ADULTERATED GINGER—RESPONSIBLE FOR RECENT PARALYSIS EPIDEMIC.

BY PETER VALAER.

The story of the rise and fall of alleged Fluidextract of Ginger or "Jake" is an old, old story not created by Prohibition but was a problem many years before the advent of the Volstead Act. However, a new and dreadful chapter is written with the appearance of poison ginger or phenol-containing ginger which began to be distributed early in February 1930, and reached its high tide during March, slowly receding toward the end of June, leaving in its wake more than 16,000 victims—some slightly paralyzed in hands and feet, many more seriously paralyzed to the extent of total paralysis, and some, possibly ten victims, have died while being paralyzed. Many theories have been advanced and abandoned as to the cause of the paralysis.

It is clear to those who have carefully studied the investigation that there is no one holding a permit to withdraw denatured or non-beverage (pure) alcohol involved in this gigantic plot to manufacture, distribute and sell this adulterated, substandard and beverage ginger. While hundreds of distributors and sellers have been apprehended and action taken against them, to date the actual manufacturers of phenol gingers have not been found.

To briefly outline the kinds of ginger found on the market it may be said that before the appearance of the phenol ginger the most common form of adulteration was the use of castor oil, the formula being very simple. Enough ginger, usually in the form of oleoresin of ginger (which is usually the alcohol or acetone soluble material extracted from the ground root of either Jamaica, African, Cochin, Japanese or other kinds of crude ground ginger), was added to give it a ginger character which usually amounted to tincture of ginger, sometimes stronger than but usually weaker than tincture preparations. This base when analyzed would show only about .5% solids; the other 3.5% of solids are added in the form of tasteless castor oil. The U. S. P. Fluidextract of Ginger, the only preparation which can be sold unrestricted as a standard medicinal preparation and which is unfit for beverage purposes, contains not less than 4% solids (oleoresin) extracted from the ginger root. This U. S. P. preparation is nearly black in color and exceedingly pungent in taste and entirely unfit for beverage purposes.

In the past twenty odd years, there has been found ginger adulterated with castor oil, molasses, glycerin, herb extract, sugar, mineral oil, glycols and other substances.

Geographically, the field of the paralysis ginger has been investigated and wherever the phenol ginger has been found there have been paralysis victims; in regions where there was plenty of adulterated ginger but no phenol gingers there has been not one case of paralysis. Overwhelmingly the evidence shows that it is the phenol ginger that is responsible. Very reluctantly have many been forced to admit this, principally because the textbooks did not list the phenol ester as a poison. Testimony of innumerable witnesses afflicted with this "jakitis" have agreed that this ginger preparation and ginger alone is responsible. All samples with case history, and there are many, show heavy phenol- or cresol-like bodies. This alleged Fluidextract of Ginger causing the paralysis did not contain any trace of

denaturant used in completely or specially denatured alcohol. It does not contain mineral poisons, lead, arsenic or alkaloidal poisons. This adulterated ginger is the mildest of all beverage gingers in outward character, having a pleasant molasses-like odor, which is due to the crude rosin oil found in all of it along with this tri-(*O*)-cresyl phosphates and di-ethylene glycol. The color is due to a dressing of real ginger, given it from Fluidextract of Ginger or from oleoresin of ginger (the non-volatile solids material of true Fluidextract of Ginger), to which it owes its character, the pleasant aromatic pungency of ginger.

Those not familiar with the esters of phenol or cresylic bodies combined with phosphates think of them as unpleasant substances, like carbolic acid or lysol, but this is not the case because obviously no such substance could be used, as the material added in place of most of the ginger must be as pleasant and as tasteless as possible so as not to interfere with the true ginger character, the purpose being to render it less pungent and fit for beverage purposes. From a beverage standpoint crude rosin oil and tri-cresyl phosphate both are quite unobjectionable as an adulterant, the former imparting a slight characteristic on its own account and the tri-cresyl phosphate being almost tasteless and odorless could affect its taste but little.

The result of the addition of these adulterants is a very cheap ginger, the tri-cresyl phosphate selling at about 30 cents a pint and the rosin oil selling at about 30 cents a gallon.

It was this cheap, grossly adulterated ginger, carrying the paralysis producing portion, which during these fatal months undersold, particularly the castor oil ginger and other adulterated gingers and played havoc through the Carolinas, Georgia, Tennessee, Mississippi, Alabama, Texas, Kansas, Ohio and Oklahoma, as well as other states. Tri-ortho-cresyl phosphate and rosin oil are ideal substitutes for oleoresin of ginger being soluble in alcohol and quite miscible with the true oleoresin that must be added if it is to be sold as Fluidextract of Ginger.

No one who has ever seen U. S. P. Fluidextract of Ginger, even once, or has touched a drop of the same to his tongue would ever again be confused between it and adulterated ginger, already described here—one of the principal differences being the color, the adulterated article being quite light, read about 4 in the $^1/_{16}$" cell of a Lovibond tintometer, while the true U. S. P. Fluidextract of Ginger would never read less than 19 and the average being 22, the difference in the taste of the article being even more pronounced—the volatile oil in true Fluidextract of Ginger being not less than 1%, the adulterated article showing usually less than $^1/_{10}$ of this amount. There are numerous other points of difference, not necessary to mention here.

Experiments conducted to determine the action of cresyl-bearing ginger on animals showed that a picture of phenol poisoning is obtained which is followed by paralysis in the legs of animals. This can be reproduced with fair consistency, using for these experiments monkeys, rabbits and chickens. Alcohol, U. S. P. Fluidextract of Ginger and adulterated fluidextract containing castor oil or other ordinary adulterants used to make solids do not produce these symptoms. (See Public Health Report, Vol. 45, 330, July 25, 1930.)

It is believed that paralysis producing tri-ortho-cresyl phosphate was added without knowledge of its dangerous character. It has been reported that very few

patients afflicted with ginger paralysis are improving. For a time it was generally supposed that they were actually growing worse. In some slight cases recovery has been effected. It may be that in time all the cases may recover but the mending of the affected nerve tissue is slow. Some monkeys once well paralyzed with ginger have almost completely recovered.

Many methods of treatments have been used—none having been particularly effective. Electric treatments, hot baths, remedies such as strychnine, nux vomica, sodium thiosulphate, iodine, all have been used. Many useless quack remedies have been brought forth.

It would seem that distributors and wholesalers have responsibilities for the character of goods they handle. The retailer knows full well if his customers consume it for beverage purposes, but what seems more reprehensible than all is the druggist retailer who will procure his Fluidextract of Ergot, Cascara and other standard drugs from reliable drug houses and then purchase Fluidextract of Ginger, which is pale in color, thin in body and with only a suggestion of ginger, from an unknown distributor or manufacturer.

It has required months of untiring effort on the part of the pharmacologists of the Hygienic Laboratory and the Bureau of Industrial Alcohol Chemists to determine the true cause of the paralysis epidemic, and many animals had to be sacrificed for this purpose. It required more than 20 gallons of the adulterated ginger to positively prove the presence of the tri-ortho-cresyl phosphate.

This ginger was found to be adulterated with about 2% of tri-ortho-cresyl phosphate, about 1% di-ethylene glycol, some rosin oil, a small amount of unidentified impurities and a small dressing of genuine ginger resins about .5% from which it gets its general ginger character.

It is the tri-ortho-cresyl esters that are responsible for the paralysis epidemic. Paralysis can be produced by this chemical when chemically pure or in a commercial state of purity or when it is used as an adulterant of Fluidextract of Ginger.

This opens a new field in pharmacology, the study of the action of the phenol esters in the human body.

Most of the chemical work in this investigation was done by Mr. George E. Mallory and Mr. W. H. Frazier of the Bureau of Industrial Alcohol in the Treasury.

This splendid piece of pharmacological work was done by and under the direction of Maurice I. Smith, M.D., National Institute of Health (Hygienic Laboratory).

See Vol. 45, 330, July 25, 1930. "Public Health Report."

NOTE: There will be published in the *Public Health Report* the complete and finished data on the action of tri-ortho-cresyl phosphate which will finish the experiment in the relation to paralytic ginger. There will also be issued an extensive mimeograph by the Bureau of Industrial alcohol covering all the chemical work involved in the analysis and isolation of tri-ortho cresyl phosphate and other ingredients found in the adulterated ginger. Both of these publications will be available on application to the Bureau of Industrial Alcohol, Washington, D. C.