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THE

PHOSPHATES IN NUTRITION

AND THE MINERAL THEORY OF

Consumption and Allied Wasting Diseases,

AN ENTIRELY NEW AND SUCCESSFUL TREATMENT, AS SUGGESTED BY THE OBSERVATIONS AND EXPERIMENTS OF

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AS PRACTICALLY CARRIED OUT BY

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THE

PHOSPHATES IN NUTRITION.

CHAPTER I.

RESULTS OF DR. M. F. ANDERSON'S EXPERIMENTS.

Although up to the present day Consumption has proved intractable to almost every form of treatment, it has been and is a subject of universal interest. Its inception is so insidious, its advance so rapid, and its mortality in all classes and at all ages so great that its treatment must ever be of interest, and any research in either the field of therapeutics or pathology, any experiments in chemistry or physiology that throw any light upon the subject should claim the attention of every thoughtful practitioner. Dr. M. F. Anderson, of England has recently published a book on the subject of "Phosphates in Nutrition," a very able review of which may be found in the *Edinburgh Medical Journal* for November, 1878, and *Braithwaite's Retrospect* for January, 1879.

In it he clearly sets forth the results of his experiments on the part the Phosphates play in causing and maintaining organic disease in the human system, and

draws therefrom certain conclusions in regard to therapeutics that are well worth a careful study. He maintains that the inorganic ingredients of the blood and tissues have hitherto received too little attention at the hands of physicians. He believes that the only form in which Phosphorus is met with in the fluids or solids is as Phosphoric Acid, and that usually in the form of a Phosphate. This is in direct opposition to the views and teachings of many chemists and physiologists, who maintain that Phosphorus exists, as such, in various albuminous compounds, or in some other form than that of Phosphoric Acid. He further states as the results of his research, that in the blood and tissues these salts are always *tribasic*, having in addition in nervous tissue, Phosphoric Acid as a hydrate and in combination with the albuminous material of the same.

The great point upon which the whole theory hinges is that these Phosphatic salts enter largely into and are necessary for the proper nutrition of vascular tissue, and that their presence may be demonstrated in the inner coats of the arteries and the whole structure of the capillaries.

In confirmation of his views he goes on to show that organs will be rich in the Phosphates in exact proportion to their vascularity. The bones are of course an exception, as the Phosphate of Lime is there simply for the purpose of giving strength, its presence being explained upon purely mechanical grounds. He cites tendons and ligaments as examples of low vascularity and proportionally low phosphatic presence, there being but a trace.

Passing then to a discussion of the function of the arterial and venous radicles and the lymphatics, he demonstrates very clearly the fact that they serve a double purpose, viz.: that of tissue renovators and builders and of scavengers or removers of waste materials, *i. e.*, the

results of tissue metamorphosis. Advancing with the subject, he lays the primal, progressive and final danger in Phthisis at the door of these builders and renovators of tissue, showing that they erect almost nothing, and tear down much to supply material for combustion and the production of animal heat. He then makes application of his facts and reasoning to Consumption, Scurvy, Rickets and Cancer, in all of which he claims that the arterioles, capillaries and lymphatics are seriously affected by an absence of Phosphoric Acid and its salts: their own nutrition being below the normal, they are unable to carry on the reparative processes in a normal degree, and indeed turn upon and tear down the tissues that it is their function to nourish, to supply their own and the wants of the system. The evil is then two-fold; (*a*) tissues that should be renovated are destroyed, and (*b*) the resulting effete material, tissue *débris* gradually collects in and about the cells until a thorough clogging of the machinery takes place and the vital chemistry of the part is wholly reversed or done away with. Further, the whole system is poisoned by this material and hectic and its fellow troubles result.

In reference to Scurvy, Dr Anderson finds that the remedial power of lime or lemon juice in this disease lies in the Citric Acid which it contains, and that it acts thus by virtue of its power to render the insoluble phosphates soluble. He says, "The anti-scorbutic action of lemon juice is thus reduced to its citric acid, and the efficacy of this depends on the conversion of insoluble phosphates into soluble for the formation of tissue phosphates. He shows that while two samples of fresh meat yielded respectively .256 and .230 per cent. of Phosphoric acid, salt meat such as is used on ship-board had but .147 per cent. before soaking; the prolonged soaking which it got before use still further removing the soluble phosphates.

Turning again to Consumption, Dr. Anderson says that this condition of rapid tissue destruction to supply material for combustion, and the maintenance of heat, is, in a certain measure, relieved by the judicious exhibition of *Cod Liver Oil;* but says that the resulting improvement will not be permanent, and ascribes it to the absence of the proper form or amount of Phosphates in the food or medicine. As we all know, it is nonsensical to attempt to heal the lung lesion while the body is being consumed. Once the general health improves, the pulmonary troubles begin to mend or remain stationary.

That the tissues may cease to waste as rapidly as before the oil was given, does not prove that the oil will exert a curative effect. There is another block in the path: the results of tissue metamorphosis, that are interfering with local nutrition and poisoning the system. How shall we rid the tissues of this material? Dalton*, in speaking of the Potassium and Sodium Phosphate, says: "Of all the internal fluids, the most essential is the plasma of the blood, since it affords the materials of nutrition for the entire system; and its alkaline reaction, which is distinctly marked, has been found to be invariably present, not only in the human subject, but also in every species of animal in which it has been examined.

"This reaction of the blood is, moreover, necessary to life, since Bernard† has shown that if an injection of dilute acetic or lactic acid be made into the veins of the living animal, death always results before the point of neutralization has been reached.

"The alkaline reaction of the blood plasma gives to this fluid its extraordinary capacity for dissolving Carbonic Acid. According to Liebig, water, which holds in solution one per cent. of Sodium Phosphate, is enabled

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* Human Physiology. Phila., 1875, p. 49.

† Liquides de l'Organisme. Paris, 1859, tome 1, p. 412.

to absorb and retain twice its usual proportion of Carbonic Acid; and other alkaline salts, as is well known, have a similar action upon this gas. Consequently, the blood, as it circulates among the tissues, rapidly absorbs from them the Carbonic Acid that has formed in their substance, and incessantly carries it away to be eliminated by the lungs.

"This important property of the circulating fluid depends upon its alkaline reaction. The alkalescence of the blood is due, in a great measure, to *the alkaline phosphates;** which are present in human blood in the proportion of 0.67 part in one thousand parts."

The part which the Phosphates play in the blood is thus seen, and is a very important one, though probably secondary to its nutrient action on the capillaries. That retained products of decomposition often prove a source of great evil, is beyond question. Dr. T. Lauder Brunton† says; "The intercellular fluid, in which these products (of decomposition or tissue waste) are contained, is absorbed with the general circulation by the veins and lymphatics. Unless some provision were made for its removal, it would soon accumulate in the blood and arrest the functional activity of the various tissues, beginning with, that most susceptible of all, the nervous tissue, causing death."

The doctor further states that, aside from their action on capillary nutrition, the Phosphates aid in the secondary assimilation of the other materials of the ingesta.

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* The italics are ours.

† Practitioner, Aug., 1878, p. 91.

CHAPTER II.

THERAPEUTIC INDICATIONS FOR THE USE OF THE PHOSPHATES.

Phosphates.. { Alkaline. { Lime Phosphate, $Ca_3\ P_4\ O_8$ / Magnesium Phosphate, $Mg_1\ H\ PO_4$ } Earthy... { Sodium Phosphate, $Na_2\ H\ PO_4$ / Potassium Phosphate, $K_2\ H\ PO_4$ }

A careful review of the foregoing facts so ably set forth by Dr. Anderson in his valuable work, leads us at once to the conviction:

1st. That the primal trouble in these diseases (Consumption, Scrofulosis, etc.) lies with the capillaries, which, by reason of a lack or total absence of the Phosphates are unable to properly nourish the tissues. A rational treatment, therefore, must be that which supplies these salts in a palatable and easily assimilated form.

2d. That a lack of these salts in the blood allows the accumulation of tissue detritus, and a gradual poisoning of the system, manifested by chills, hectic, and profuse night-sweats; these sweats and the diarrhoea still further impoverishing the blood in its much needed saline ingredients.

The treatment of Consumption and diseases of like nature by the Phosphatic salts is by no means new, for the profession generally, following the lead of Dr. Churchill, have for some time been using the Hypophosphites of Lime and Soda. This preparation was first introduced in the Hospitals of Paris some thirty years ago. The results which were then and have since been attained, show that the doctor, although taking a

step in advance, had not reached perfection, and it is nothing more than is reasonable that in the time that has elapsed some new preparation or modification, based on recent physiological and chemical discoveries, should improve upon and supersede it. The idea or theory on which this treatment is based is a correct one, but the application is faulty in two respects:

1st. Instead of the *Hypophosphites* the *Phosphates* should be used; and,

2d. The bases should be of the kind and in about the proportion found in the food, have a relative proportion to the amount in the brain, muscles and nerves, and be given with the oil in an *acid* solution.

We have already seen that Phosphorus exists in the system only as a tribasic phosphate,* nervous tissue having in addition Phosphoric Acid as a hydrate, and in union with the albuminous matter. The Phosphates are proximate principles of the body. Dalton† says, "A proximate principle is properly defined to be any substance, whether simple or compound, chemically speaking, which exists under its own form, in the animal fluid or solid, and which can be extracted by means which do not alter or destroy its chemical properties."

As Dr. Anderson claims, and others verify, the Phosphates are the salts needed. The Hypophosphites are not found in the blood, tissues or excretions, and when given in this form Phosphoric Acid meets the indications, if at all, but very imperfectly. It is claimed by the advocates of the Hypophosphite treatment, that the Phosphates are of no essential benefit, being rapidly excreted in the form in which they were taken. This is true also of the Sodium Chloride, but it is not denied

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* The only exception to this is the acid bi-phosphate of the urine, which, however, appears only in an *excretion*.

† Human Physiology, Phila., 1875, p. 35.

that it is of the greatest use, and necessary to the tissues, fluids and animal membranes in which it exists, and by which the process of osmosis is so greatly facilitated. The experiments of Boussingault upon animals, and those on the relative permeability of animal membranes by solutions, with and without the Chloride, are too well known to need quoting at length here. The Phosphates possess the same property, though in a less degree. Furthermore we think there can be no question as to whether the salts of Phosphoric Acid do undergo certain changes in the blood. The idea that the Phosphates we find in our urine are the same that we took in with our food is preposterous, and against all chemical knowledge.

It is claimed by some that the Hypophosphites are superior to the Phosphates in the treatment of these diseases, from the fact that the former represent Phosphorus but partly oxidized, and that the remedial power lies in its taking two more atoms of oxygen to itself after entering the system, passing off by the kidneys as a Phosphate; the Phosphate thus being burnt up material. If this is so, or was intended to be so, why does not Nature give us Hypophosphites in our food, and store it up in our muscles and nervous tissue?

"Our vegetable food of every kind contains these Phosphates, and in not much dissimilar proportion.

"The nutritive salts of wheat are identical with those of meat, and one understands that what is true of meat must also be true for bread, and that the nutritive value of flour is less in the same proportions as it contains less of the nutritive salts than the grain. The nutritive salts of wheat and meat are Phosphates, and consist of compounds of Phosphoric Acid with potash, magnesia, lime and iron. The simple relation of the quantity of these substances contained in wheat and in flour, as shown by

chemical analysis, will be sufficient to make obvious the difference in the nutritive value of the two:

1,000 lbs. of wheat contains 21 lbs. of Phosphates.
1,000 " flour " 5½ " "

PROF. J. V. LIEBIG."

In the mothers' milk, which is the food, *par excellence*, for tissue formation, Hypophosphites are not present, but Phosphates are, and in goodly amount. Can we follow any better example than that given us so uniformly by Nature? And when the treatment fully bears out and verifies the theory, is it not well to follow it to the best of our ability? It is to be recollected, in this connection, that we are not seeking to find a specific for a disease, but to feed and build up wasting tissues.

Speaking of the Phosphate of Magnesia, Dr. Dalton* says: "Like the lime phosphate, which it everywhere accompanies, it is present in all the tissues and fluids of the body, though this substance is, for the most part, in the smaller quantity of the two. Thus, in the bones, the lime phosphate is in the proportion of 576 parts per thousand, while the magnesium phosphate forms only 12.5 parts. In the blood, the calcareous salt amounts to 0.30 part per thousand, the magnesium salt to 0.22 part; and in the milk there are 2.72 parts of lime phosphate to 0.53 part of magnesium phosphate. *On the other hand, the salts of magnesium have been found to be in larger quantity than those of lime in the muscles, and nearly twice as abundant in the brain.*†

It will thus be seen that while the Lime Phosphate is in excess in the bones, milk, and blood, the Magnesium Phosphate is in excess in the muscles and nervous tissue. This fact calls on us to let the Lime Phosphate play a minor and the Magnesium salt a major part in the

* Op. Cit, p. 48.

† The italics are ours.

treatment of Consumption, and the Nervous and Wasting diseases.

Those physicians who advocate the use of the Hypophosphites, aside from the error of giving the wrong salt, persist in making Lime and Sodium their chief bases. The need for Phosphate of Lime in the bones, of which it forms 576 parts per 1000, and in the milk that goes to the child whose bones are rapidly forming, is very apparent, and affords an indication for treatment in Rachitis. The case is different in Consumption. Even if we hope for a cure by calcification there is always enough Lime present to accomplish it, provided the nourishment of the general system, dependent on a fairly healthy condition of the capillaries, allows it to take place. Enough Sodium is furnished by the Chloride of the same. In this food-treatment of the wasting diseases we should choose our phosphatic salts after the pattern nature furnishes us in the proportion in which they are present in our food.

"One pound of wheat contains about 140 grains of phosphates, made up as follows: Phosphoric acid, 66 grains; potash, 41 grains; magnesia, 16 grains; lime, 6 grains; soda, 3 grains; iron, 3 grains; sulphuric acid, 3 grains; silica and clorine, 2 grains.

In meat the most important is phosphate of potash; magnesia is also present. The proportion of lime, when present, is so small that it rarely amounts to one-fourth of the magnesia."—Prof. LIEBIG. *See Turner's Chemistry.*

"The phosphates contained in wheat are soluble; they are not combined with organic matter, but are in a free condition; further, the greatest part are those of potash and magnesia."—Prof. GRACE CALVERT, F. R. S.

There are those in and out of the profession who claim extraordinary results from using what is improperly called "Vitalized Phosphates." Phosphates are phosphates, and nothing more, wherever we find them, and the fact of their having passed through certain living or organized bodies, or originated in them, can exercise no influence on their therapeutic value. However originating, if supplied to the tissues in proper form and proportion, they will do their work.

CHAPTER III.

THE OLEO-MINERAL TREATMENT OF PHTHISIS, SCROFULOSIS, WASTING AND NERVOUS DISEASES, AS BASED ON THE THEORY OF FOOD THERAPEUTICS.

We have shown in the last chapter, that while the Oleo-Mineral treatment is especially adapted to those diseases whose origin lies in defective nutrition, the facts have been unintentionally perverted to suit a false theory ; i. e., that of supplying Phosphorus to tissues that do not need it, and in which it has no place, but which do need Phosphates. It is for this reason that the treatment has so generally failed, and brought nothing but disappointment to its originators and supporters.

The common treatment, that by Cod Liver Oil alone, is a good one, but that by oil and phosphates is a better. Having once recognized the value of Cod Liver Oil in the treatment of these diseases, a great advance was made when the emulsion of the oil was proposed and carried out. By the minute subdivision thus attained, the weakened pancreas, the juice of which is necessarily below the normal standard, is relieved of extra work, and a pleasant taste and smell substituted for that which was before disgusting. The cooking, seasoning, and flavoring of food is one of the features that marks the dividing line between man and animals, and that is more fully developed as we ascend in the scale of civilization. It is a well-known fact that a dish that is palatable will be

digested rapidly and thoroughly, where one that is nauseous, or insipid, will be but partly or poorly digested, and will pass off by the bowels in a few hours by means of an irritative diarrhœa. This is especially true of persons who are nervous, and whose stomachs are weak and easily disordered.

There is, however, one great fault to be found with the majority of the emulsions now in the market. They are made up with alkalies (the Hypophosphites) in combination with the oil, thus defeating the great aim of the preparation—minute subdivision ensuring ease of assimilation—and presenting a *liquid soap*, much of which passes off by the bowels.

Assuming, then, that a judicious combination of the oil emulsion and the phosphates, with an agreeable taste and smell, is indicated in these diseases, how can we accomplish it without saponification of the oil? By presenting the oil in an *acid* solution, the acidity being due to free Phosphoric Acid. It has been my endeavor, and I am pleased to say that I have succeeded in producing just such a combination. This preparation has now been before the public and in the hands of the profession for some time, and all who have used it have tested its practical working and great worth. Children take it without question, and digest it readily.

One great point in its favor is its thorough *miscibility with water*, forming a kind of milk. It can thus be diluted to suit any taste, or the idiosyncrasy of any stomach. It may be well to state here that the pleasant taste and odor of this preparation are not attained at the expense of the oil. *It always contains* 50 *per cent. of the best Norway Cod Liver Oil.* Above all, this preparation is founded on a rational basis of facts that are sure to carry conviction to the minds of those who study them, and the truths will be borne out and verified by the results of the treatment.

As we have seen from Dr. Anderson's experiments, the Phosphates exercise their peculiar functions directly in the capillaries and tissues themselves. From Dr. Dalton,* also, we demonstrate the increased scavenger power of the blood by reason of the presence of these salts. They, of course, do this work, although secondary to their nutritive action on the capillaries, when given *with* the oil, and to this is probably due much of the relief from night-sweats and hectic. There are cases, however, where, when given alone, they act to special advantage. Stout, plethoric people, who eat much and exercise but little; whose tissues are in a boggy, ill-drained condition, will find this preparation of the Phosphates (Phospho-Nutritine) of the greatest service in accomplishing tissue defecation and sewerage. The dull, heavy, somnolent feeling experienced by these patients is soon relieved, and a slow poisoning by tissue detritus avoided.

We have seen that in the brain, muscles and nervous system Phosphate of Magnesia is present in about double the quantity of Phosphates of Lime, and in a relatively larger proportion than the Phosphates of the other bases. This preparation contains the Phosphates in about this proportion, and it will be found of inestimable value in the rational treatment of the various neuroses, especially nervous asthenia. In these days of mental strain and over-work, some preparation is needed that will assist brain and nerve power, not by stimulation, as commonly understood, but by *direct nourishment*. There are some cases where the oil and phosphates are indicated, in which it is better to commence with the Phospho-Nutritine until the nervous and capillary systems are improved, when the oil will be better borne than if given at the outset of the treatment.

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* Op. Cit., p. 49.

It has been found that the prolonged use of the Hypophosphites is apt to cause a Phosphatic sediment in the urine, and predispose to calculous disease. The use of this acid preparation of the Phosphates is open to no such danger, the slight excess of Phosphoric Acid to which the preparation owes its acidity, going to render the urine more acid, though not abnormally so, and thus carrying off any excess of phosphates in a soluble form. In the so-called "Phosphatic Diathesis" this preparation of the phosphates has been found to be quickly remedial. "In the urine a portion of the alkaline Sodium Phosphate is replaced by the Acid Sodium Biphosphate, which gives to this fluid its property of reddening blue litmus paper, although it contains no free acid."*

"The diurnal excretion of Phosphoric Acid by the urine is from 30 to 90 grains. The mean of twenty-five sets of observations by Dr. Parkes was 48.80 grains a day."†

We have already briefly noticed Dr. Anderson's conclusions in regard to Scurvy. He has proved that this terrible disease is due to an almost total absence of the Phosphates in salt meat, which forms the chief diet of sailors on long voyages. Accepting this fact, we must conclude that a combination of these phosphates in an acid solution is the very thing for this affection, and it would give me great pleasure to furnish some ship's crew who contemplate a long voyage, with enough of this preparation to fully test the accuracy of Dr. Anderson's views, and at once set at rest the question of the causes and proper treatment of Scurvy.

In conclusion I would say that the comparatively new and very valuable views and research of Dr. Anderson, having so direct a bearing on the treatment of

* Dalton, Op. Cit., p. 48.

† Roberts on the Urine, p. 43.

Consumption, Scrofula, Wasting and Nervous diseases, has led me to lay them before the profession in this country, knowing that they will recognize and apply practically the points of real value. I would further say that I am certain that no other preparation of the Phosphates, or combination of the Phosphates and Oil, in the market so fully carry out the ideas here expressed; as do mine.

FORMULÆ.

Phillips' Phospho-Nutritine.

One DRACHM *represents the Soluble Wheat Phosphates in two ounces of Wheat as follows:*

PHOSPHATES,	17½ *grains.*
PHOSPHORIC ACID,	8¼ *grains.*
POTASH,	5⅛ "
MAGNESIA,	2 "
LIME,	¾ "
SODA,	⅜ "
IRON,	⅛ "
SULPHURIC ACID,	⅜ "
SILICA,	¼ "
CHLORINE,	

The acidity of this preparation is due to Free Phosphoric Acid.

Phillips' Cod Liver Oil and Phospho-Nutritine.

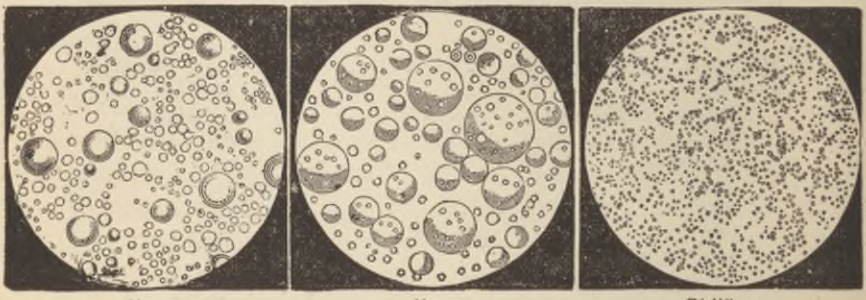
Tablespoonful (℥ss.) contains

BEST NORWEGIAN COD LIVER OIL,	50%
MUCILAGINOUS MATTER,	50%
GLYCERINE,	
FLAVORING MATTER,	
PHOSPHO-NUTRITINE, (3i)	
	100

To Physicians.

Aware of the many preparations of Cod Liver Oil placed before your notice in the last few years, I could not hope to enlist your attention to another, unless it contained unusual merits and entirely new features. The advantage of having Cod Liver Oil in a palatable and pleasant shape, which can be diluted to any extent, so as not to nauseate, or lower the tone of the stomach, and which is necessarily more easily assimilated, must be apparent, and I therefore confidently commend my ***Palatable Cod Liver Oil*** to your attention, as possessing these properties, soliciting an examination of it. The Oil is combined with ***Phospho-Nutritine***, a preparation of the Soluble Wheat Phosphates, by which all the disagreeable taste and smell is overcome, and tonic properties added. Without the aid of alkalies, an exceedingly minute division of the oil globules is accomplished, and an emulsion produced that is as miscible in water as milk, and as much under your control as any tincture. An article, therefore, which must appeal to scientific knowledge and common sense.

I would like you to make the following experiments: Stir well in a glass of water a teaspoonful of the Palatable Cod Liver Oil, and try any other emulsion under the same conditions. Now examine carefully the different mixtures as to combination, palatability and appearance. Then from each take a fractional part of a drop and put them under a microscope of 50 or more diameters, which will show impartially the comparative quantity of oil, the size of the globules, and whether or not there are any soap bubbles present.



No. 1. No. 2. Phillips.

I give above, illustrations of two of the leading emulsions in the market, as they appear under the microscope, in comparison with mine, (the large bubbles in No. 1 and No. 2 are soap.) The difference is very marked, and I think when you have made these experiments yourself, you will not be surprised at the satisfactory results had from the use of my oil.

I should be pleased to have you make a practical test of this combination in your practice.

Very respectfully,

Chas. N. Phillips

Manufacturing Chemist, New York.

I beg to advise that my Medicinal Preparations are now put up in the following styles:

MILK OF MAGNESIA.

A Hydrated Liquid Magnesia, which will not separate, precipitate, or form concretions.

Retails per Bottle 50 Cents. Large $1.00.

Apothecaries' Dispensing Bottles, 5 lbs. each.

PHOSPHO-NUTRITINE.

The Soluble Phosphates of Wheat. The nerve tissue and brain elements of Food.

Retails per Bottle, $1.00.

Apothecaries' Dispensing Bottles, 5 lbs. each.

PHILLIPS' PALATABLE COD LIVER OIL,

(IN COMBINATION WITH PHOSPHO-NUTRITINE.)

Without Alkalis or any objectional element. As miscible in water as milk, and as much under the control of the Physician as a tincture. Its superiority proved by any scientific or practical test.

Being the only acid oil preparation it is miscible with water, in which it should be thoroughly mixed before taken, insuring ready assimilation and pleasant taste.

Retails per Bottle, $1.00, small size 50 Cents.

All dispensing druggists keep my goods.