The Physiology of Vitamin A*

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VITAMIN "A" is ingested either preformed or as one of the carotenes, hydrolysed, absorbed[1,2] with the aid of bile into the lymph and blood and esterified with high fatty acids. It is stored largely in the liver where it is found in oil droplets. When intake is high, it may also be found in the Kupfer cells which destroy it. The blood concentration does not necessarily parallel the liver concentration and the factors controlling the mobilization of vitamin "A" from liver are not understood. Gastro-intestinal or biliary disturbances may readily result in the failure of absorption of vitamin "A" even though there is an ordinarily sufficient amount in the diet and much larger amounts of vitamin "A" are required by individuals who have alimentary disturbances. Vitamin "E" (α. β. γ. tocopherol), another fat soluble vitamin, is also of importance[1] and it has been shown clearly that the absorption of "A" is improved, particularly when only small amounts are present, if "E" is fed simultaneously. Apparently, vitamin "E" exerts a protective, anti-oxidative action on the vitamin and on fats in general. This relationship may account for some of the differences between chemical and biological assays of material containing vitamin "A"; fortunately, most of the common dietary sources of "A" also contain "E". The accepted dietary requirements of vitamin "A" in humans at present are, minimal, 20 I.U./Kg./day and optimal, 60 I.U./Kg./day.

The fundamental physiological function of "A" is obscure, but certain histological changes[3] resulting from "A" deficiency are illuminating.

Epithelial structures such as the salivary glands and the mucous membranes of the mouth cavity; the respiratory system, including the nasal cavity and sinuses; the genito-urinary system; and the conjunctivae and tear glands, first atrophy and then show reparative proliferation of the basal cells with production of keratinized epithelium. There may also be hyperkeratotic lesions of the skin. Gastro-intestinal structures, liver and renal tubules are not so affected. The picture is one of rather general loss of function, with keratinization, of specialized secreting epithelium and in overgrowth of structures already of the stratified squamous type. Restoration of normal structure follows administration of "A". These tissue changes are believed to account for the increased susceptibility to infection shown in these regions.

Some examples of "A" deficiency show neurological disorders such as paralyses and several workers have clearly shown nerve degenerations to occur in the central nervous system and in peripheral nerves. However according to Wolbach[3] the nerve changes are secondary to growth effects. In "A" deficiency there is prompt retardation in the growth of endochondral bone. This occurs before growth in general is affected and, for a time, there is relative overgrowth of soft tissues including the C.N.S. Overcrowding of the cranial cavity results with consequent irregular degenerations. If growth is retarded by general food insufficiency, growth rates of C.N.S. and skeleton remain parallel and no paralysis ensues.

In so far as the eye is concerned, tear formation is diminished, the conjunctiva covering the cornea becomes dry, keratinized and opaque,[4a] a condi-

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tion which is readily seen and is called xerophthalmia. In its earlier stages it may be detected by slit lamp examination[9]. If it is not too severe and there has been no secondary infection with consequent destruction of the eye, restoration of vitamin "A" may effect a cure. This is a specific entity and consequently vitamin "A" is often spoken of as the anti-xerophthalmic vitamin.

Other histological effects noted in "A" deficiency are placental degeneration in the pregnant rat with fetal death; atrophy of the testis; anemia with accumulation of hemosiderin in the liver and spleen; and atrophy of enamel organ of teeth.

Overdosage with "A" seems to have little effect and even with extreme hypervitaminosis "A" (e.g. 30,000-40,000 I.U. daily to small rats) results are hard to evaluate. There does seem to be decalcification and osteoporosis of the skeleton. There is little evidence that supra-optimal doses of "A" protect a well nourished individual against infections.

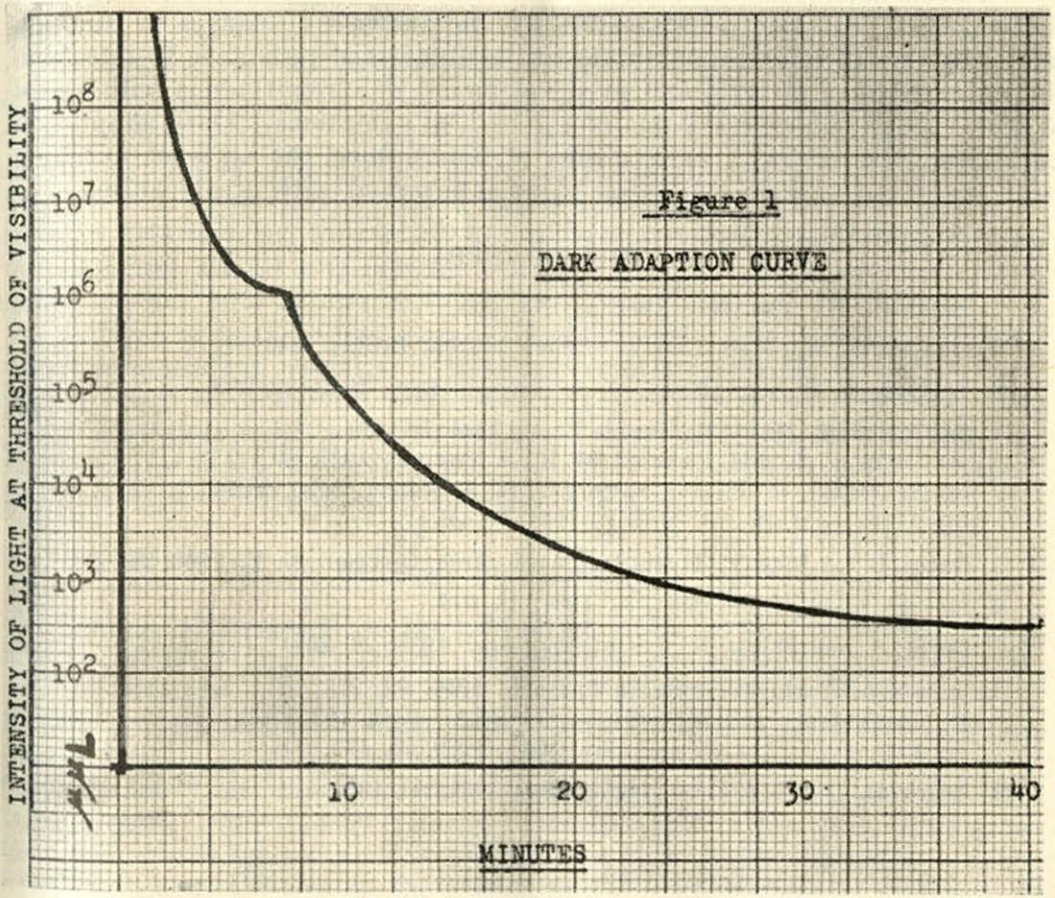
Historically, "A" has been described and identified more or less as follows. In the early days of vitamin studies it was reported to be the growth vitamin because a deficiency resulted in a cessation of growth. Then it was considered to be the anti-infection vitamin because deficiencies resulted in increased susceptibility to respiratory and other infections. Later, the antixerophthalmic aspect was stressed. These observations are still facts but other severe nutritional deficiencies also result in retardation of growth and increased incidence of infection. To wait until xerophthalmia sets in or until cessation of growth occurs or until keratomalacia and infection of the mucous membranes is present is to diagnose only severe cases of vitamin "A" deficiency. However, these conditions do occur and there are several examples of large population groups showing a large incidence of xerophthalmia, keratomalacia, etc., as a result of diets seriously deficient in "A".

The procedure which is most often carried out to-day to ascertain early stages in "A" deficiency is to determine the power of dark adaptation of the eye. Fundamentally the ability of the eye to see objects in dim light depends upon the concurrent bleaching and reformation of visual purple in the retina and vitamin "A" is one of the precursors of visual purple. Without vitamin "A", visual purple will not be formed, and normal dark adaptation of the eye will not be possible. Unfortunately in practice the problem is not simple. The methods of measuring dark adaptation have not been well controlled and large numbers of papers have been published, useless because of unsatisfactory methods. Even now when satisfactory apparatus is available it is very difficult to draw conclusions as to how much "A" deficiency is present in the community. Figures[2] reported range from about 1 per cent to 90 per cent of similar groups of people. Many studies[5] have failed to show good correlation between vitamin "A" intake and dark adaptation even in experimental series in which carefully controlled diets high in "A" and very low in "A" are contrasted. Others of course do show an apparent correlation. It seems probable that there should be some such correlation especially if one is considering pronounced changes only, but the evidence to show small degrees of deficiency must be taken with great caution. In addition to the instrumental difficulties there are many physiological factors involved other than "A" which affect the dark adaptation[6]. For example, ascorbic acid (vitamin C) exerts a considerable effect (almost as much at times as "A") as does riboflavin (vitamin B_2).

Age is important, subjects of advancing years showing slow and incomplete dark adaptation. Sleeplessness and fatigue as well as anoxia or fever also temporarily reduce dark adaptation. Psychological conditions during the test such as inattention and poor co-operation make for seriously incorrect readings. Furthermore, eye conditions such as retinitis pigmentosa, severe myopia, opacities in the transparent media of the eye, and a small pupil, may greatly reduce the amount of light reaching the retina and so cause poor dark adaptation readings. In individual cases these interfering factors can be studied but they are usually ignored in statistical studies of large groups.

Clausen[2] states that night blindness is the earliest symptom of "A" deficiency and allows a diagnosis on the basis of night blindness if (a) organic eye disease is absent *and* (b) the history suggests "A" deficiency *and* (c) large doses of "A" (50,000-100,000 I.U./day) relieve the condition in 3-5 days. He also points out that at best, dark adaptation studies show the "A" of the retina and not "A" of general body stores.

A typical normal dark adaptation curve following 3 minutes preparatory exposure to bright white illumination (1500-2000 millilamberts) is shown in Figure I.



The first shoulder on the curve after about 7 minutes at a level of some .001 millilambert (1 microlambert) represents the limit of cone dark adaptation and the final rod adaptation is reached in 30-40 minutes, at a level of 100-1000 micro-microlamberts ($\mu.\mu.$L.). The Hecht[7] adaptometer is the instrument which best controls all optical factors and with which such curves are made. The procedure however is tedious and not suitable for large numbers. Many devices[8], photometers of various designs, have been adopted to speed the determination but they show defects such as lack of constancy or calibration of illumination, of poor control of preparatory light conditions, of too small a target to be looked for, or of lack of a fixation point and few give the complete curve. These shorter procedures differ greatly in the degree of preliminary light adaptation required and in the selection of the final light level used; differences which of course make it difficult to compare closely the results of different groups of workers. For example, Pett in his studies, after a light exposure of only 30 seconds, measured the time taken for his dim light to become visible. As this time was normally less than 10 seconds, he was clearly measuring cone rather than rod adaptation and he did not begin to measure the maximum degree of dark adaptation possible. True, he did relate his results to the state of "A" nutrition but confirmatory studies are needed.

To conclude, it may be restated that vitamin "A" is essential to abundant health, that pronounced deficiencies will be shown by changes in function and structure of mucous membranes with diminished resistance to infection, by impairment of growth, and by development of xerophthalmia with visual defects. Night blindness is one of the earliest symptoms. Dark adaptation measurements, however, as a means of determining the state of nutrition with regard to vitamin "A" need to be interpreted with great caution.

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Physiology of Vitamin D*

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Avitaminosis D

NUTRITIONAL diseases due to a deficiency of vitamin D are rickets, osteomalacia and certain forms of tetany—they are all rather closely related.

Rickets is a disease of young children, the chief characteristic of which is a failure to deposit or retain calcium in the bones, with the result that they become soft and deformed. Osteomalacia is a disease of adults characterized by an inability to retain bone calcium as a result of which there occurs softening and deformity of the skeleton, attended by rheumatic pain and weakness. Tetany is a condition manifested by muscular twitchings, cramps and convulsions, resulting from a lowered ionic calcium level of the tissue fluids. Since low calcium levels occur in severe vitamin D deficiency, tetany is seen as a complication of rickets and osteomalacia.

Incidence of Avitaminosis D

Rickets has been reported in most parts of the world. It is more prevalent in the temperate zones, where ultraviolet rays from sunlight are seasonal, than in sub-tropical zones. It is most prevalent in cities where poor housing, inadequate diets and limited exposure to sunlight often exist together. In North America and Europe about 5% of children show bone deformity by X-ray. Follis in 1943 reported that in 230 autopsies on American children dead from various causes, almost 50% showed evidence of imperfect bone formation due to inadequate amounts of vitamin D.

Osteomalacia, the adult disease, is occasionally seen in men but most often encountered in pregnant or lactating women. Although a rare disorder under modern civilization it still constitutes a serious problem in India and China. The disease was prevalent in Europe shortly after the last war and was responsible for many deformities and fractures. It had its basis in months of near starvation with prolonged vitamin D deficiency.

Sources of Vitamin D

Vitamin D is a specific in the prevention and treatment of rickets, osteomalacia and accompanying tetany. The best natural source of vitamin D is in fish oils, but eggs, milk fat and meat contain smaller amounts. Exposure of the skin to ultraviolet light, either artificial or from the sun, results in the formation of vitamin D within the body. It is noteworthy that neither Eskimos, who eat a lot of fish, nor children in the tropics, who get ample sunlight, are found to suffer from rickets. Many foods deficient in the vitamin contain precursors which by the action of ultraviolet light yield vitamin D. Such 'irradiated' foods are now on the market and it seems logical to anticipate a much wider use of them as a dietary source of vitamin D in the winter months.

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Physiology of Vitamin D

The physiology of vitamin D is still unsettled after twenty-one years of investigation. Vitamin D has been shown to promote the absorption, retention and utilization of calcium and phosphorus, so that a discussion of its physiology is impossible without dealing in some detail with the metabolism of these mineral substances.

(1) *The absorption of calcium and phosphorus from the intestine.*

For the maintenance of healthy bone, human adults require a daily absorption of approximately 0.5 gm. of calcium and 0.9 gm. of phosphorus from the diet. This is accomplished with very little need for vitamin D if the calcium and phosphorus are present in a readily assimilated form. In children however, and in pregnant or lactating women, where bone formation and calcium metabolism are very active, an adequate intake not only of extra amounts of calcium and phosphorus, but also of vitamin D, is essential to ensure absorption and retention sufficient that a mineral deficit will not occur.

A number of aspects of calcium and phosphorus absorption have received attention in the last few years. It has been found that calcium and phosphorus are most readily absorbed from the intestine when present in adequate and approximately equal amounts. If either one of them is much in excess of the other, absorption of both is seriously impaired. This effect is less noticeable if vitamin D is present. In recent years, the effect of the acid-base content of diets has been stressed. It has been shown that a diet containing an excess of organic acid and an alkaline ash favours absorption. This effect has now been traced to a specific beneficial action of tartrate, citrate and lactate in such a diet. Of the calcium and phosphorus in the diet only a fraction is absorbed even normally, because much of the mineral is in a form not readily assimilated by the body. One of the functions of vitamin D may consist in making these substances more readily available by facilitating a conversion of food complexes into more readily diffusible forms of the minerals. It is known for example, that the phorphorus of phytic acid from cereals is more readily absorbed if vitamin D is present.

Apart from this example, the mechanism by which vitamin D improves the absorption of calcium and phosphorus is unknown. It is clear that in vitamin D deficiency the absorption is poorer and more calcium and phosphorus are lost in the feces. Addition of the vitamin results in better absorption and retention.

Laxatives, notably mineral oil (which is taken daily by some people), cause a decreased absorption of calcium and phosphorus and increase the vitamin D requirement. An excess of fat in the intestine in diseases such as steatorrhea, sprue and celiac, has a similar effect.

It has been ascertained from isotope studies that once absorbed, the calcium and phosphorus are normally well retained. Calcium is excreted into the intestine but in a form readily reabsorbed; most actual loss of calcium and phosphorus occurs in the urine. The normal fecal residue of calcium and phosphorus is almost wholly from the diet.

(2) *The concentration of calcium and phosphorus in the blood.*

Calcium and phosphorus levels in the blood are in equilibrium with the ionic calcium and phosphorus in the tissue fluid bathing the bone cells. It

follows then that disturbances of blood levels can affect bone structure. Maintenance of normal calcium and phosphorus levels in the blood depends primarily on a balance between absorption and excretion, the bone acting as a reservoir or storehouse. Moreover, calcium and phosphorus concentrations are mutually related, because they are in chemical ionic equilibrium with the bone salt calcium phosphate. The ionic product of calcium and phosphate is a constant, any change in one tends to be accompanied by an opposite change in the other.

The parathyroid gland plays a closely associated role in bone metabolism in that it controls the level of calcium in the blood. It does so through its effect on the excretion of phosphorus by the kidney. Parathormone causes increased excretion of phosphate, with the result that blood calcium must be increased to maintain the constant. Vitamin D is also credited with an ability to alter phosphate excretion by the kidney but, in restoring a lowered calcium level to normal, vitamin D acts primarily to improve absorption and retention of the mineral—parathormone makes up the deficit at the expense of bone. Excess vitamin D results in hypercalcification; excess parathormone results in decalcification.

(3) *The formation of bone.*

The most important aspect of calcium and phosphorus metabolism is the effect of their ionic concentrations on bone formation. At the end of the shaft of a growing bone is a thin area bounded on one side by cartilage, on the other by true bone. In the normal course of events the cartilage cells degenerate and the matrix is invaded by blood capillaries and osteoblast (bone forming) cells; the deposition of calcium and phosphorus then occurs as a complex salt containing chiefly calcium phosphate and calcium carbonate.

The simplest explanation of the process might be that the concentrations of calcium, phosphate and carbonate ions increase until their solubility product is exceeded and the salts precipitated out by a simple inorganic chemical process. However, the fact that precipitation occurs at a specific site in the bone suggests that some local factor, presumably causing an increase in ionization, is responsible for initiating and controlling the process. Just what this local factor is remains in doubt. The enzyme phosphatase, always associated with active osteoblast cells, has been suggested by Robinson as responsible for increasing phosphate ion, but this has not yet been proven. Vitamin D is believed to play a role in this local reaction, though again direct proof is lacking. Nicolaysen, in 1939, was able to produce calcification of bone without Vitamin D by injecting calcium and phosphate in suitable quantity, but the architecture of the bone laid down was abnormal unless vitamin D was present. In bone hyperplasias and in vitamin D deficiency there is an increased phosphatase in the circulating blood. This has led Robinson to suggest that vitamin D acts to keep phosphatase action localized near the osteoblast cells.

It is known that in the absence of vitamin D the cartilage cells fail their normal course of degeneration and calcification does not take place. Do the cartilage cells cease to degenerate because calcification has failed?—or has calcification ceased because the cartilage cells are still living? This argument remains to be settled. When vitamin D is restored the normal process is resumed, but how the vitamin functions apart from favouring suitable calcium and phosphorous concentrations has not yet been determined.

(4) *Hypervitaminosis* D.

The effect of excessive doses of vitamin D must be mentioned because it can result in a definite pathological condition. Both the calcium and phosphorus levels of the blood are raised above normal and deposition of mineral may occur not only in the bones but also in various organs of the body, especially in the kidneys,blood vessels and heart. The effect may be fatal and caution in the use of large doses of vitamin D cannot be overemphasized. Park suggests that during therapy with massive doses of vitamin D the blood calcium level should not be allowed to exceed 12 mgm.% and it must be remembered that toxic symptoms may occur without hypercalcaemia.

Vitamin D and Other Diseases

Apart from the physiological effects of vitamin D in preventing the diseases already described the vitamin has been widely used in the treatment of several other conditions.

(a) A number of workers have attempted to show that dental caries are due to vitamin D deficiency. While it is true that a lack of vitamin D during growth results in a tooth more susceptible to decay there is no conclusive evidence that extra vitamin D affords any protection, apart from normal nutrition, once the tooth has grown. Indeed vitamin D deficiency in the adult seems to cause little change in the grown tooth.

(b) Vitamin D has been widely used in the treatment of various allergic conditions and asthma, and certain skin disorders such as acne and psoriasis. There is to-day no definite evidence that vitamin D is of value in any of these conditions—such results as have been observed may be attributed to nothing more than a general improvement in health.

(c) It has been reported very recently, by an American Naval research group, that vitamins A and D together improve night vision more effectively than vitamin A alone.

(d) Vitamin D is thought by some to exert an improvement in abnormal capillary permeability, which is believed to depend on the presence together of adequate amounts of calcium and vitamin C. Possibly such an effect may be mediated through improved calcium metabolism.

(e) Of particular interest recently has been the suggestion that vitamin D may exert a beneficial effect in arthritis. In November 1943 an article by Paul de Kruif appeared in *The Reader's Digest* entitled "Hope for the Victims of Arthritis". The answer—massive doses of vitamin D over a prolonged period of time. Within a week pharmacists reported an increase of 500% in the sales of vitamin D concentrates. Dr. de Kruif's article, based chiefly on the work of Snyder and his associates, referred to research on the problem by Dr. Freyberg of the University of Michigan and Dr. Boots of Columbia University.

In the next issue of J.A.M.A. appeared a critical letter to the editor from Dr. Boots. Neither he nor Dr. Freyberg had been consulted by de Kruif. Several months previously Dr. Freyberg had stated that, from his experiments, the results of using vitamin D in arthritis were "certainly far from impressive". Dr. Boots' findings had been similar; a limited number of patients "felt much

better" under treatment; in a rare instance the result was a marked improvement in symptoms, but he "did not recommend vitamin D as a cure for rheumatoid arthritis".

In Summary it may be said:

(1) That vitamin D is a specific for the prevention and treatment of rickets, osteomalacia and certain types of tetany.

(2) It's action favours the absorption, retention and utilization of calcium and phosphorus.

(3) It may exert specific functions in the intestine, in the kidney, and at the site of bone formation—but these functions are by no means understood.

(4) It seems to be closely associated with the parathyroid gland and the enzyme phosphatase.

(5) The vitamin requirement is greatest in early childhood; beyond childhood the requirement is not known, but it appears to be essential during pregnancy and lactation.

(6) Evidence does not warrant the claim that vitamin D is of benefit in allergic disorders or skin conditions, nor that massive doses can be regarded as a cure for rheumatoid arthritis; in fact prolonged excessive doses of the vitamin may do serious harm.

The Chemistry and Production of Vitamin A*

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CONSERVATIVE estimates place the United States demands for vitamin A at 130,000,000,000,000 U.S.P. units for the year 1944. This figure includes the requirements for Lease Lend and for home consumption. A similar estimate is not available for Canada. If the American supply of vitamin A were to be obtained entirely from cod liver oil, it would be necessary for the Maritime Provinces to produce 10,000,000 imperial gallons during 1944. Last year the Canadian production of medicinal cod liver oil was but a small fraction of this ount.

Vitamin A is the only member of the now large group of accessory food factors which is produced exclusively in the animal body from precursors derived entirely from the plant kingdom. These plant precursors are the so-called carotenes which in part account for the yellow colour of carrots and the leafy vegetables.

The fish liver and body oils provide us with our only commercial source of Vitamin A. In a few short years, this demand for vitamin A has been the impetus for the development of a sizable fisheries by-product industry both here and on the Pacific coast.

On the Pacific coast the main sources of vitamin A are dogfish, soupfin shark and halibut liver oils. All of these oils are classed as medium to high potency; that is, they range from 8000 to 300,000 i.u. per gram. In the case of the Pacific dogfish and shark, the liver contains 50% or more oil.

Our Atlantic sources of vitamin A are cod, haddock, hake, pollock, halibut, tuna and swordfish livers. The first four of these are classed as low potency oils; that is, they contain from 1,000 to 3,000 i.u. per gram. Halibut, tuna and swordfish livers all yield oil of higher potency (30,000 to 500,000 i.u. per gram). The oil content of the livers is in general inversely proportional to the vitamin level of the oils; that is, cod livers yield from 35 to 70% oil with an average potency of 3,000 i.u. while halibut livers contain from 10 to 30% oil having from 30,000 to 300,000 i.u. of vitamin A. To meet the tremendous demand for this vitamin, other Atlantic sources have been investigated over the past three years. These include the spiny dogfish, blue shark, mackerel shark and monkfish. The only one of these that shows promise is the last. Proportionately, cod liver oil provides the greatest amount of vitamin A on the Atlantic coast with little likelihood that other sources will replace it from first position.

A word or two about the methods used in the production of fish liver oils may be of interest. For livers of the cod type a process commonly known as steam rendering is used. The livers are thoroughly cooked by admitting live steam into a suitable kettle containing the livers. After thorough cooking the liberated oil is washed free of the livers and floated to the surface. From this point it is strained, then destearinated if it is to be used for medicinal purposes. The high potency livers may be rendered in several ways. The oils may be recovered by solvent extraction or more commonly by alkali digestion

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of the livers with steam. Because the oil from such livers is of high value, it is customary to re-work the liver residues several times before they are discarded. The high potency oils are not destearinated again for the reason of high potency.

The production of vitamin A from fish liver oils has become a highly technical process requiring the use of extensive equipment and well trained personnel. The future of the industry is best described as a large question mark. Present trends are toward the use of encapsulated concentrates. If this trend continues it will mean a great slackening of interest in cod and other low potency oils. This will be accompanied by an appreciable decrease in the monetary value of cod liver oil. At present this oil commands a price well beyond its vitamin A potency because it allegedly contains "intrinsic values" not found in concentrates—"intrinsic values" which have recently received impetus from the discovery that vitamin E is necessary for proper assimilation of vitamin A. This, despite the fact that other parts of the normal diet provide much greater amounts of vitamin E than does cod liver oil.

Regional Anaesthesia

Captain H. A. L. Murphy, R.C.A.M.C.

Regional anaesthesia is the result of a certain number of delicate surgical procedures, by which it is possible to control pain temporarily, by interrupting the sensory nerve conductivity of any region of the body. This usually does not interfere with the motor function of the nerve.

Regional anaesthesia may be produced by two different types of procedure:

(1) Field Block.

(2) Nerve Block.

Field block is where one creates a wall of anaesthesia encircling the operating field. Nerve block is where you inject your anaesthetic solution into or around the nerves whose conductivity it is desired to cut off.

Local anaesthesia differs from regional anaesthesia in that, in local we infiltrate the area along the line of incision, and the whole area which is to be operated upon.

Physiology

The anaesthetic substances such as procaine or novocaine form a physiochemical combination with the nerve substance causing afferent impulses not to be transmitted, slowed or weakened in their passage to the central nervous system. Also, the efferent impulses from the central nervous system are hampered since their normal cycle has been interrupted by the drug. Thus painful stimuli are either not felt or interpreted as touch, contact, or pressure.

It must be remembered that the blood vessels, particularly the arteries are surrounded by a network of sympathetic fibres whose chief function it is to control the tonus of the blood vessel wall. In some nerve blocks the anaesthetic agent does not reach these nerves, surrounding the blood vessels and I have found some pain stimuli evolve from handling these vessels. An interesting point is that in a brachial plexus block, if our solution flows down around the subclavian artery, the arm turns pink and shows evidence of hyperemia. It has been shown that all drugs used in regional work are destroyed in the liver and excreted by the kidneys.

It is felt that regional anaesthesia is important to the Army Anaesthetist, especially in field surgery because the equipment is compact, easy to carry and simple to use. Here it alleviates pain during transportation and is the one anaesthetic which the anaesthetist can administer ahead of the surgeon and does not require the constant attention of the anaesthetist. The patient can be watched by a competent nurse or medical orderly during operation and too I feel that this type of anaesthesia can be used by the civilian anaesthetist to the advantage of the surgeon and safety of the patient.

Indications for Regional Anaesthesia

(1) In severely shocked patients regional anaesthesia is the method of choice, of course the shock should be treated first.

(2) In the case of the patient with heart disease where general anaesthetic involves risk, a nerve block is the safest procedure for the patient.

(3) In the case where patient has had a recent meal, thereby contra-indicating the use of a general, regional is indicated.

(4) In the case of fractures and lacerations of the upper extremity, especially where tendons are involved we find a nerve block most satisfactory as you usually do not get motor paralysis and the patient can move the parts, thereby aiding surgical repair.

Contra-Indications

(1) Highly emotional, apprehensive, nervous, hysterical type of individual is not suited to this type of anaesthesia. However, these patients, we must remember can be subdued by proper pre-medication.

(2) Regional anaesthesia should not be used in or near areas of infection. (Local infiltration here is to be avoided.)

(3) History of neuritis or nervous disease.

(4) Where there is pre-existing vascular disease, especially in the case of the fingers or toes.

(5) Where the patient is sensitive to procaine. (Inquire from patient if he has had a reaction from local anaesthetic for tooth extraction.)

Reactions:

Two types.

(1) *Circulatory and Respiratory*—characterized by a drop in blood pressure, depression of respiration, pallor, sweating, weak pulse, and occasional nausea and vomiting. This can be treated by administering oxygen or artificial respiration if necessary, and the use of analeptics such as:—ephedrine, epiniphrine or adrenalin, coramine, caffeine, sodio benzoate.

(2) *Neurological Reactions*:—characterized by talkativeness, excitement, and convulsions, treated by oxygen, artificial respirations and with the short acting barbiturates such as:—onetothol given intravenously enough to control the convulsions.

Solutions Used in Regional Anaesthesia

The most common drug used on this continent is procaine (novocaine) which will give from forty-five minutes to one hour's anaesthesia. Nupercaine (1-1000) which is most popular in Europe will give anaesthesia up to two and one-half to three hours.

I feel that these solutions should be made up at time of using. Physiological saline is the most common diluent employed. Healthy adults will tolerate:—

175 to 225 cc of .5% solution of procaine
100 to 125 cc of .1% " " "
25 to 50 cc of .2— " " "

Cachectic and debilitated patients will tolerate only 30 or 40— of the above dosages according to the individual case.

I would like to add here that according to Major Gordon's report in the C.M.J. he used intravenous novocaine for burned patients to anaesthetize

the burned area, and gives up to 1 gram of .2% novocaine intravenously. The procaine solution should be warmed to body temperature because if cold the onset of anaesthesia will be delayed.

Vasoconstrictors such as ephedrine, cobefrin and neosynephrine are frequently added to the procaine solution for the following reasons:

(a) To prevent rapid absorption of the anaesthetic agent, thereby prolonging the anaesthesia and reducing the toxic effects.

(b) To promote haemastasis.

These vasoconstrictors are contra-indicated in the case of coronary disease, hyperthyroidism, and should not be used in the case of fingers and toes. (Add 6 minums of adrenalin solution 1-1000 to each hundred cc's of anaesthetic solution. Where nupercaine is used 30 to 40 cc of 1-1000 nupercaine can be tolerated.

Nerve Block Tray

3 Medicine Glasses	1 sponge forceps
1 Tuberculin Syringe	Sponges
1 10 cc syringe Luer Lock	3 towels
1 spinal needle No. 22	Adrenalin 1 in 1000
1 No. 19 1 No. 22	Procaine
1 No. 24 1 No. 11	Sterile normal saline

Premedication

This is important because it relieves the fear and anxiety and reduces the pain during injection. We use nembutal Gr 1½-2 hours before and morphine sulphate Grs ¼ Hyoscine grs 1/200th 15 minutes before. Barbiturates as nembutal or secondal are used as they decrease the nervousness and counteract the tendency of toxic doses to produce excitement or convulsions. However they have no prophalactic affects on the circulatory reactions.

Procedure:

(1) The skin is prepared as if for surgical operation.

(2) All needles are tested for imperfections in order to avoid breakages when introduced into the tissues.

(3) Tourniquets—May be used when desired by the surgeon. This prolongs anaesthesia.

(4) The tissues should be handled gently, nerves should not be traumatized when injecting the solution.

(5) When injecting one must always draw back on the plunger of the syringe to make sure the needle is not within a blood vessel. If within a blood vessel withdraw needle and re-insert in different position.

(6) The point of the needle should be kept moving during infiltration.

It must be remembered that it requires approximately 15 minutes to obtain complete anaesthesia. This is one objection from the surgeon's standpoint, but if one compares this to the time required for the preparation and induction of a general anaesthetic, it should not be considered a drawback,

or disadvantage. If toward the end of operation, patient becomes restless and complains of pain, morphine grs ¼ given intravenously, will alleviate these complaints and allow time for completion of operation.

I would like to discuss a few of the common nerve blocks which we have been using.

Regional Anaesthesia of Upper Extremity

It is the arm, elbow, forearm and hand on which we have used the greatest number of nerve blocks. The brachial plexus block is most useful as it anaesthetizes the whole limb and can be used for fractures where muscular relaxation is not necessary as for example, for fracture of upper part of humerus where an application of a shoulder spica is necessary. Anyone who has attempted to apply one of these casts under general anaesthesia or no anaesthesia knows what a difficult task it is. Also this block is useful for open reduction of elbow, repair of tendons and nerves and plastic operations. The supraclavicular portion of the brachial plexus has the shape of a triangle having its base attached to the cervical vertebral column and its apex at the mid portion of the clavicle. It lies first above and then on the outer side of the subclavian artery and vein, and is frequently threaded by the transverse cervical and posterior scapular artery. On emerging from the scaleni muscles the brachial plexus crosses the upper surface of the first rib and then passes beneath the clavicle. It is just underneath deep fascia. One must avoid here, injection into the large blood vessels, near the sight of injection and avoid creating a pneumo-thorax or haemothorax by inserting the needle through the plura.

Paralysis of the radial nerve have been reported but this is rare.

To perform a brachial plexus block for the right upper extremity, the patient lies in a supine position with a pillow under shoulders, head turned to opposite side, shoulder depressed and the arm lying by the side. Measure the length of the clavicle from the sterno-clavicular to the acromioclavicular articulation and determine accurately the mid point of the clavicle. Mark this point, then measure 3 centimeters above this point or one finger breadth, and make your skin wheel at this latter mark. With the index finger of the right hand palpate immediately above the clavicle for the pulsation of the subclavian artery, depress it downward and medially, and with your other hand insert a 50 mm. needle through the skin wheal, passing it downward, backward, and inward to contact the upper surface of the first rib. Ask your patient to tell you if any paraesthesia of the limb occurs, if so hold your needle steady, connect your syringe, withdraw your plunger to make sure you are not in a blood vessel and if not inject 20 cc of 2% procaine.

Now we must remember that the brachial plexus acquires branches from the 2nd and 3rd thoracic nerves (intercosto-brachial) and to anaesthetize these superficial nerves, which supply the medial side of the arm and upper 3rd of the forearm, a subcutaneous injection of 1 % procaine solution is infiltrated around the medial side of the arm just below the axilla. This will not be required if the operation is in the distal two-thirds of the forearm and hand.

Regional Nerve Block for the Forearm

To do this we anaesthetize the median, radial and ulnar nerve at the elbow region.

The *median* nerve is blocked by inserting your needle through the skin wheal which is made in the elbow crease, just medial to the brachial artery which lies on the medial side of the biceps tendon. Insert your needle perpendicularly to the skin, attempt to obtain paraesthesia and then inject 3 or 4 cc of 2% procaine solution. The median nerve lies just underneath the deep fascia, whereas the radial nerve lies much deeper between the muscle layers.

For the *radial* nerve make skin wheal in the elbow crease one centimeter lateral to the lateral edge of the biceps tendon. Insert needle through skin wheal advancing toward the external condyle of the humerus, and after contacting the above withdraw the needle a millimeter or two and inject 3 or 4 cc of 2% procaine.

The *ulnar* nerve is the easiest nerve to block as it runs in the groove between the internal condyle of the humerus and the olecranon process. Using the same technique inject 3 or 4 cc of 2% procaine solution.

In addition to the above, to anaesthetize the superficial nerves of the skin from the radial above, an intradermal or subcutaneous ring of procaine solution is made above the field of operation.

Regional Anaesthesia of the Hand

For severe lacerations, gunshot wounds, repairing of tendons, dislocations and fractures, a wrist block gives very satisfactory anaesthesia.

At the wrist the median nerve lies just underneath the deep fascia between the flexor carpi radialis and palmarus longus tendons. If the wrist is flexed against resistance, these tendons are easily palpated. If no palmaras longus tendon is present, insert needle just medial to the flexor carpi radialis tendon. Using the same technique paraesthesia is usually easily obtained. Inject 6 or 8 cc of 2% procaine solution.

The ulnar nerve lies just under the flexor carpi ulnaris tendon which can easily be palpated on the ulnar side of the wrist. Use 5 or 6 cc of 2% procaine in this region.

Now to complete the hand block, infiltrate a subcutaneous ring of 1% procaine solution around the wrist to block the superficial branches of the radial nerve.

Regional Anaesthesia of the Finger

Here we do not use vasoconstrictors. The injection is carried out around the finger from the skin to the bone and the region is gently massaged, 5 to 10 cc of 1% procaine is used. As the fingers are richly supplied with sensory nerves, it is important to ascertain that anaesthesia be complete before surgery is started.

For metacarpal-phalange joint and the metacarpals one can block the nerves by inserting needle dorsally between the metacarpals, on each situation infiltrating right down to the palm. Also infiltrate a few cc's of 1% procaine solution in the webbed space on each side.

Anaesthesia for Fractured Bones of Arm and Forearm

A skin wheal is made opposite the fractured site. Pass the needle through the skin wheal, into the haematoma at site of fracture, where blood is aspirated, and inject 10 to 20 cc of 2% procaine solution into haematoma.

Regional Anaesthesia for Thigh, Leg and Foot

Due to the varied nerve supply, a low spinal is a much simpler procedure to anaesthetize the lower limb. However, we have found that blocking the sciatic nerve for sciatica, and in the diagnosis of "Extruded Nucleus Pulposus" has proved interesting. To inject the sciatic nerve the patient lies on the side opposite to the one to be injected, with the knee on that side flexed, so that the shaft of the femur is in line with the posterior superior iliac spine. Draw a line from the top of the greater trocanter to the superior iliac spine. Bisect this line and at the point of bisection draw a line perpendicularly 3 centimeters distal. This is the site of insertion of needle. Insert needle perpendicularly to skin about 6 or 8 cm. and one usually gets paraesthesia due to piercing the sciatic nerve. Inject 10 to 20 cc of 2% procaine. Patient is then asked to fully extend leg, flex leg and do the bicycle exercises. In England 10 cc of nupercaine 1-1000 is used for sciatica.

In the case of "Extruded Nucleus Pulposus" being present, the pain is not relieved by this injection.

There is one other regional anaesthetic which I would like to mention and that is anaesthesia of the penis for circumcision, and all surgery for the distal portion of the penis. This is called, by Magid and Culp of the United States Army, the ideal penile anaesthetic, obtained by injection of the corpra cavernosa. After shaving, cleaning and draping the penis in the usual manner, hold the penis between thumb and forefinger and pass a No. 23 gauge needle boldly into the corpus, withdraw plunger and if no blood, inject 8 to 10 cc of 2% procaine containing vasoconstrictor.

If the point of the needle has been inserted to proper depth, no force is required for the injection and no swelling of area will result. The process is repeated in the other corpra cavernosa and similar care being taken to avoid midline vessels on the dorsal surface.

Anaesthesia is almost instantaneous.

Occasionally a few drops of procaine are injected into the frenulum to avoid a delay in obtaining complete anaesthesia in this area.

In the series of 300 cases reported there have been no reactions and anaesthesia lasts from 3 to 7 hours.

Of 660 anaesthetics which have been administered at the Halifax Military Hospital since March 1, 1943, to February 1, 1944, 58.6% were spinal, 24.3% pentathol, 5.7% N20, ether and oxygen 11.4% have been regional neve blocks, and we have found that regional anaesthesia has been satisfactory for the surgeon and safe for the patient.

Case Report

Actinomycosis

THIS paper does not attempt to present any new ideas or discoveries, but it was felt that as this disease is relatively rare in this area, a case occurring in the city of Halifax might be of interest. Dr. Ralph P. Smith, Provincial Pathologist, estimates that a case is found about once every two years in Nova Scotia. The last two coming to his attention involved the appendix. A brief resume of the features of the disease will be given before presenting a new case found in a local soldier.

Actinomycosis, also known as lumpy jaw of cattle, is one of the chronic infectious granulomata which tend to suppurate. It occurs more frequently in men than in women, affecting young adults chiefly. The causative agent is the actinomycosis, or ray fungus, which may bet ransmitted from man to man, from animal to man, or by inhalation or ingestion. The most common mode of access is thought to be through decayed teeth, especially of lower jaw. Inhalation of straw dust may cause infection of lungs simulating tuberculosis. Infection of alimentary tract by chewing of grass and grains may occur, in which case lesions are chiefly found in caecum or appendix. Skin lesions are chiefly found in the jaw area, but are also seen along the mid line of the back, having spread from the vertebrae.

The skin lesion is fairly characteristic, beginning as a firm, purplish nodule, gradually softening, becoming dusky-red and then deeply fluctuating. Sinuses form discharging thin purulent material containing tiny whitish or yellowish granules which are masses of fungi. These are the so-called "sulphur granules" which are diagnostic. Generally the involved area is no larger than your palm, or smaller, but rarely it may be widespread. The induration is marked and persistent, and usually adherent to deeper structures.

Diagnosis is confirmed by finding the ray fungus in the smear, or in sections snipped from the edge of the sinus. In some cases the characteristic granules cannot be found and cultures of the pus are repeatedly negative. These cases may resemble sarcoma, carcinoma, tertiary syphilis, or blastomycosis.

Treatment: is both internal and external usually.

1. Potassium or sodium iodide by mouth or intravenously, using gradually increasing doses until toleration is reached.

2. X-ray treatment may be given alone or with iodides. Combined therapy is believed by some to be almost 100% successful.

3. Gamma rays are used successfully, aiding in breaking down the hard masses and thus allowing drainage. This treatment also helps to prevent extension to the chest, but probably causes more scarring.

4. An autogenous vaccine has been found efficacious recently.

5. Sulfadiazine was reported to have cured an American Negro soldier after being given over a period of 120 days (J.A.M.A., Dec. 25, 1943).

6. Penicillin has been reported useful but records are not yet available.

Case Report

A Canadian soldier, a native of Halifax, age 30 years, had a right lower wisdom tooth removed eight or nine weeks previous to admission to hospital. Following this extraction he had difficulty in freely moving the jaw, and said he could not open it to the full extent. About one week prior to admission he noticed a painful, hard swelling beginning under the right side of the jaw. This enlarged and he was referred to the Dental Officer, and from there to the Military Hospital.

Past Medical History: Was essentially negative until he contracted syphilis in 1941 while overseas. He was pronounced cured after 18 months' treatment. In June 1943 he suffered a perforated duodenal ulcer, which was repaired in Scotland, following which he was repatriated to Canada.

Personal History: Previous to enlistment at the outbreak of war this man had been a taxi driver in Halifax. He had never worked on a farm and could not recall any contact with cattle or other animals. Family history was irrelevant.

Physical Examination: There was a swelling under right jaw about the size of a small egg, brownish red in color, which was an indurated mass rather than a fluctuant abscess. It was pointing into the mouth lateral to the right molars, and in a few days drained of its own accord. Further examination was essentially normal.

Differential Diagnosis: As follows:

1. Celulitis with possible osteomyelitis.
2. Tumor of mandible.
3. Actinomycosis.

It was decided to treat it expectantly as a cellulitis, but in spite of chemotherapy and intensive local heat, no improvement was made. X-ray of mandible was negative on two occasions. After three weeks there was sufficient localization to permit external drainage and a small amount of pus was obtained. Culture from this revealed nothing helpful.

The clinical picture and poor response to ordinary treatment made it clear that we were dealing with a chronic granuloma, and repeated smears eventually showed mycelia typical of the ray fungus.

In view of the length of time usually required in treatment, and because of recurrence of his ulcer symptoms, it was considered expedient to release him from active service for further treatment by D.P. & N.H.

CAPTAIN N. W. NIX, Halifax Military Hospital

Correspondence

184 College Street
Toronto 2B, April 12
1944

Doctor H. G. Grant
Secretary
The Nova Scotia Medical Society
Halifax, N. S.
Dear Doctor Grant:

For your information, we are enclosing herewith a copy of a letter sent by Dr. F. A. Brockenshire to the Officer Commanding, C.A.M.C. Training Centre, Camp Borden.

As this deals with the equipment purchased by the Nova Scotia and Ontario Divisions and the Canadian Medical Association for Officers' Training Centres, we thought you would like to have it for your files.

Yours sincerely

(Sgd.) T. C. ROUTLEY
General Secretary

Windsor, Ontario
December 13, 1943

The Officer Commanding
A22. C.A.M.C. Training Centre,
Camp Borden, Ontario.
Dear Sir:

Organized medicine in Canada is prepared to spend a sum up to $2,500.00 for the purchase of suitable furniture to be used in the lounges at your officers' mess. This will confirm our recent discussion and verbal authorization.

Dr. McPhedran and myself were pleased with your selection, as indicated in a tender, and when purchased, at what you consider to be the best advantage, will you be good enough to send the account to me?

As discussed with you, it is of course understood these pieces of furniture will remain the property of our Associations, the officers of which, will decide what future use will be made of them as for instance, when the Medical Officers' Training Centre is closed or the number of officers decreases to such extent that some or all of the furniture is no longer considered necessary in that location. With this in mind, it is suggested each piece of furniture be suitably marked with an attached plate if possible, bearing the following inscription:

Purchased and Loaned to this Centre
by
The Canadian Medical Association
The Ontario Medical Association
The Nova Scotia Medical Society

It is also suggested a plaque be suitably placed in one of the rooms indicating the same thing. The form of the plaque and wording of inscription can be decided later. I would be pleased to receive suggested samples.

It is also suggested that this arrangement be confirmed by letter from the D.G.M.S. and if considered advisable, that a legal document be prepared, copies of which should be retained in your files and ours.

Yours very truly

(Sgd.) F. A. BROCKENSHIRE

Society Meetings

Pictou County Medical Society

At a meeting of the Pictou County Medical Society held at New Glasgow on May 11th, the following officers were appointed.

President ..... Dr. J. S. Murray, River John

Vice-President ..... Dr. A. E. Blackett, New Glasgow.

Secretary-Treasurer ..... Dr. C. B. Crummey, New Glasgow.

Representatives on the Executive of The Medical Society of Nova Scotia, Dr. H. B. Whitman, Westville, for one year more, and Dr. J. S. Murray for a period of two years.

Antigonish-Guysborough Medical Society

At the annual meeting of the Antigonish-Guysborough Medical Society held last fall the following officers were elected:

President ..... Dr. W. F. MacKinnon, Antigonish

Vice-President ..... Dr. J. J. Stanton, Canso

Secretary ..... Dr. J. J. Carroll, Antigonish

Executive ..... Dr. D. J. MacMaster, Antigonish
Dr. R. J. MacDonald, Antigonish
Dr. J. S. Brean, Mulgrave

Representatives on the Executive of The Medical Society of Nova Scotia Dr. W. F. MacKinnon, Antigonish, Dr. J. J. Carroll, Antigonish.

THE ANNUAL MEETING

OF

THE MEDICAL SOCIETY OF NOVA SCOTIA

will be held at

WHITE POINT BEACH

JULY 5th and 6th

Make your plans now to attend the annual meeting. A strong scientific programme has been arranged and there is no more delightful place to spend a few days than at White Point. The programme will be published in the June edition.

Make your reservation now either with the Secretary or with Mr. Howard B. Elliot, Manager White Point Beach, 9 Elm Street, Halifax, N.S.

Obituary

THE death occurred at the Victoria General Hospital, Halifax, on May 19th of Doctor John William Thompson Patton of Truro. He had been in indifferent health the past few months and entered the hospital three weeks ago for medical treatment and died of a heart attack.

Doctor Patton was born at Ponds, Pictou County, October 24, 1868, son of the late Elizabeth Murray and James William Patton. He was educated at the Common School at Ponds, Pictou Academy, New Glasgow High School and graduated from McGill in 1900, where he was one of the most brilliant students in his year, winning the Gold Medal. He received his F.A.C.S. in 1922, and took post-graduate courses in Chicago and Boston. He practised in Truro for many years, sixteen as a general practitioner and then specialized in eye, ear, nose and throat treatment.

Doctor Patton played a leading part in Truro civic life being secretary of the Truro Board of Trade for more than fifteen years. He was past president of the Truro Golf Club, a member of the Curling Club, a member of Rotary, and a keen fisherman and hunter as well. He was a member of the Colchester Hospital Medical Society, the Colchester-East Hants Medical Society, the Medical Society of Nova Scotia, the Canadian Medical Association, and on the staff of the Colchester Hospital.

He was twice married, both wives predeceasing him, his first wife being Bertha Grace Turner of Truro, and the second Thelma York of Parrsboro. A daughter, and son, Huntley, by his first marriage, also predeceased him.

The funeral service was held from St. John's Anglican Church on Monday, the 22nd.

Doctor J. W. Smith of Liverpool will give an address at the luncheon (memoirs).

Scientific Programme of the Annual Meeting

The full scientific programme will be published in next month's edition and we can assure you it will be of a high order. We cannot at this date give all the speakers and their topics, but the following will contribute: Colonel W. P. Warner, Consultant in Medicine, Department of National Defence, will speak on "War Medicine". Doctor Harris McPhedran, the President of the Canadian Medical Association, will talk on some medical subject. Doctor E. L. Eagles, D.M.H.O., Windsor, will speak on "Venereal Disease Control in Nova Scotia." Doctor N. H. Gosse will give a paper on "Fractures of the Hip". Surgeon Captain Wendell MacLeod, R.C.N., will talk on "Penicillin". Doctor C. A. Donkin of Bridgewater will give a paper on "Anaesthesia". Doctor N. W. Philpott, Associate Professor of Obstetrics and Gynaecology, McGill University, will give two papers, the topics to be announced later.

Medicine

The National Physicians' Committee for the Extension of Medical Service objects—and we think rightly—to the medical provisions of the Wagner bill to broaden the scope of social security. This bill would make possible, if not inevitable, a change from private to "political" medicine in the United States.

Under terms of the bill, social security taxes would be increased to pro vide the Surgeon General with some $3,000,000,000 annually to pay for medical service to the 110,000,000 persons who would be covered.

The almost blanket power to spend so much money would naturally mean destruction of medicine as it is now practised in the United States and the substitution of a bureaucratically controlled system of national clinics and dispensaries.—*Milwaukee Journal.*

Shipping Address for Your Art Exhibit

Artist-physicians desiring to exhibit their works at the June A.M.A. Meeting should ship their works not later than May 20th to the following address:

American Physicians Art Association, Room 1302, 308 W. Washington St., Chicago, Ill. Pack carefully and ship by express collect, including $50 insurance.

Mead Johnson & Company have offered to pay the express charges both ways (including insurance up to $50).

Art objects exhibited are automatically eligible for inclusion in the next Parergon, as well as for one of the numerous A.P.A. Association prizes.

Further information may be obtained from Francis H. Redewill, M.D., Secretary, American Physicians Art Association, Flood Bldg., San Francisco, Calif.