directions state, the finished product will be a little too stiff and much more work will be needed to get a smooth ointment.

In a communication to Chairman Seltzer of Sub-Committee 13, we suggested that the new ointment base which we have been discussing would make a good Simple Ointment. Bibbins[1] and Lascoff independently submitted a formula for Simple Ointment, each containing the same ingredients but in different proportions. For purposes of comparison, these three formulas are shown in Table I below.

TABLE I.

Ingredients.	Lascoff Formula, Grams.	Bibbins Formula, Grams.	Purdue Formula, Grams.
White wax	90	60	50
Anhydrous wool fat	120	90	50
White petrolatum	390	450	900

These formulas differ in consistency of the finished product. As to this quality, who is to decide? It is our feeling, however, that Simple Ointment is designed to be used as a diluent in ointment mixtures or as a base for certain simple prescriptions as the occasion arises. In either case, it should not be too stiff, which, we believe, is the case with the present Simple Ointment.

We wish to conclude by saying that we have no argument for the use of a mixed base, largely composed of petrolatum, where animal fats or vegetable oils are therapeutically indicated. In all other instances, we believe that a simple compound base, in the nature of those given in Table I, is a great improvement over any that are now official. It is certainly much better than petrolatum alone. A base such as has been proposed does not solve all of our ointment ills, but it alleviates a number of them.

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DISPERSED PHASE FLAVORS IN EMULSIONS.*

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The purpose of this report is to describe a slight modification of the technic commonly employed in flavoring emulsions to improve their palatability. No new flavors will be suggested since this paper deals with the methods of employing flavors and not with the quality or advantages of any particular flavor.

The first mention of Emulsions occurs in the Edinburgh Pharmacopœia of 1839. In 1870 a formula was published for a preparation very similar to Emulsion of Cod Liver Oil called Cod Liver Cream. Emulsions as a class were not admitted to the United States Pharmacopœia until the seventh revision when the Emulsions of Ammoniac, Almond, Asafetida and Chloroform were recognized. However, for several revisions previous to 1890 Emulsions of Ammoniac and Al-

[1] U. S. P. XI Bulletins, Sub-Committee 13, Bull. 31, page 70 (1932).

* Section on Practical Pharmacy and Dispensing, A. PH. A., Toronto meeting, 1932.

[1] Associate Professor of Pharmacy and Dean of The School of Pharmacy of The George Washington University.

mond were official but were designated as Mixtures. Emulsion of Cod Liver Oil was first recognized in the U. S. P. of 1900.

Dr. William Clayton in his comprehensive treatise, "The Theory of Emulsions," cites over 400 references from the current literature dealing with the innumerable problems and theories of emulsification. A great amount of research has been done on emulsions by physical chemists and others but to-day their is little agreement on the problem. As pharmacists, however, we are more concerned with the preparation of permanent, attractive and palatable preparations than with the underlying theories involved. Through the efforts of many able pharmacists we have to-day methods of preparation, and emulsifying agents, which appear quite satisfactory for practical purposes. I shall discuss only the problem of rendering medicinal emulsions more acceptable to the patient. This limited group, intended for internal administration, consists almost entirely of oil-in-water emulsions, of which Emulsion of Cod Liver Oil can be considered as a type and upon which this work was done. For the purpose of discussion may we at least tentatively accept the pharmaceutical definition that "Emulsions are homogeneous mixtures of immiscible substances (usually liquids) held by the intervention of an intermediate agent?" The intermediate agent or emulsifier is acacia in the case of Emulsion of Cod Liver Oil and in most other official emulsions. Acacia is water soluble, therefore producing an oil-in-water emulsion in which the oil droplets are dispersed through a continuous phase of water.

May I be permitted to attempt to draw a mental picture of an oil-in-water emulsion so that the reasons offered for this proposed method of flavoring will be clear? Scoville, Bentley and others describe an emulsion of this type as essentially composed of droplets of oil which are completely surrounded by droplets of water. Thus the oil globules are prevented from coalescing by the immiscible film which surrounds them. The emulsifying agent (acacia) which permits oil and water to be mixed in a homogeneous state performs three functions: (1) it lowers the surface tension of the water, (2) it increases the viscosity of the mixture thus retarding separation and (3) it prevents the coalescence of the oil globules by surrounding each globule with an immiscible film. This brief description is intended solely to cover the pharmaceutical aspects of an emulsion and does not attempt to reconcile the many controversial theories of the structure of emulsions in the physical sense.

Visualize now a single droplet of cod liver oil completely surrounded by an immiscible film of acacia and water as the primary nucleus of the emulsion. To this we add methyl salicylate, which is immiscible with the acacia and water film and therefore cannot mix with the cod liver oil at the center. It therefore must remain suspended in the continuous phase or in other words in the water. This represents the condition of Emulsion of Cod Liver Oil as made by the U. S. P. X method. The odor and taste of the methyl salicylate predominates when the emulsion is first swallowed because it is present in the continuous phase. Up to this point the emulsion is quite satisfactory but when the emulsion state is broken in the stomach the masking effects of the flavor is lost and the patient if and when he belches tastes cod liver oil.

The problem as here pictured is to so flavor the dispersed phase or the cod liver oil that even when the emulsion is broken down in the stomach the flavor will

remain dissolved in the oil and thus continue to disguise its taste until such time as the danger of belching has passed. However, the continuous phase must also carry some flavor to render the product palatable at the time it is taken. It has been found possible to accomplish these objectives without increasing the quantity of flavor now used.

A study of the pharmacopœias and formularies of American and European nations reveals the fact that in every case where the Continental method of emulsification is followed the flavoring agent is added to the primary emulsion. This is generally the case as well when the English method is followed, and also when tragacanth, egg yolk or other emulsifiers are used. To state the procedure in definite terms allow me to quote the U. S. P. X directions for preparing Emulsion of Cod Liver Oil:

> "Thoroughly mix the acacia with the cod liver oil in a dry mortar or other suitable vessel, then add at once 250 cc. of water, and complete the emulsification by trituration or by the aid of a suitable mechanical device. When a thick, white, homogenous mixture is obtained, add the methyl salicylate and the syrup with sufficient water to make the product measure 1000 cc. and mix thoroughly."

This method of flavoring is and has been in general practice since the beginning of the use of emulsions as a means of rendering more acceptable unpleasant drugs. A careful search has failed to show why the procedure was adopted or that it has ever been challenged.

That the method of the U. S. P. X for preparing this preparation and the same general technic which is followed in the case of most other emulsions yields a preparation having the odor of the cod liver oil covered is not questioned. Further, the taste, when first swallowed, is that of the flavor. The point at issue is that in a majority of individuals the irritation that follows the ingestion of cod liver oil causes belching and occasionally regurgitation. Under these conditions the cod liver oil is distinctly tasted and the patient frequently refuses to continue the treatment. It is believed that this is caused by the fact that in the stomach the emulsion is cracked and that the pronounced and unpleasant taste of the oil is noticed because it has been separated from the flavor. It is contended that this is due to the method of preparation where the flavor is added to the continuous phase and its power to cover the odor and taste of the cod liver oil is lost as soon as the emulsion state is altered by the stomach.

This is, of course, theoretical speculation but clinical tests seem to sustain the theory. Twenty-six four-ounce bottles of U. S. P. X Emulsion of Cod Liver Oil were distributed to students of The George Washington University. The bottles were labeled only by number with directions for taking. Ten students tasted cod liver oil and 16 tasted wintergreen when swallowed; 18 reported belching after a short time and of these 11 tasted cod liver oil and 7 tasted wintergreen. From this we assumed that approximately two-thirds of the patients taking cod liver oil suffer from belching afterward, and of those who did belch 60% tasted cod liver oil while only 38% tasted it at the time the emulsion was swallowed. The increase in the number who tasted cod liver oil after belching, over the number who tasted the oil when swallowed is significant. It is possible that this can be explained by the probable breakdown in the emulsion state, when belching would cause the cod liver oil to be tasted rather than the flavor.

With these findings in mind 26 new samples were prepared and labeled as before. In this batch the same ingredients and quantities were used but $^3/_4$ of the quantity of methyl salicylate specified (4 cc. per 1000 cc.) was dissolved in the cod liver oil before being emulsified. The remainder of the methyl salicylate was added after the primary emulsion had been made. This was expected to give a part of the flavor dissolved in the dispersed phase and a part in the continuous phase. Thus, theoretically at least, offering an Emulsion of Cod Liver Oil which possessed the odor and taste of wintergreen at the time swallowed and also preventing a taste of cod liver oil if belching followed. Except for this slight modification the second group of samples was identical with the first group. This change was predicated upon the assumption that since the flavor was miscible with the cod liver oil and was emulsified with it as a part of the dispersed phase, the flavor would remain to disguise the taste of the oil until such time when the possibility of belching was passed. There was no noticeable difference in the odor of the finished products and the students taking the preparation were unaware of any change.

These samples were distributed as before with the following results: 11 reported tasting cod liver oil when swallowed and 15 tasted wintergreen, of the total group of 26, 19 reported belching and 4 of these tasted cod liver oil while 15 tasted wintergreen. Compared to the results reported with the U. S. P. X emulsion we find essentially the same reaction to taste at the time of swallowing, approximately the same proportion belched after taking, but of those who belched only 22% tasted cod liver oil while in the U. S. P. X sample 60% tasted cod liver oil. With the modified sample 78% of those who belched tasted wintergreen while with the U. S. P. X emulsion only 38% tasted wintergreen. Making due allowance for the absence of exact control methods and differences in individual tastes the results of this limited experiment would seem to favor the principle of flavoring the dispersed phase of an emulsion where that phase possesses an undesirable taste or odor. To accomplish this the agent added to disguise taste or odor must be oil soluble. It is not thought that all of such agent should be mixed with the dispersed phase, since this would probably lessen the pleasing odor of the finished product, but arbitrarily it is suggested that $^3/_4$ of the usual quantity employed be incorporated with the oil before emulsifying. The remainder to be added in the usual way to the finished product.

In conclusion the results of this experiment indicate, (1) that the present method of flavoring emulsions disguises the odor and taste of the oil only when swallowed and in a large majority of the individuals who belch after ingestion of the emulsion, the taste of the oil predominates, the flavor failing to supply the covering properties as intended, and (2) that by dissolving a portion of the flavor in the oil before emulsifying, and adding the remainder of the flavor after the nucleus is formed, no loss of palatability at the time of ingestion is observed and in addition the taste of the oil if belched is masked by the flavor which was added directly to the oil. Further, no increase in the quantity of flavor now used is necessary. Only oil-soluble flavors such as the volatile oils, vanillin, etc., should be used in the dispersed phase, although water-soluble substances such as syrups, tinctures and elixirs may be used to advantage in the continuous phase to render the product as a whole palatable.