--Sulphurous Acid and Sulphites; Part IV--Benzoic Acid and Benzoates; Part V--Formaldehyde; Part VI--Sulphate of Copper; Part VII--Saltpeter.

When the data relating to benzoic acid were submitted, the Remsen Board had already been appointed. The Secretary, about to depart on vacation, sent for George W. Hill, Editor of the Department, and said:

"Publish what you like during my absence except that the bulletin on benzoic acid is not to go to the printer."

Mr. Hill misunderstood his instructions. He sent the benzoate bulletin to the public printer with instructions to hurry it through. When the Secretary returned the printing was finished. A reprint of it was promptly denied. The total number of pages in the parts of Bulletin 84 which have been published is 1500.

## **DATA REFUSED PUBLICATION**

Vigorous protests from those engaged in adulterating and misbranding foods were made to the Secretary of Agriculture against any further publicity in this direction. As a result of these protests he refused publication of Parts VI and VII of Bulletin 84. Part VI contained a study of the effects on health and digestion of sulphate of copper added to our foods. The conclusions drawn by the Bureau were adverse to its use. The Remsen Board subsequently made a study of sulphate of copper and reached a like decision. The ban on copper was based on the work of the Remson Board and not on that of the Bureau,

which preceded it by three years. During this interval the use of this deleterious product was unrestricted.

The seventh part treated of the use of saltpeter, particularly in meats. Owing to the well-known results of the depressing effects of saltpeter on the gonads, and for other reasons, the Bureau refused to approve the use of this coloring agent in cured meats. These two bulletins still repose in the morgue of the Department of Agriculture. They are not, however, deprived of companionship. In the testimony of the Secretary of Agriculture before the committee on expenditures in the Department of Agriculture (the Moss Committee), it is found that the following additional manuscripts prepared by the Bureau of Chemistry were refused publication, namely, Experiments Looking to Substitutes for Sulphur Dioxides in Drying Fruits, by W. D. Bigelow; Corn Sirup as a Synonym for Glucose, offered for publication in 1907; Sanitary Conditions of Canneries, Based on Results of Inspection, by A. W. . Bitting, offered for publication in 1908; Reprint of Part IV of Benzoic Acid and Benzoates, asked for in 1909; Medicated Soft Drinks, by L. F. Kebler, offered in 1909; Drug Legislation in the United States, by C. H. Greathouse, offered in 1909; Food Legislation to June 30, 1909, offered in 1910; The Estimation of Glycerine in Meat Preparations, by C. F. Cook, offered in March, 1910; Technical Drug Studies, by L. F. Kebler, offered in 1910; Experiments on the Spoilage of Tomato Ketchup, by A. W. Bitting, offered in 1911; the Influence of Environment on the Sugar Content of Cantaloupes, by M. N. Straugh and C. G. Church, offered in May, 1911; A Bacteriological Study of Eggs in the Shell and of Frozen and Desiccated Eggs, by G. W. Stiles, May, 1911; The Arsenic Content of Shellac, offered June, 1911.

All of these publications are in the morgue. They were objected to by parties using preservatives and coloring matters and articles adulterated with arsenic, and these protests against publication were approved and put in force by the Secretary of Agriculture. In other words, all the principles which animated the Inquisition were used by the Department of Agriculture to prevent any further dissemination of the studies and conclusions of the Bureau in regard to the wholesomeness of our foods. The whole power of the Department of Agriculture

was enlisted in the service of adulteration which tended to destroy the health of the American consumer. On the appointment of the Remsen Board further investigations by the Bureau were ordered to be suspended.

Further information regarding the activities of the Poison Squad were presented to the Committee of Interstate and Foreign Commerce during the final hearings on the Food and Drug Legislation. This information has the distinguishing tone of question and answer which adds much to its interest and value. Quotations from those hearings follow:

## **THE BORAX INVESTIGATION**

### **HEARINGS BEFORE THE COMMITTEE ON INTERSTATE AND FOREIGN COMMERCE**

DR. WILEY: Now, I want to introduce the borax bulletin in evidence; not to have it copied, but simply to have it as an exhibit, because all of you have copies in your desks. That will answer the question which was asked me yesterday about the kind of work done by these young men. You gentlemen need only to glance through this book of 477 pages to see the amount of labor that has been put upon this investigation.

MR. TOWNSEND: When did you begin your investigation of boric acid?

DR. WILEY: In the autumn of 1902.

MR. TOWNSEND: How long were you experimenting on that?

DR. WILEY: We were from the 1st of October to the 1st of the following July.

MR. TOWNSEND: About nine months?

DR. WILEY: Yes, sir.

MR. TOWNSEND: How soon after that did you make a report?

DR. WILEY: On the 25th of June, 1904; just about a year after the close of the investigation.

MR. TOWNSEND: You did not publish it in 1903?

DR. WILEY: We published a synopsis--a preliminary report--in 1903.

MR. TOWNSEND: You said yesterday that you had not had time, as I remember it, or had not been able--I don't remember just exactly how you answered it--to report your investigation of benzoic acid, which had only occupied three months and which was completed in the fall, as I remember it, of 1902.

DR. WILEY: On benzoic acid?

MR. TOWNSEND: Yes; benzoic. acid.

DR. WILEY: The benzoic-acid investigation was not begun until the spring of 1904, and was completed before November, 1904.

MR. TOWNSEND: Are you sure about that? As I took it down yesterday in a note, it was begun in the fall of 1902.

DR. WILEY: Then you misunderstood me; it was not. I was referring to the time I commenced the first investigation.

MR. TOWNSEND: Then I misunderstood you. Who assisted you in making those investigations on borax and benzoic acid?

DR. WILEY: About twenty or twenty-five men besides the subjects.

MR. TOWNSEND: Were any of them of national reputation as scientists?

DR. WILEY: Dr. Bigelow, who is here, is a man of good reputation. He is the one who collaborated with me in, particular. The others are chemists in fair standing, but they are not men of great reputation in a personal way.

MR. TOWNSEND: Connected with the Department?

DR. WILEY: Connected with the Department of Agriculture here; yes, sir. I will explain the

method of investigation briefly, because I know you gentlemen do not care to read this voluminous document.

The young men were selected mostly from the Department of Agriculture--I believe the first were all from the Department of Agriculture. They were young men who had passed the civil-service examinations, and therefore came to us with a good character, as is usual in such cases. These young men were volunteers. We explained to them fully the character of the work that we proposed to do, not particularly stating what we were going to give them, or how, but what our general purpose was, and that was to place in good wholesome foods certain quantities, which we were to select ourselves, of the ordinary preservatives and coloring matters used in foods, and to feed them on these foods with such materials in them.

MR. TOWNSEND: Exclusively with those materials?

DR. WILEY: Oh, no. I will explain, and you will understand how we did it. These men signed a pledge in which they agreed on their honor to carry out all the necessary regulations. They signed a pledge to eat nothing or drink nothing excepting what we gave them at the table. They signed a pledge to pursue their ordinary vocations without any excesses and to take their ordinary hours of sleep. They agreed that they would collect and present to us every particle of their secretions, so that none of it should be lost, and to follow out the rules and regulations necessary to carry out the conduct of the work.

MR. ESCH: Did you require any physical examination?

DR. WILEY: Yes, sir; we had a surgeon detailed from the Public Health Service, who examined all of these men physically and saw that they had no disease, and that they had had no disease within a year, or any sickness of any kind.

MR. TOWNSEND: They were allowed to live at their homes?

DR. WILEY: Yes, sir.

MR. TOWNSEND: How did you collect their perspiration?

DR. WILEY: Perspiration was not collected excepting in one case. We collected perspiration in one case to determine how much borax was exuded through the skin, but in no other.

MR. BARTLETT: You had a release if they died?

DR. WILEY: Yes, sir; from any injury that they might receive.

That was their preliminary work. The first thing which we did was to ascertain, by their own choice largely, the character of good wholesome foods to be used, absolutely free of adulterants, a natural diet which would keep their bodies in a state of equilibrium so that, neither the question of added weight or of losing weight--that is to say, in a fore period, which was a period of about ten days, the body was weighed every day, the amount of food which they ate was weighed, and if they gained a little we cut it off, and if they lost a little we added a little to it--so that by the end of ten days we could get their normal ration. Meanwhile their excreta were collected and analyzed, so that we had a complete check on the normal metabolic process by which the food was utilized in the body and the refuse matter excreted. You will understand that the only excretions that we got were the urine and the feces. All of the others were so small in proportion to the whole mass that they were neglected; in fact, it is impossible to get them; no one has ever attempted it. Then we began by adding to the food one of the common preservatives--borax was first. We had twelve young men, and to six of them we gave borax in the form of boracic acid, and to the other six borate of soda, to see if there was any difference in the effect of those two forms of borax attending the metabolic process.

MR. TOWNSEND: Did you explain that this was a dangerous process?

DR. WILEY: We told them that they might receive some injury from it.



MR. TOWNSEND: That is the reason you took a release?

DR. WILEY: We certainly would not ask the young men to submit to it without an explanation. We told them, of course, that there was no danger by poisons, but that there might be some disturbance to their systems.

MR. TOWNSEND: You thought that there was nothing; but you took a release because there was danger of losing life, in a sense.

DR. WILEY: Yes, sir; we kept nothing from them at all.

MR. TOWNSEND: Do you think that had any effect upon them?

DR. WILEY: We discuss that in the book. That has been one of the objections urged against this work, and it would be urged against any work of the same kind.

MR. CUSHMAN: Is that the bunch known to the public as the "poison squad"?

DR. WILEY: That is the one. I suppose it was the most widely advertised boarding house in the world.

Now, when we had established their normal diet, then they agreed to eat it every day whether they wanted it or not, because that was the important part of the experiment, that the food ingestion must be constant, otherwise you could not study the effect of the added substance on metabolism.

MR. TOWNSEND: Do you explain the effect in your book?

DR. WILEY: That is all explained in the greatest detail.

Now, of course, they did that as long as their digestion was not impaired. When it did become impaired they were released at once from any further administration of the drug. That was all we wanted to do--to get the first effects, never any more. We did not carry it to any extreme. Once a man was

undoubtedly affected he was released. You may ask how we knew how any disturbance produced was due to borax, and I answer because we eliminated all the variables but that one. In the case of the man who had led the same life, pursued the same vocation, eaten the same food, and who did the same things, the only variable was the preservative; so that if the variations are those which would be expected to be produced by such a variable, we logically traced the result of those variations to that one variable, and especially so if when we withdrew it the disturbance was removed. Then the symptoms which had ensued would be removed, and that was additional proof. Therefore as far as possible we ruled out every influence excepting the one which we were controlling. Then we had what we called "periods" of five days, so that we studied them in periods of five days. We called it the first preservative period, the second preservative period, and so on, until we had usually the preservative periods lasting for about twenty days. That was the usual rule. That was followed by a period in which nothing but pure food was given for ten days, the object being if possible to restore the man to the normal state. I will say very frankly that ten days as a rule was not long enough to do that; but as they then had a holiday and rested for some time, it didn't make so much difference to us.

MR. TOWNSEND: What do you mean by a holiday?

DR. WILEY: We kept our table going all the time, but when a man had worked for about forty days on these experiments we then allowed forty days' rest, the same time that we had been working on him.

MR. BARTLETT: That is, you discontinued this character of food.

DR. WILEY: We gave him then nothing but pure food. We did not have to measure his food or collect his excreta; and he simply rested and got ready for another trial.

Now, in our first year's work we only fed six men at a time, so that we had constant observation--six men on holiday and six men on observation--but in subsequent

investigations we found it much more convenient to feed all of the men at the same time and give them the holiday at the same time. That appears from the fact that the chemical work, so far as analysis of foods is concerned, is just as great for six men as it is for twelve, because we did not analyze each person's food, but the food which we gave all, so that we knew the composition of it. Therefore one analysis would do for a hundred men just as well as six. But the excreta that were turned in had to be analyzed separately--that is, every day, or the composite for a number of days, whichever seemed desirable.

MR. TOWNSEND: When you examined that excreta: did you examine for any other substance besides boric acid or benzoic acid?

DR. WILEY: In the digestion of food the process is of two kinds. We have what is called metabolized food and nonmetabolized food, which is found largely in the feces. Parts of the feces never enter the system at all; they are the refuse matter, and therefore we say that they are nonmetabolized. We simply wanted to determine how much protein, how much fat, how much sugar, etc., had come out in the feces and had escaped digestion. Then we examined the urine, which contains the principal part of the degradation products of the metabolized food. When the food enters the system, after the process of digestion, it has two great functions, as you gentlemen know. One is to supply heat and energy. That food is all burned up and converted into water and carbon dioxide, just the same as you burn a piece of coal in the fire and convert it into carbon dioxide and into water. And the great mass of food which we eat is burned in the body and produces heat and energy. Of course the water and the carbon dioxide that come from the lungs and the skin we did not collect.

Then the food which goes to build the tissues, or enters into the tissue, pushes out the degradation products in the same quantity when the body is in equilibrium, just as you fill a tube full of marbles, and when you put one marble in it you will push out another at the other end. Now, if I feed you on nitrogen to-day or to-morrow, when I

go to determine the nitrogen in your urine I do not determine the nitrogen that you have eaten to-day or yesterday, but if your body is in equilibrium the amount of nitrogen pushed out is exactly what you push in. That is what we call the balance, and in that way we can determine whether any substance added to the food disturbs the metabolic process and interferes with digestion. And you can only determine it in that way. The amount of disturbance is so slight that you will never notice it and yet so pronounced that our chemical balance will reveal it.

MR. BARTLETT: Doctor, I see in the bill of fare that you give here that some of the gentlemen took cranberries. What did you add to the cranberries, anything?

DR. WILEY: No, sir; we took cranberries without anything. We did not add any benzoic acid to those. I say that we used the ordinary foods, a plain ration, so that each man would eat on the same day the same number of calories, the same amount of nitrogen, the same amount of phosphoric acid, the same amount of sulphur. We gave an excellent food, the very best of the retailed canned goods. I will say that nearly all of our vegetables are canned vegetables. That shows our attitude toward canned foods, which has been said to be very hostile. We used them because they are more uniform in character, and when put up by reputable firms are apt to be better than the vegetables that you can buy in the open market. Our canned foods were canned to order, so that all that we used during the year were exactly alike. And so important was that fact in the eyes of an enterprising advertiser that he went to one of the firms that sold us these goods--we didn't buy all from one firm--and wanted them to pay him hundreds of dollars to write articles saying that we were using his canned foods. Of course, we promptly refused to allow his name to be used.

MR. LOVERING: Did these young men know when they were eating pure food or not, and in what proportion?

DR. WILEY: They did not know what it was, necessarily, or how much. That was our

business. All they knew was the fact that they were using something.

MR. MANN: For a long time the daily papers published what they were being fed upon.

DR. WILEY: You can not always rely upon newspaper accounts of scientific investigations.

MR. MANN: I suppose the young men read the accounts, and if you did not tell them exactly what they were being fed they might have thought they were being fed on something else.

MR. RYAN: This so-called "poison squad" was selected from employees of the various departments.

DR. WILEY: Almost altogether from the Department of Agriculture. We had a few from the other departments, however, and a few from a medical school.

MR. RYAN: Did they receive additional compensation for entering into this?

DR. WILEY: Not those that were in our Department. Those that came from the outside were paid \$5 a month in addition to the other. We had to give them some compensation; they could not serve in the Department under other circumstances, because it was illegal. We gave them a mere nominal sum so as to make their employment legal. We would not take anybody who was not in the Department in some capacity.

MR. BARTLETT: Did you use real butter or oleomargarine?

DR. WILEY: The butter was made to order, and contained neither salt nor coloring matter--pure butter.

MR. ESCH: How about milk?

DR. WILDY: The milk came from dairies inspected by the District authorities and by myself.

MR. ESCH: Did you at any time adulterate the milk?

Dim. WILEY: We sometimes put the preservative we used in the milk.

MR. BARTLETT: Formaldehyde?

DR. WILEY: Formaldehyde we did constantly, and borax part of the time.

MR. ESCH: How did the health of these men continue; have you any statistics on that?

DR. WILEY: That is all here; everything is recorded in full.

MR. CUSHMAN: Can you tell, in a general way, some of the symptoms, or would that be interrupting the effect of your remarks?

DR. WILEY: If you would like a résumé of the borax matter, I will give that in a few words. I will take the experiment where we gave a minimum quantity, such as you would ordinarily get if you ate meat and butter containing one-half of 1 per cent of borax, in the ordinary quantities of meat and butter and other preserved foods which a healthy man would eat. With the ordinary quantities of butter and meat preserved with borax there would be consumed about 7-1/2 grains of borax per day by each individual; and so we fed that for sixty days in succession, beginning with the preliminary period of ten days, then following sixty days in which we gave the borax.

MR. MANN: How much borax?

DR. WILEY: Seven and one-half grains a day. That was given in two doses. Part of the time in one dose, and part of the time we divided it and gave 3-3/4 grains at one time and 3-3/4 grains at another time.

MR. TOWNSEND: How did you give it?

DR. WILEY: In butter and in milk and in capsules. We tried all methods.

MR. BARTLETT: Did you give any tomato catsup with any of these meats?

DR. WILEY: I don't think we did.

Now, I want to say this, because I regard it as important. For fifteen or twenty days, or even longer in some cases, no visible effects were produced in what you would call "symptoms." The young men had normal appetites and performed their work without any discomfort, and had no complaints. After that time they began to eat their ration with some little discomfort. They were under obligation to do it, but they often said: "I wish you could let this go; I don't want it." Their appetites began to fail. At the end every one of their appetites was very badly affected, and some of them were unable any longer to eat the full amount. Of course we never required anything that was impossible. They developed persistent headaches in most cases, followed by general depression and debility. It was extremely well marked in every instance.

MR. KENNEDY: Did they get nauseated and want to refuse the food with the preservative in?

DR. WILEY: They were occasionally nauseated. We had every variety of food that anybody commonly eats. We varied their menu every day.

MR. KENNEDY: Did the boys seem to get tired of it; did they want to refuse the food?

DR. WILEY: That is the reason we had to resort to capsules, because the very moment he found it in the milk or in the butter he didn't want to use the butter. I would say that this is all set out in here. We were led to the use of capsules because of the objections to which you refer. It may be all wrong, but that, of course, is a matter for you gentlemen to decide.

MR. ADA MSON: When they took the food, did it have some effect on the appetite?

DR. WILEY: It had a worse effect in the food when they knew it was in the food, because it became repugnant to them.

MR. KENNEDY: Don't you think this repugnance is nature's own method of

correcting these things I I remember that out in our town two fellows made a wager with another fellow that he could not eat a quail a day for thirty days in succession. He did it, but it made him sick. That was because there was nothing wrong with the quail, but he was taking it too consistently.

DR. WILEY: There is a great difference between a quail and borax; the latter is a drug.

MR. KENNEDY: A man's life was imperiled by his trying to win that bet; he became very sick.

DR. WILEY: I will answer that by saying that it is the universal experience of physicians that the drug habit grows; the more drug you take the more you need to produce the effect, and the less its effect; so that it is just the opposite to the effect that you mention.

MR. TOWNSEND: Did you try the same experiment with benzoic acid?

DR. WILEY: Not for so long a time, but a shorter length of time.

MR. TOWNSEND: But on the same plan?

DR. WILEY: The same plan. That will be fully brought out in the publication.

MR. WANGER: Was there, at the end of the period of the administration of these preservatives, an immediate relief and restoration of the appetite, or was that a slow process?

DR. WILEY: Unfortunately the effects in some cases were very much prolonged. Some of the young men--the experiments ended in July, or in June, the end of the year--and some of the young men complained even through the summer, and it was late in the autumn before they recovered their full normal appetites.

MR. WANGER: That would furnish a strong presumption that it was not the mental idea connected with the daily use of the preservatives that caused the loss of appetite.

DR. WILEY: It might be that the mental attitude was a strong factor, but when you get used to a thing after three or four days the mental attitude becomes less important. And I got a beautiful illustration of that in our own investigation, because I realized that a very reasonable objection is made against experiments of this kind, against all pharmacological experiments, by reason of the mental attitude of the patient, and I give full credit to the objection in the book, which you will see. I discuss that fully and frankly, and give value to the objections.

But this strange thing happened when we came to salicylic acid. We had an almost new set of young men. We had a few that had come over from the borax period, but one year of this kind of life is as much as a young man wants. They enlisted for a year. So we had a new list. They must have had the same attitude toward salicylic acid that the first set had toward borax, and yet when we began to feed them salicylic acid there was an immediate improvement in the appetite; most of the young men seemed better, wanted more to eat, and it had exactly the opposite effect that borax had. Now, if it had been mental attitude in both cases the effect upon these men would have been the same. But we had the opposite effect. So I think that is the most happy proof. It came instantly, unexpectedly; we were not looking for it. The effect of the mental attitude, which must be considered, does not have the great importance that has been ascribed to it.

MR. TOWNSEND: These men made releases?

DR. WILEY: Yes, sir.

MR. TOWNSEND: How do you explain the effect of a drug--the fact that the constant use of it injures a person to it?

DR. WILEY: I think that is easily explained. As you get used to the effect of a drug you never improve in health. The man who forms the opium habit takes more and more of the drug, but his health goes down all the time. You can tolerate more of the drug, but your health is going all the time, and it takes more of the drug to produce a given effect.

MR. MANN: You say that in the experiments with borax the effects continued some time after the feeding of the borax to the young men, so that there is a cumulative effect of borax upon the system?

DR. WILEY: I referred to that yesterday, and I will restate it. Professor Rost, of the imperial board of health of Berlin, whose work I have here, criticized our work because we said that practically all of the borax was eradicated from the body after ten days. He contends that a lot of it remains in there for a longer time and comes out in the waste material a little at a time for weeks and months, so that his testimony is very much more in favor of the cumulative effects of those substances than our own.

MR. TOWNSEND: Have you tested for that?

DR. WILEY: We have made some tests on that during this last winter, but I have not as yet collated and studied the data.

MR. MANN: Does your report show that in your opinion the use of borax has a deleterious effect upon the organs of the body?

DR. WILEY: Of course you understand, Mr. Mann, the tests that we have made are not the same as those made upon animals fed for pharmacological experiments, because after a given time the animals are killed and their organs are examined, and the changes in the cells are studied by the microscope. We were precluded from doing that.

MR. MANN: Is that your conclusion?

DR. WILEY: My conclusion is that the cells must have been injured, but I had no demonstration of it, because I could not kill the young men and examine the kidneys.

MR. MANN: Your judgment was that the borax was excreted from the body; it did not remain, but that the effects did remain? How else could the effect remain excepting in some way affecting the organs of the body?

DR. WILEY: I think it must have affected the organs of the body. I think that is conclusive proof of it.

MR. ADAMSON: Is the process of resolving these foods into their original elements so difficult that scientists cannot furnish the people any practical method of safely separating preservatives from food when they get ready to use them?

DR. WILEY: It is quite impractical to separate the whole of any preservatives from food, though it probably can be done.

MR. MANN: Does it make any difference how borax is administered, whether administered by itself or administered in connection with foods, and is there a difference in the effect between the administration of a preservative in milk or in some kind of solid food, for instance?

DR. WILEY: The ideal way to administer substances of this kind would be in solution in the food. But that has such practical difficulties that in almost all pharmacological experiments like these which have been performed by the thousand in the world, the method which we finally adopted as the best has been adopted--that is, the introduction of the substance into the stomach in the form of capsules, where nature quickly mixes it entirely up with the contents of the stomach.

MR. MANN: Do not some scientists think that there is a difference in effect whether it is administered in one food or another?

DR. WILEY: That is the objection I have seen in scientific publications and in the public press urged against our work by Mr. H. H. Langdon, who has written a great many letters condemnatory of the work. Mr. Langdon, as I have learned, is employed by the borax company to do this work. He has called attention to that point in the public press.

Many poetic descriptions of the poison squad were published, among the best of which are the following by S. W. Gillilan and Lew Dockstader:

## THE SONG OF THE POISON SQUAD

(Respectfully Dedicated to the Department of Agriculture)  
By S. W. GILLILAN

O we're the merriest herd of hulks  
that ever the world has seen;

We don't shy off from your rough  
on rats or even from Paris green:

We're on the hunt for a toxic dope  
That's certain to kill, sans fail.

But 'tis a tricky, elusive thing and  
knows we are on its trail;

For all the things that could kill  
we've downed in many a gruesome wad,

And still we're gaining a pound a day,  
for we are the Pizen Squad.

On Prussic acid we break our fast;  
we lunch on a morphine stew;

We dine with a matchhead consomme,  
drink carbolic acid brew;

Corrosive sublimate tones us up  
like laudanum. ketchup rare,

While tyro-toxicon condiments  
are wholesome as mountain air.

Thus all the "deadlies" we double-dare  
to put us beneath the sod;

We're death-immunes and we're proud as  
proud—

Hooray for the Pizen Squad!

As Sung by Lew Dockstader--  
in His Minstrel Company  
Washington, D. C., week of October 4, 1903

If ever you should visit the Smithsonian Institute,

Look out that Professor Wiley doesn't make you  
a recruit.

He's got a lot of fellows there that tell him how  
they feel,

They take a batch of poison every time they eat a  
meal.

For breakfast they get cyanide of liver, coffin  
shaped,

For dinner, undertaker's pie, all trimmed with  
crepe;

For supper, arsenic fritters, fried in appetizing  
shade,

And late at night they get a prussic acid  
lemonade.

(Chorus)

They may get over it, but they'll never look the  
same.

That kind of a bill of fare would drive most men  
insane.

Next week he'll give them moth balls,

a LA Newburgh, or else plain.

They may get over it, but they'll never look the  
same.