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Trichiniasis in Nova Scotia Now

RALPH P. SMITH, M.D., D.P.H. (M.D., D.P.H.)

THE Name has the following synonyms—trichinosis and trichinelliasis The parasite is called the trichinella spiralis or trichina spiralis (Owen 1835) because it resembles a coiled hair.

History—The trichinella spiralis was first discovered in its encysted stage in the muscles of patients, autopsied in London, England, by Peacock (1828), Hilton (1833) and again by Sir James Paget (1835). The first case in North America was reported in 1842 by Bowditch of Boston. Joseph Leidy of Philadelphia first found the cysts in hogs' flesh (1846) and suggested their similarity to those found in man.

The investigations of Leuckart (1855) and Virchow (1859) proved that these cysts, when fed to certain experimental hosts, grew to adults in a few days and that the females produced living young in the duodenal wall, which migrated to the muscles and later encysted.

In 1860, Zenker demonstrated the clinical importance of trichiniasis. Nevertheless several years elapsed before the German investigators proved experimentally that the consumption of infected pig's flesh, raw or insufficiently cooked, was responsible for the disease in man. In 1897, Brown pointed out that eosinophilia was highly suggestive of trichiniasis.

Geographical Distribution: Trichiniasis has a cosmopolitan distribution, but is much less important as an infection of man in the tropics and Orient, than it is in Europe and the United States. According to his biographer, Virchow estimated the human incidence in Germany in his day to be about 90%.

In 1898, Osler found only 0.6% of the diaphragms at routine autopsies in Johns Hopkins infected, but lacking the newer methods of detection this figure is probably too low. In 1916, Ransom estimated that 6% of American hogs were infected. The number of human cases in North America has apparently increased appreciably since 1929, especially in New York, Mass., Conn., Minn., Missouri (St. Louis), and California. Routine microscopical examination of human cases post-mortem in St. Louis showed a 15% incidence; Riley and Scheifley (1934) 17.9% in Minneapolis. Peptic digest methods, which yield almost 100% higher positive results than microscopical section (Most and Helpern 1941), have indicated 22% in Manhattan, N. Y., 27.6% in Boston (Queen 1931), 17.5% in Rochester, N. Y. (Queen 1931), 24% in San Franiccos. (McNaught and Anderson 1936), and 13.67% in Maryland and Washington, D. C., (Hall and Collins 1937). Most and Helpern's results were obtained from examination of 100 autopsies on persons dying by violence or suddenly from natural causes. In 1938, in spite of the high incidence found post-mortem Sawitz[4] reported that only 5,000 to 6,000 clinical cases had been recorded since 1842, and more recently that the average number of cases reported in States which contain ⅔rds of the total population is less than 500 a year. Kerr, Jacobs and Cuvillier (1938) summarized the results of various workers of the U. S. P. H. Service, stating that of 3,000 examined 16.3% were found positive for trichiniasis.

These findings suggest that one out of every 6 or 7 persons in United States or as Sawitz (1938) estimated 16 million are infested.

*Paper delivered at the annual meeting of the Nova Scotia Health Officers' Association, Kentville, N. S., July 6, 1943.

The disparity between the incidence of trichiniasis in the people of United States and the number of cases in which a clinical diagnosis is being made, indicates that some revision of the former concepts is desirable (Blumer 1936).

In Britain in contrast to United States and Germany, the disease has always been considered a rare one. Van Someren (1937) reports that previous to 1937 only 26 cases had been recorded in the literature and that in 200 autopsies only 1% were found infected. In 1927, 1,000 carcases of pigs in Birmingham were examined with negative results and also smaller numbers elsewhere. Young (1941) in the Wolverhampton district examined 2,500, too, with negative findings and is continuing her examinations only on boars and old sows as the life of the average pork pig is so short, usually only a year.

Since the outbreak of the present war this low incidence in humans in Britain has suddenly been altered by epidemic outbreaks. In the winter of 1940-41 more than 500 cases in the Wolverhampton district alone have been reported as well as others in various parts of England and Wales. These were principally located in Birmingham (Bacon 1941), Wolverhampton (Sheldon 1941 and Lee 1941), Herts (Garrod and Maclean 1941) and Penrith.

In Canada, little attention has been given trichiniasis and the extent to which American surveys can be applied here, is unknown.

The incidence in humans in Toronto in 420 autopsies is reported by Kuitenen-Ekbaum (1941) as being only 7 (1.7%) (Clarke (Unpublished quoted by Kuitenen-Ekbaum) examined 78 diaphragms in Toronto with negative results). The Pathological reports of Montreal General Hospital show 2 positives out of 919 from 1883 to 1895. Cameron found evidence of trichiniasis in 2,995 hogs in Eastern Canada in 0.57%. My own small series of specimens examined, namely approximately 75, all proved negative.

A few small outbreaks of human cases have been reported in recent years. Meakins and Gervais (1935) reported 7 cases in one family with the death of one child in Montreal, P. Q., during January 1935, and Gervais (1938) 68 cases in the same city 10 months later. Cecilioni (1941) and Deadman and Wilson (1941) describe a small epidemic of 23 cases in Hamilton ,Ontario in November, 1940. In October, 1942, Reid and Read published the first known case in Nova Scotia, although I, personally, had suspected that others had occurred previously and had laid in a supply of Trichinella Intradermal Antigen almost a year before and supplied it to them. In 1928 I found the encysted larvae in the muscles of a pig sent to me from Cape Breton. The total number of human cases in Nova Scotia is about 55, as far as I can ascertain.

Mechanism of Infection, Morphology, Life Cycle and Biology of the Parasite

Trichiniasis is acquired in only one way, namely by eating meat which contains living larvae of the nematode, trichinella or trichina spiralis. A qualification of this statement has to be made. Prenatal transmission may occur though Beeson (1941) flatly states that it does not. Augustine (1934) supports Beeson's statement by negative findings in a child born of an infected mother and experimental infections in rats, rabbits and swine. Kuitenen-Ekbaum (1941) found the encysted larvae in the diaphragm of a premature infant whose mother gave an eosinophilia of 7% 3 weeks later. Hood and

Olson (1939) in their survey of trichiniasis in the Chicago area included the diaphragms of 48 infants under 1 year with 4 positive. Roth (1939) in experimental infestation of pregnant guinea pigs found 9 out of 22 foetuses positive but no correlation between the incidence of infection in the mother and stage of pregnancy with the occurrence of the trichinae in the foetus. Salzer (1916) discovered the parasite in the human placenta in one case and the mother's milk in another. The above findings suggest that prenatal trichiniasis in humans is probably not as uncommon as has been thought. The reason that there are not more reports of positive findings in infants is probably the fact that infants have usually been excluded from post-mortems for trichiniasis.

The infection is not conveyed by the excreta and only rarely are the larvae detected there, (Cecilioni, Deadman and Wilson in one case 1941).

The cycle of the parasite is essentially the same in all hosts. When man consumes raw or rare flesh containing cysts of trichinella, the cysts are digested out of the flesh in the stomach and duodenum, and the larvae soon invade the duodenal and jejunal mucosa, developing into their adult male and female stage, apparently moulting 4 times (Kreis 1937), within 5 to 7 days. The adults closely resemble oxyuris vermicularis in size. The male measures 1.4-1.6 mm. x 0.04 mm. The anterior part of the body is narrowed; the orifice of the cloaca is terminal and the cloaca which is guarded by two conspicuous papillae, is evertible during coitus. The female measures 3-4 mm. x 0.06 mm. and is about twice as long and 1½ times as broad as the adult male; its anus is terminal.

At first the adult worms may be lodged in the glandular crypts but later the females burrow into the villi, the deeper layers of the intestinal wall and even into the mesenteric lymph nodes. After fertilization the females begin to deposit larvae, some of which may at first escape into the intestinal lumen but later the majority reach the intestinal lymphatics or mesenteric venules and become distributed throughout the body. Soon after copulation the males die, and after penetration into the mucous membrane the females live for five to seven weeks, giving birth to as many as 1,500 larvae each. These larvae measure 100 microns x 6 microns. Larvi-position ("transition") occurs over an average period of 6 weeks. All the larvae do not mature into encapsulated organisms. They are carried through the right heart and lungs to the arterial circulation which they reach between the 7th and 23rd day. They may become lodged in the various tissues of the body, including the myocardium, but are capable of further development and encystment only in voluntary or skeletal muscle, which they enter from the adjacent capillaries. Mauss and Otto (1942) found 10,000 times as many larvae in the skeletal muscles of mice as elsewhere with comparable infections. They conclude that invasion of organs and tissues other than skeletal muscles is of minor significance except in peculiarly heavy infections, when the myocardium, central nervous system, pancreas, kidney, gall bladder, smooth muscles of the intestines and tissues of the respiratory tract may all be involved. The larvae in the myocardium of rats are destroyed in situ (Dunlop and Weller 1933).

The greatest invasion takes place in muscles poor in glycogen. The capsule or cyst wall begins to form about a month after infection and is an ellipsoidal sheath with blunt ends, resulting from swelling of the sarcolemma from round cell and eosinophile infiltration around the larvae, which become

tightly coiled within. The long axis of the cyst parallels that of the muscle fibres.

The adult females and males are gradually excreted in the faeces. The size of the larvae on encystment is from 0.8 mm. to 1 mm. and they may remain alive for 31 years. Those which are arrested in other organs stimulate an acute inflammatory reaction and are usually destroyed in a few weeks.

Muscles such as the diaphragm, those of larynx, tongue, abdomen, and intercostal spaces, biceps, pectorals, gastrocnemii, deltoid and psoas and others which are constantly active, are the most heavily infected. The growth of the larva to 1 mm. within its cyst capsule causes degeneration or swelling of the adjacent muscles, the thickening and change in the sarcolemma, the acute focal interstitial myositis and finally proliferation of connective tissue. Insulin increases and dextrose decreases the number of the encysting larvae (Lewis 1928(.

Calcification usually occurs within 6 to 9 months; it may be accelerated by feeding irradiated ergesterol or calcium salts (Wantland, 1934). In man 5 larvae per gramme of body weight can produce death. In pigs 10 and in laboratory rats 30 larvae per gramme are lethal.

Epidemiology—While both adults and larvae of trichinella spiralis develop within the same host, two hosts are required to complete the life cycle. In nature the infection is normally propagated by the black and brown rat which are cannabalistic.

In St. Louis, Mo., 75% of the rats examined were infected.

Pigs, wild boars, bears, cats, dogs and other mammals, such as the mongoose, which eat flesh become secondarily infected. Chickens are rarely infected.

Man thus acquires his infection from consuming infected lean pork and incidentally bear's tenderloin. Experimental infection has been carried out in pigs, mice, rats, guinea pigs and rabbits, and the trichinae can also be reared in fowls, pigeons and ducks but the larvae do not encyst in the muscular system, being expelled in the faeces.

Illness Associated with Trichiniasis

The pathology and symptomatology are naturally divided into three stages:—(1) Invasion or incubation; (2) Migration of the larvae, and (3 Encystment of larvae and tissue repair.

During the first period of 7 to 14 days there is an irritation and inflammation of duodenal and jejunal epithelium with symptoms of nausea, vomiting, toxic diarrhoea or dysentery, colic and profuse sweating. These symptoms begin as early as 24 hours after exposure and may overlap the 2nd stage. There may be bright scarlet macules or maculo-papular eruptions of the skin of trunk and extremities. With the beginning of larvi-position and larval migration and with infiltration in the muscles, there are rheumatic muscular pains, mild or excruciatingly painful, frequently dyspnoea or difficulty in breathing, in mastication, swallowing and speech, and at times spastic paralysis of the muscles, particularly of the extremities. The latter may simulate a Poliomyelitis. One such case was sent to the Polio Clinic in Dartmouth before its real nature was discovered.

Oedema, particularly around the eyes, sides of nose, temples and hands may precede and usually accompanies this stage. Later when involvement of the muscles is very marked the legs, too, may show this change.

There is a characteristically remittent fever or continuous fever (102° F to 105° F) with plateau formation, suggesting typhoid. Extensive conjunctival haemorrhages which may extend to the margin of the cornea and obliterate the larger part of sclera and splinter haemorrhages beneath the finger nails as embolic phenomena may be seen (McNaught, 1939). An eosinophilia from 5% to 90% with a total leucocyte count of 30,000 per c.m.m. is found usually within the first two days in 99% of cases and its absence is a bad prognostic sign. The eosinophiles return to normal in 4 to 6 months. With encystation of the larvae the critical third stage comes on. It may be accompanied by cachexia, toxic oedema and extreme dehydration. In grave cases the pulse is at first fast and strong, then drops rapidly and cyanosis supervenes. The blood pressure falls rapidly and the patient collapses. (Cheney, 1926).

Nervous disorders which include peripheral neuritis, defects of vision, delayed or lost reflexes, restlessness, disorientation, hallucinations, defects of vision, delirium and encephalitis may all be seen. Spink (1935) has reported a case of permanent right hemiplegia.

The patient may succumb to toxaemia, myocarditis initiated by the invading larvae or to complications such as lobar pneumonia, peritonitis, pleurisy or nephritis. Spink (1935) had a fatal case of myocarditis and found electro-cardiographic changes present in 6 out of 18 cases.

The four cardinal features are fever, orbital oedema, myalgia and eosinophilia, but many other signs and symptoms may occur, depending on the chance deposition of the parasites in the various parts of the body, e.g. brain, lungs and heart. They may thus give clinical signs suggestive of encephalitis, pneumonia, or myocarditis.

While the above symptoms are characteristic of clinical trichiniasis the onset and progress of the disease may at times be sufficiently atypical to lead to an inaccurate diagnosis.

Two important factors influencing the severity of the illness are the size of the infecting dose and the resistance offered by the host to the parasite. The size of the dose has a direct effect on the severity of the illness. This is natural, since the causal agent, unlike a bacterium or virus, does not multiply within the body of the host. In experimental animals it is possible to determine the number which may be expected to cause death and the severity of the illness (Roth, 1939).

The reaction of the host to invasion may be influenced by natural or acquired immunity. Among persons and animals not previously exposed to trichiniasis there appears to be a marked variation in natural susceptibility as in most epidemics of humans only a small proportion of those exposed show signs of illness, e.g. of a family of 6 who ate approximately equal amounts of pork sausage 4 remained well, one had a mild attack of 4 days duration and one was seriously ill for 3 weeks with the classical syndrome (Beeson, 1941). Beeson claims that children as a group have a natural immunity but this is not borne out by our figures in Elmsdale, Nova Scotia, or by Cecilioni, Deadman, etc., who had 9 children in 21 cases.

THE NOVA SCOTIA EPIDEMIC OF TRICHINIASIS

District	Number of Cases	Eosinophilia	Muscle Biopsy	Adult Female	Girls	Boys	Adult Males
Elmsdale	approx. 20	11	0	8	3	0	0
Musquodoboit	2	0	0	2	0	0	0
Dartmouth	9	8	0	5	0	0	4
R.C.N. Hospital, Halifax	1	1	1	0	0	0	1
R.C.A.F. Hospital, Dartmouth	1	1	1	0	0	0	1
Halifax Military Hospital	1	1	1	0	0	0	1
Halifax. V. G. Hospital and private	11	11	1	10	0	1	0
Windsor	9	9	0	4	2	3	0
Stellarton	1	1	0	0	0	0	0
	55	43	4	29	5	4	7

Total Number of Cases 55
Number of Cases where sex given 45
% Adult Females 64.5%
% Girls ..... 11 % 75.5%
% Boys ..... 9 %
% Adult Males 15.5% 24.5%
The percentage of children infected was 20%.

It is possible, too, that a degree of active immunity may be got as Roth (1939b) and McCoy (1931) working with experimental guinea pigs and rats obtained partial or complete immunity to reinfection. McCoy (1932) was not uniformly successful in producing immunity in monkeys though partially so.

In humans there have been a few verified instances of recurrent trichiniasis (Kaufmann, 1940; Most and Helpern 1941; Wyrens, Tillish and Magath, 1941), but it is possible that many undiagnosed cases acquire light infections which confer considerable immunity to re-infection (McCoy, 1933; Bachman and Rodriguez-Molina 1933).

The Clinical Picture in the English Epidemic (*B.M.J.*, 15th February, 1941, Editorial) departs from the usual description in several ways. According to Sheldon only 10% had vomiting and 5% diarrhoea, the majority being constipated, sometimes severely. The absence of prodromal gastro-intestinal disturbance is therefore not a point against diagnosis, and symptomatic recognition must depend mainly on the first features of the stage of invasion. The first of these is usually swelling of the eyelids, accompanied by severe frontal headache, unrelieved by ordinary sedatives. A few days later involvement of the skeletal muscles usually causes pain, tenderness and stiffness. These effects are very variable, ranging from complete absence in slight cases to a condition said to be worse than labour pains, and causing such stiffness and heaviness that patients said they, "might have been plaster statues;" the duration of muscular symptoms also varies from a few days to 5 weeks. *A prominent and unusual feature in this epidemic has been evidence of involvement of the nervous system.* 1. Some present the picture of *Meningitis* (head retraction, semi-consciousness irritability, photophobia, a meningeal cry, a positive Kernig sign and extensor plantar responses). 2. Others are deeply lethargic, depressed and even deluded. 3. Finally, 13 of 76 cases described by Sheldon presented *signs of focal cerebral lesions in the form of monoplegia or ataxia.*

Not only may these nervous manifestations complicate a severe and otherwise a typical case, but in some a cerebellar lesion with giddiness, weakness and ataxia have been the first manifestations, even preceding the swollen eyes. Nearly all the cases complained of a general ill-feeling and depression.

Recovery usually begins within three weeks of the time of onset of symptoms. Some muscular stiffness and weakness may persist for several weeks or months, but complete recovery is the rule, even though the muscles are heavily infected with live parasites. However, persistent myalgia, muscular atrophy and contracture are the most unfavourable sequelae reported in literature. It seems feasible, too, that in some of the severe cases permanent myocardial damage must result from the myocarditis found and it might be advisable to follow them up clinically and electrocardiographically.

Prognosis: Prognosis is usually good in mild cases, grave in severe infections. Absence of an eosinophilia is a bad prognostic sign. The mortality is given as 6 to 15%. Prognosis depends on the number of ingested larvae which have grown to maturity in the intestine and the resistance of the patient. Early diarrhoea is a favourable symptom as it may free patient of a considerable number of immature worms. It is worthy of note that no fatal cases have been recorded in the earlier Canadian epidemic, the British epidemic or in any of the Nova Scotian cases as far as can be ascertained.

Differential Diagnosis: Differential diagnosis from a variety of conditions must be made, such as acute glomerulo-nephritis, acute food poisoning, botulism, cholera, diarrhoea and dysentery of other origin, typhoid fever, rheumatic fever, arthritis, influenza, polyneuritis, fibrositis, sinusitis, pneumonia, myocarditis, encephalitis, meningitis or other cerebral lesion, poliomyelitis, and angioneurotic oedema, etc. Arbesman, Witebsy, and Osgood (1942) emphasize the difficulty of diagnosis of angioneurotic oedema of eyelids, general malase and eosinophilia in an atopic patient from an early case of trichiniasis, as a positive skin test may be delayed for 6 weeks. If negative after that time it would rule the latter disease out. Even a positive intradermal test would be of little help in such cases, as there is a higher percentage of positives found in allergic individuals. A precipitin test would need to be performed to finally clinch the diagnosis.

Fortunately the true nature of the disease seems to be invariably betrayed in most normal individuals within the first few days if not at the very onset, by the oedema of the eyelids, an absolutely constant sign which in the absence of albuminuria calls for a differential leucocyte count; a marked eosinophilia almost certainly establishes the diagnosis. This blood change may apparently in a few cases develop late and thus repeated counts should be done in the first 10 days.

Diagnosis

1. History of the recent consumption of raw or uncooked pork.
2. History of the four cardinal features and wide variety of possible symptoms.
3. The eosinophilia.
4. The laboratory examination of stools during the diarrhoeal stage for adult worms and larvae, the blood and spinal fluid or mother's milk during the period of migration and recovery of the larvae at times provide a specific diagnosis.
5. The Intradermal Test (2nd and 3rd week).
6. The Serum Precipitin Test after the 3rd week.
7. Muscle Biopsy for the larvae.
8. X-ray of muscles for calcified nodules (after 6 months).

Unfortunately as Augustine (1937) pointed out concentration of the blood for larvae and the searching of the stools for adult worms and larvae so often yield no result as to be a waste of time, though 3 cases in Cecilioni, Deadman and Wilson's series showed the presence of larvae resembling those of trichinella spiralis. Evers (1939) in a review of the literature states that up to that date 24 cases of larvae in the cerebro-spinal fluid had been reported. He found the larvae in one case showing toxic encephalitis and neuroretinitis as did Cecilioni *et al.* Accordingly, in cases pointing to early involvement of the central nervous system microscopical examination of a centrifuged deposit of cerebro-spinal fluid seems indicated.

The Intradermal Test: The trichinella antigen now used consists of phenolized buffer saline extract of powdered trichinella larvae, using as a control the saline used in the preparation of the antigen. The antigen is diluted to 1:8,000 (U.S. P.H. Service and P.D. and Co.); 1:10,000 (Lilley). 1:10 cc. of each is injected intradermally. An immediate positive result is indicated

by a raised wheal over 5 mm. in diameter and surrounded by a large erythematous halo with the trichinella antigen in 5 to 20 minutes. Pseudopodia may or may not be seen. This becomes positive in the 2nd or 3rd week. A delayed result may occur in 18 to 24 hours but there is some doubt as to its significance. McNaught, Beard and Myers (1941) claim that the delayed reaction occurs early in the infection and also in long standing quiescent cases. McCoy, Miller and Friedlander (1933) state that it has no significance. A review of the literature indicates a positive finding with the intradermal test in approximately 95% of acute cases.

In 1933 McCoy *et al* report 92% positive results in 11 to 43 days.

In 1935 Augustine and Spink found 33 out of 34 positive, the negative case being moribund but gave a positive serum Precipitin Test.

In 1936 Kaljus obtained 74% positive of 66 cases.

In 1938 Bozicevich had 44 out of 44 cases positive with both intradermal and precipitin tests and 20 of 136 others exposed but not ill.

In 1941 McNaught, Beard and Myers obtained 97.2 %positive immediate intradermal tests in 36 cases and a negative in a moribund case; 47.2% or 17 out of 36 possible cases; 6.7% and 18.1% of 194 controls gave immediate and delayed positives respectively.

In England Beeson and Maddock in 1941 give the following figures:
22 out of 22 immediate positives in clinical cases of 3 or 4 months.
12 out of 80 immediate positives in those not known to have the disease though 9 of the twelve had been ill during the epidemic but with atypical symptoms.

In the controls a higher percentage of positives is found in the older age groups.

The duration of the positive findings of the Intradermal test assumes importance in Field studies in localities where trichinosis has been recognized, as mild or symptomatic cases are far more frequent than typical ones.

McCoy *et al* (1933) noted a drop in the positive findings from 92% to 62% in a group tested 3½ to 7½ years after.

Theiler, Augustine and Spink re-examined two cases after 7½ years with negative results but both groups (McCoy *et al* and Theiler *et al*) also found positives after 7½ years.

Augustine (1937), states that since both the intradermal and precipitin reactions persist for a year or more (usually five to seven years) they serve admirably for ascertaining the full extent of an epidemic during its later stages or even when it is all over, as well as for confirming the diagnosis in individual cases.

The trichinella intradermal test may give positives with other parasites such as Ascaris, trichina trichiuris, and hookworm, but McNaught *et al* claims that it is not got with a dilution of 1:8,000 or 1:10,000 but that a certain number are got in 1:100 and 1:500 dilutions.

A certain number of normal controls give a positive: in 6.7% of 47 normal controls (McCoy) and 6.4% in 194 by McNaught and Anderson. Arbesman, Witebsky and Osgood (1942) found 22.6% positives in a group of atopic individuals with an eosinophilia as against 7.4% positives in a group of normal individuals, and they emphasize that it has a limited value particularly in allergic individuals for diagnosis of recent infestation. However, by careful

questioning a history of allergy could be obtained, and allowance made for that in field studies. They warn against the possible sensitization of a normal individual by repeated tests as was pointed out by Barron and Brunner.

The Precipitin serum test: This test becomes positive at the 4th week and also remains positive for a number of years. Sawitz (1937) modification is used but Hall (1937) claims that in chronic cases that it is less sensitive than the intradermal test. The trichinella antigen for the precipitin test is stated by McNaught (1941) to be not available but that the tests were being done by the Department of Zoology, National Institute of Health, Washington, D. C. It may, however, be available now.

For the diagnosis of individual cases and Field surveys it is advisable to carry out this test as an additional confirmation of the intradermal one.

Muscle Biopsy provides the final proof of the disease. A small portion of muscle is taken from the pectorals, biceps or gastrocneumius during life or from the diaphragm, psoas and intercostals post-mortem.

Methods of Examination

(a) *Pressure*: A small piece of the muscle (human or pig) is teased out and pressed between heavy glass slides and examined microscopically.
(b) *Histological Sections* (stained by Haemotoxylin and eosin): Many areas and sections need to be made but the finding of a focal interstitial myositis is very suggestive.
(c) *Digestion* in artificial-gastric juice (pepsin in 0.3% HCl) overnight at 37° C. Centrifuge and examine sediment for living larvae.
(d) A portion of the suspected meat may be fed to white rats or mice and after 2 weeks subject the diaphragm as above for the larvae.

Most and Helpern (1941) in their paper found that 8% or ⅓rd of their positive results in 100 persons were obtained by the pressure method; 11% (½ of the positives) by Histological Section and 21% (95% of their series positives) by the Digestion Method. These authors advise that in addition to routine histological examination muscle obtained by biopsy should be studied routinely by the press, then submitted to digestion to determine the number of larvae per gramme of muscle. In their experience random sections from a single block proved frequently negative.

Treatment

(1) Evacuate the gastro-intestinal tract thoroughly (Calomel or castor oil and a few hours later Mag. Sulph.).
(2) Sulphanilamide and Phenothiazine. McNaught, Beard and DeEds (1938) have had moderate success in reducing the number of larvae in muscles of experimental rats, and Van Someren (1939) was able to reduce the number of adult worms in the intestinal walls by feeding butolan (Bayer). Reid and Read had no success with suphonilamide in their case.
(3) Anthelminthics are useless and may even prove harmful.
(4) It is possible that convalescent serum taken from an infected individual at the height of the disease (23rd day) may prove an efficient detoxifying agent as Salzer (1916) has suggested. It is not parasitical.
(5) After obtaining a specific diagnosis all necessary supportive treatment

should be given. The bowels should be kept open and alkalinized and the kidneys given special attention. Sedatives to reduce muscle pain. Heart and respiratory stimulants. In dehydrated patients (shown by the raised red cell count up 1 or 2 millions and raised Haemoglobin percentage) sterile hypertonic saline infusions may be given by hypodermoclysis.

Prevention

1. *Cooking*: It cannot be too strongly urged that all pork and pork products should everywhere be thoroughly cooked. Sausages are chiefly suspect and it does not seem to be generally known that the meat they contain has usually not been cooked at all, nor are all physicians perhaps aware that eating raw sausages is a common habit.

In the Wolverhampton epidemic all patients were asked about it and 37 out of 59 confessed to it. Of 280 families questioned by R. H. H. Jolly M. O. H. Wolverhampton (1941) 37% were raw sausage eaters and in 23% (174 persons) the habit was confined to the housewife. The same finding was common in the Elmsdale and Dartmouth cases, which in the former were confined to the women and children, none of the men of the household suffering because they had their food properly cooked.

This, too, explains the high sex incidence in females, e.g. 64 females to 14 males in Sheldon's cases; 19 single females, 69 married females, 23 children and only 13 adult males in Jolly's cases; 14 females to 7 males in Cecilioni, Deadman and Wilson's series. In our own epidemic about ¾ths of the 55 estimated cases were females.

Apparently working class women content themselves with raw sausage because housework leaves them no time or inclination to prepare a proper meal; their husbands, on the other hand, expect things to be cooked for them. In other countries, like United States, no such difference between sexes has been noted (Beeson 1941), probably because of the universal eating of half-raw "hot-dogs" there. An unexplained fact is the high incidence in female dogs in the Dutch East Indies (Leiper).

2. *Effect of cooking on the parasite*: Trichinella larvae are killed when the meat in which they are encysted is cooked to a temperature of 70° C. (190° F). This temperature is not always obtained in the central portion of a large roast, after hours in a hot oven (Woodhead 1895). Information is lacking in regard to the temperature within a sausage during the customary methods of cooking but the frequent occurrence of trichiniasis in persons who have eaten cooked sausages would suggest that a satisfactory temperature is often not obtained. On the other hand the frying of thin slices of ham or bacon should be sufficient to dispose of the parasites (Beeson 1941). A practical method of ascertaining whether meat has been rendered safe by cooking (Beeson) is to note the colour of the juice which exudes from it. If the piece has become brown or grey, the temperature has been raised to 80° C.

3. *Refrigeration*: The larvae will stand refrigeration better than cooking. They can live for many weeks in meat kept at 0° C. A temperature of 5° F. (-15° C.) for 20 days kills them (Ransom 1916), or at -4° F. for 24 hours renders the meat practically innocuous (Augustine 1933). This is a partial safeguard for imported meat.

4. *Smoking, Pickling and Drying*: In United States additional reliance is placed upon pickling and preserving although the ordinary methods of smoking, salting and drying even long continued are often insufficient to kill the worm. Such may have a deleterious action on the parasites (Ostertag 1934), but is not an absolute safeguard.

5. *Inspection of pork*: Inspection of pork in the larger slaughterhouses of Europe and America has reduced epidemics, (Federal Regulations in United States extends to the preparation of sausages and other pork products which are ordinarily consumed uncooked), but Stiles (1901) has shown that such examinations are not entirely dependable and give a sense of false security. In United States most of the epidemics have been traced to pork obtained from country slaughterhouses, as pork products customarily eaten raw are adequately processed only in Government inspected abattoirs; smaller plants are entirely unsupervised (Schwartz 1929). The pork used by most of the Nova Scotian cases was from the larger firms and not locally produced.

6. The most practical methods to control the infection consist in the destruction of all the carcases and viscera of hogs dying on farms, elimination of raw garbage feeding and extermination of rats and mice around farms. In this connection it is worth mentioning that the incidence of trichiniasis in swine is comparatively high in the United States (2 to 6%) and raw garbage feeding with pork scraps is a common practice and thus transmission from one generation of pigs to the next is made possible. The lowest incidence in swine is where grain feeding is usual and the highest in areas where garbage feeding is the rule.

Some people contend that garbage feeding is dangerous not because of the pork scraps but because it attracts rats to the locality and that pigs get it when they eat rats. The contention is refuted by the fact that boiling of garbage before feeding effects a reduction in the incidence, although rats presumably still have access to it, before and after boiling (Beeson). Hall (1937) states swine infection from rats is of little importance. Boiling of the garbage before feeding is required by law in Britain, and the condition in pigs in Britain is a rarity, but trichiniasis is endemic in rats there. Leiper's field studies revealed rats in Wolverhampton and Penrith infested. Rats probably support the existence of the parasite by cannabalism within their own species or they may acquire infection from other animal flesh as they are scavengers. From this endemic focus an occasional case of swine trichiniasis may develop and cause a local epidemic in man. A possible explanation of the recent outbreaks in Britain is that an unusually large number of old sows have been slaughtered recently because of food shortage to feed them. Old sows, which are usually used for sausage manufacture, like old humans, are more liable to trichinosis than young pigs because they have lived longer and thus had more opportunity to acquire the infection.

The Disease in Pigs: Leiper (1941) states that pigs appear to show a slight chill and their progress in growth and weight is behind. They show an eosinophilia of from 7% to 31% within 2 days, which reaches its maximum by the 20th day. It returns to normal about the 30th day. Farmers might call the pigs "bad doers".

In conclusion, I would suggest that a request be made to all physicians in Nova Scotia to report the number of suspected or proven cases of trichiniasis

to the Department of Public Health; that field studies be made of the incidence of the disease by means of the intradermal and precipitin tests; examination of the diaphragms and other muscles of cases which come to post-mortem; that all garbage used for feeding pigs should first be boiled as is required by law; and lastly that the other measures outlined already, such as periodic warnings against the use of raw or improperly cooked pork products, especially sausages, should be repeated every few months.

NOTICE:

To avoid confusion on the first day, doctors are requested to register at once by mail with

Dr. J. V. GRAHAM
51 Coburg Road
Halifax.

Stating the programme they want to attend and enclosing the Registration fee.

Neo-Natal Haemorrhage and the Role of Vitamin K

G. B. Wiswell

Halifax, N. S.

APPROXIMATELY 5,000 babies have been born at the Grace Maternity Hospital during the past 3 years, and over 1,600 arrived in 1942. A large number of these babies showed evidence of bleeding of greater or lesser degree and this fact suggested the title of this paper, which is a review of the recent literature on this subject, augmented by our experience with these babies during this period.

Haemorrhage of the new born is an emergency, which every general practitioner, obstetrician and paediatrician must face sooner or later. In its various forms not due to trauma, it is associated with 10% of neo-natal deaths. Cerebral haemorrhages, traumatic and spontaneous, with asphyxia and prematurity, account for 30-40% of fetal deaths. In prematures, cerebral haemorrhage is three times more common than in normal full time infants, and is often the hidden cause of death in these babies. In its severe types, such as intracranial haemorrhage, and true haemorrhagic disease, neo-natal haemorrhage not only may be a cause of death, but it may convert an otherwise normal baby into an idiot.

The frequency depends on the classifications of the various types of haemorrhage. If we include all kinds of bleeding in all parts of the body occurring during the new born period, we have a recorded incidence of 1 in 120 or less. If on the other hand we include only those cases occurring in the neo-natal period after minor cases have been ruled out, a rate of 1 in 9,000 of true haemorrhagic disease is found. This figure satisfies the claims of those who state that most of the bleeding is of a mild type, and will cease without any harm to the baby. They state further that a great many cases show no change in the clotting mechanism and that other still unknown causes, such as changes in the capillary vessels, are the factors involved. The fact remains, however, that although clinical haemorrhagic disease is comparatively rare, sub-clinical is quite common, and we do not know when the sub-clinical will become a fully developed and serious case of haemorrhage.

We assume for clinical purposes that we have two main types of bleeding, those occurring without any change in the clotting mechanism and those occurring with changes. Examples of the first type are cases with gross trauma, sepsis, syphilis, or haemolytic jaundice, and with changes in the walls of the capillary vessels. Examples of the second type are those due to hypoprothrombinemia and those with idiopathic bleeding of unknown causes. It is obvious that cases of traumatic haemorrhage may also have a low blood prothrombin, so that for treatment purposes all babies with symptomatic bleeding should be classed as having a possible dysfunction of the clotting mechanism unless the blood can be tested for prothrombin and clotting time,

*Paper presented at the 90th Annual Meeting of The Medical Society of Nova Scotia Kentville, Nova Scotia, July 7, 1943.

a laboratory procedure which cannot always be carried out without proper facilities and loss of valuable time.

The disturbance of clotting mechanism in these babies is now recognized as being due with few exceptions to low prothrombin percentage in the blood. This in turn arises from a deficiency of Vitamin K, the name given to a group of substances, chiefly naptho-quinones, possessing anti-haemorrhagic properties by their activating effect on prothrombin. They occur naturally in green foods, as spinach, cabbage and cauliflower, and in putrefying fish meal and are produced by mico-organisms in the intestinal tract and by chemical methods in the laboratory. Vitamin K was originally manufactured from alfalfa and fish meal and put up in ampoules dissolved in peanut oil, and given by mouth or intramuscularly. It is now made synthetically in the laboratory as C^{11} H^{8} O^{2} and is called 2 Methyl, 1-4 Naptho-quinone, or Menadione. The latter possesses the greatest Vitamin K activity of all anti-haemorrhagic naptho-quinones produced. Peanut oil is also the best solvent and it is marketed in this form in ampoules ready for intramuscular injection or oral use. Quantities and dosage are usually expressed in terms of weight. Derivatives of menadione are marketed in various chemical combinations by the different manufacturers. K^{1} is found in green foods and is produced by the action of bacteria in the intestinal tract. Chemically it is 2 methyl, 3 phytyl, 1-4 naptho-quinone, or phytyl menadione. It can be administered by mouth or intravenously in solution without untoward reactions. It has only one-third the potency of menadione. K^{2} is found naturally in fish meal, and chemically is C^{41} H^{60} O^{1}. It has not been produced synthetically and is much less potent than K^{1}. K^{5} is manufactured by Parke,Davis as Synkamin, and chemicanlly is an aqueous solution of 4 amino, 2 methyl, 1 naphthol hydrochloride. It may be used orally, intramuscularly or intravenously. Hykinone marketed by Abbott is a stable aqueous solution of 2 methyl, 1-4 naptho hydro-quinone, 3 sodium sulfonate and can be used without reactions by any route. Synkavite is produced by Hoffman-La Roche, and is an aqueous solution of the compound 2 methyl, 1-4 naptho-hydro quinone di-phosphoric ester tetra sodium salt. This product has about half the potency of menadione. It is used intramuscularly, and is put up in 5 mg. tablets for oral use. At present we are using Synkamin and Synkavite in our work at the Grace Hospital.

Deficiencies of Vitamin K occur in the body as a result of various factors. Dysfunction of the liver causes a deficiency and we have low prothrombin indices in obstructive jaundice. Physiological jaundice of the new born, even though severe, has no relation to Vitamin K deficiency, as the prothrombin values are normal. Overtaxation of the liver and degeneration of the B-Coli during the latter half of pregnancy impair the production of Vitamin K by the mother. Psychic emotional upsets have also been shown to reduce Vitamin K and cause hypoprothrombinemia. Other causes of deficiency are lack of green foods, milk, eggs and meat in the mother's diet. This may be one reason why haemorrhages are not as common in the higher economic group, and may explain the higher rate of winter and spring months. Toxemia of pregnancy, if prolonged, decreases the prothrombin level. If combined with defective diet, the level remains low until the 6th day, and then rises slowly. Prolonged labour does not affect the time, but anaesthetics do, particularly chloroform, probably as a result of their effect on the liver of the baby. Barbiturates depress the level to a dangerous degree. More Vitamin K is needed, when

these compounds are used during labour. The neo-natal cause of low prothrombin is sterility of the gastro-intestinal tract due to late feeding. There are no bacteria to produce Vitamin K. Artificial feeding within two hours of birth will produce Vitamin K more quickly and the return to normal readings is more rapid, but the post-natal drop is not affected. The extent of this fall depends primarily on the Vitamin K content of the mother's blood. Asphyxia and Anoxemia cause hypoprothrombinemia, and the asphyxiated baby is more likely to bleed, particularly in the brain, than a normal baby.

Under normal conditions, the prothrombin time after birth up to 12 hours is 15 to 20 seconds, from second to fourth day it rises to 60-70 seconds and from the 6th to the 10th day it gradually returns to normal again. Any time over 75 seconds indicates a potential bleeder, and any time over 100 seconds is dangerous. Prematures show higher levels and are all potential bleeders. In haemorrhagic disease, the time has been known to rise to 360 seconds or more than six minutes. Haemorrhage occurs usually during the 2nd to the 4th day with an average of 54 hours. It may occur earlier before birth, if the prothrombin time is high, and later up to the tenth day, for the same reason. If the prothrombin time remains high after the 10th day, it is probably caused by impaired liver function and faulty fat metabolism, which prevents the formation of prothrombin. Traumatic haemorrhage is always aggravated by prothrombin deficiency, and this may be operating when pressure is greatest during delivery. Prothrombin will not stop haemorrhage from large vessels, and the haemostatic defences cannot cope with extensive bleeding. It is true also that prothrombin time may be high and yet the baby show no signs of bleeding. The opposite is true, because a baby may bleed in various locations without any change in blood prothrombin level. There are still unknown factors involved in neo-natal haemorrhages. Possibly in some cases the platelets may be resistant to disintegration. The fibrinogen and calcium of the blood are not concerned. How Vitamin K controls the production of prothrombin has yet to be proved. It probably acts as a catalyst, and is not more intimately associated with the process. The naptho-quinone radical has not been demonstrated in the chemical formula of prothrombin. Large doses of Vitamin K are well tolerated and no toxic effect has ever been observed in mother or baby. An abnormally high prothrombin level has never been produced. Vitamin K is not associated with the fragility or permeability of the capillary vessels. It is thought that Vitamin P is concerned with this phenomenon, and that a deficiency is responsible for the bleeding that occurs on this account. Vitamin P or citrin is found as hesperidin in the citrus fruits, particularly lemons, and this vitamin with Vitamin C explains the improvement that occurs in bleeding conditions, following an increase of these fruits in the diet. It is also assumed that an unknown, hypothetic toxin may effect the walls of the vessels, or that an endoctrine factor is involved. Again, allergy is held responsible for the fragility of the capillaries.

The location of the bleeding is influenced by mechanical factors and injuries. On this account, the gastro-intestinal tract is the commonest site. Bleeding points may be seen on hard palate or pharnyx; blood may be vomited, or tarry stools passed, or stools streaked with bright blood. Next we see bleeding from the navel, skin, scalp, vagina, brain, adrenal and kidney in this order of frequency. Intracranial haemorrhage is the most important on account of the subsequent damage it may cause and is of two types, one accom-

panied by general oozing including the brain and all mucous surfaces, the other involving the brain and meninges only. Retinal haemorrhage is common and is not necessarily associated with brain haemorrhage. It is rather an index of bleeding tendency and occurs in 44% of untreated cases, and may be serious on account of its effect on the future vision of the child. Adrenal haemorrhage is always serious, particularly if bilateral. It is more common in breech babies presumably on account of injury to the back, and slapping for resuscitation. We had four cases of adrenal haemorrhage, verified by post mortem, during the past year. Cephalhaematoma is frequent as a result of mechanical pressure on the head during delivery. There may be as many as five distinct areas of haemorrhage, and considerable blood may be lost in this way. These subside in a period of three to six weeks, and should be left alone, never aspirated, or incised, unless infected. A haematoma of the sterno-mastoid is not uncommon. Navel haemorrhage is comparatively frequent and may be serious, especially as it may not be discovered in time. We lost one premature on this account last year.

Treatment: Prophylaxis

It has been shown that neo-natal haemorrhage occurs because of the low prothrombin level in the blood of the baby. The discovery of Vitamin K and the demonstration of its action in correcting this hypoprothrombinemia have brought about an extraordinary efficient method of treating haemorrhages. It is now established that Vitamin K is a specific for the treatment of this dangerous condition and that its routine use as a prophylactic will drop the incidence to nothing. Vitamin K should be available for treating haemorrhage in the baby just as ergot is now carried for haemorrhage in the mother.

It is neither wise nor safe to question the diagnosis or the cause when haemorrhage occurs. Every baby should receive pre-natal Vitamin K, as all babies that bleed are in danger. If not possible, for economic reasons, then at least those known to be in danger should receive it, those with unfavourable presentations, those in danger as a result of protracted labour, or contracted pelvis or rigid os, and all prematures. While no proof exists that cerebral haemorrhage is a form of haemorrhagic disease, it is possible that lowered prothrombin is the important factor in allowing bleeding to continue, indirectly causing gross damage. Those exposed to, or suffering from cerebral haemorrhage should therefore receive ample dosage. It should also be used in all operative procedures during the first ten days.

Vitamin K may be given orally, intramuscularly or intravenously to mother or baby. Water soluble preparations should be used as only these pass through the placenta. It may be given orally during the last few weeks of pregnancy or a few days before term. As Vitamin K is not stored to any extent and is eliminated quite rapidly, this method is not advisable. It may be given orally during labour. Four mgm. in a teaspoon of water acts in 3-4 hours, and if given five hours before delivery will keep prothrombin time below 25 seconds. One mgm. given orally to the baby can reduce the time from 360 to 30 seconds in 2 hours. The objection to oral administration to the mother is that a great many women vomit during labour and as a result of sedation the stomach may not empty. This also applies to the baby and as a result the Vitamin is not absorbed. Intramuscular injection is the most

satisfactory method and it has a more prolonged effect. Given during labour, it causes a definite elevation of the blood prothrombin in the infant during and after delivery. As intracranial haemorrhage occurs before or during birth process, this method is more effectual in preventing haemorrhage than treating the baby after it is born. It should be given before pressure on the head becomes too great. Five mgm. given to the mother between 5 and 20 hours before birth will keep prothrombin at the normal of 25 seconds for 10 days. If given less than 5 hours before birth, it is safer to give the baby an additional dose of 2 mgm. If more than 20 hours elapse before delivery after the mother has been given 5 mgm., this dose should be repeated. If the mother has not been treated, the baby should have a prophylactic dose of 2 mgm. intramuscularly, immediately after birth and all prematures should have an additional prophylactic dose. Repetition of these doses is seldom necessary.

Treatment: Curative

Actual haemorrhage calls for immediate intramuscular or intravenous injection of Vitamin K. Any bleeding however slight demands prompt and efficient treatment. If the infant bleeds slightly, the loss of prothrombin in this blood may be sufficient to lower the prothrombin to a dangerous level and cause serious haemorrhage. If the haemoglobin is normal, Vitamin K is all that is necessary to stop the bleeding. If the haemorrhage is more severe, and the haemoglobin is low, transfusion will be necessary and should not be delayed. A second transfusion is not required when Vitamin K is used. Intramuscular blood which we have used in the past with so much faith, has now been shown to be of no value in doses of 20cc. When transfusing, the blood should always be grouped and cross matched, and the Rh. factor determined if possible. Intragroup reactions are due to the Rh. factor—so called because it is the agglutinogen present in the red blood cells of the Rhesus monkey. When their cells were injected into a rabbit, agglutinins were formed in the rabbit's serum, and an iso-immunization occurred, and this anti-Rh. rabbit serum, when injected into the Rhesus monkey, agglutinated the monkey's red cells. It was subsequently discovered that the blood of 85% of humans carried this same factor, and was therefore Rh. positive, while that of the remaining 15% lacked this factor and was therefore Rh. negative. The Rh. factor is transmitted from an Rh. father to the fetus as a Mendelian dominant character. If the mother is Rh. negative, the baby's cells passing through the placenta cause an immunizing reaction and the production of an anti-Rh. factor in the mother's blood. This latter passes back into the baby's circulation and gives rise to haemolysis of the baby's cells. If the baby survives it will present one of the syndromes of erythroblastosis, e.g. haemolytic jaundice of the new born. Ordinarily, transfusion will cause no reaction as a result of the Rh. factor, as the great majority of humans are Rh. positive. Serious reactions occur if the mother happens to be Rh. negative and the baby Rh. positive or if the baby is Rh. negative and receives a second transfusion from an Rh. positive donor, the first having caused the production of the anti-Rh. factor in the baby's serum. From these observations it is apparent that the only safe blood to use in transfusing a new born baby or a woman recently pregnant should be Rh. negative, and all Maternity Hospitals should have Rh. negative donors available for this purpose. The anti-Rh. agglutinins disappear from the baby's and the mother's blood in the course of two months and give no further trouble.

The technique of transfusion is not difficult. The internal saphenous vein is used and can be isolated by cutting down on it anterior to the internal malleolus. A 22 gauge needle with a blunt short level is inserted in it, and can be kept in place more easily than a glass canula which we have also used. The blood is citrated and forced slowly into the vein with a 20 cc. syringe. A ½ inch rubber connection between the syringe and needle is easier to handle than connecting the syringe directly. The average baby weighing 7 pounds will take 70 to 100 cc. without any serious disturbance. One baby had a haemoglobinuria, probably as a result of a reaction, but improved without any ill effects. The improvement in the baby's condition after transfusion is immediate and so rapid that it can be put back on its nursing routine within an hour.

Conclusions: Neo-natal haemorrhage due to hypoprothrombinemia is caused by Vitamin K deficiency. The prophylactic use of Vitamin K compounds to control and prevent this hypoprothrombinemia of the new born should be universally adopted. Every infant should be protected in utero by Vitamin K administered to the mother in sufficient amount and sufficient time before delivery to be effective.

In the preparation of this paper I owe anonymous thanks to various authors of books and papers, from which I have extracted a great many of the facts presented.

Personal Interest Notes

The marriage took place at Liverpool on August 8th of Miss Eleanor Louise Rudderham, daughter of Mrs. Obed Rudderham and the late Mr. Rudderham of Liverpool, and Dr. George Murray Smith, son of Dr. Jordan W. Smith and the late Mrs. Smith, also of Liverpool. Dr. Smith graduated from the Dalhousie Medical School on January 5th, 1943, and is practising in Liverpool.

The BULLETIN extends congratulations to Dr. and Mrs. John M. Stewart of Halifax on the birth of a daughter on August 22nd; and to Dr. and Mrs. E. L. Ramsay of Clark's Harbour on the birth of a daughter, Elizabeth Ann, on September 8th.

Dr. L. F. Doiron of Digby had an operation for acute appendicitis early in August, and is at present convalescing.

Lieutenant-Colonel R. H. Sutherland has retired from the R.C.A.MC., and has established himself again in practice at his home in Pictou.

DALHOUSIE UNIVERSITY
FACULTY OF MEDICINE

NINETEENTH
REFRESHER COURSE
October 11th to October 15th, 1943 inclusive

The Course is open to all qualified practitioners irrespective of residence or college of graduation.
Send advance registration to:

DR. J. V. GRAHAM
Chairman, Refresher Course Committee
51 Coburg Road
Halifax, N. S.

NOTES

1. All afternoon lectures will be held in the ballroom of the Lord Nelson Hotel.
2. Each attendant is requested to register his name, home address and Halifax address. The register will be found in the Dalhousie Public Health Clinic, Morris Street. It opens at 8.00 a.m., Monday, October 11th.
3. Registration fee of $2.00 is payable by each civilian physician taking the Course. Medical Officers of the Canadian and United Nations' Army, Navy and Air Forces are invited to register and attend the Course without payment of any fee.
4. Attendance at clinics, etc., in the morning will be limited to the number that can be comfortably accommodated, and will be by ticket only. Advance registration is requested, stating choice of clinics, etc. Choice may be made from either Programme A or Programme B, but not from both.

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PROGRAMME A

MORNING

Monday, October 11

Chairman—
Dr. H. W. Schwartz

VICTORIA GENERAL HOSPITAL

9.00-10.00 a.m.
Medical Clinic
Dr. Frank Kennedy

10.10-11.10 a.m.
Medical Clinic
Drs. K. A. MacKenzie and J. R. Corston

11.20 a.m.-12.20 p.m.
Surgical Clinic
Drs. C. E. Kinley and A. L. Murphy

CHILDREN'S HOSPITAL

9.00 a.m.-12.20 p.m.
Medical and Surgical Clinics
Drs. P. Weatherbe, J. C. Acker, N. B. Coward, A. M. Marshall and J. W. Merritt

Tuesday, October 12

R.C.N. HOSPITAL

9.00-10.00 a.m.
Clinic—"Dysentery"
Surgeon Commander J. W. MacLeod

10.10-11.10 a.m.
Clinic—"Arthritis and Low Back Pain"
Surg. Lt. Commander J. W. Graham

11.20 a.m.-12.20 p.m.
Demonstration—
Stader Splints
Surg. Lt. W. G. Breckenridge

NOVA SCOTIA HOSPITAL

9.00 a.m.-12.20 p.m.
Clinic—"Poliomyelitis" Demonstration of cases treated by the Kenny Method.
Dr. C. E. Kinley and Staff

Wednesday, October 13

Chairman—
Dr. W. G. Colwell

VICTORIA GENERAL HOSPITAL

9.00-10.00 a.m.
Clinic—"Diagnosis and Treatment of Ruptured Intravertebral Discs with Herniation of the Nucleus Polposus"
Dr. Max M. Peet

10.10-11.10 a.m.
Gynaecological Clinic
Dr. H. J. Stander

11.20 a.m.-12.20 p.m.
Surgical Clinic
Drs. W. A. Curry and J. V. Graham

Thursday, October 14

R.C.N. HOSPITAL

9.00-10.00 a.m.
Clinic—"Minor Surgery of the Rectum"
Surg. Lt. Commander W. K. Welsh

10.10-11.10 a.m.
Clinic—"Sterility in the Male"
Surg. Lt. Commander D. R. Mitchell

11.20 a.m.-12.20 p.m.
Clinic—"Common Diseases of the Skin"
Surg. Lt. Commander D. S. Mitchell

D. P. H. CLINIC

9.00-10.00 a.m.
Clinical Lecture
"Burns—Treatment and Plastic Surgery" with film
S/Ldr. Stewart Thompson

10.10-11.10 a.m.
Paper—"Nutrition" with film
S/Ldr. J. F. McCreary

Friday, October 15

Chairman—
Dr. A. L. Murphy

VICTORIA GENERAL HOSPITAL

9.00-10.00 a.m.
Surgical Clinic
Drs. H. K. MacDonald and J. W. Merritt

10.10-11.10 a.m.
Clinic—"Identification of the Placenta by X-ray"
Surg. Lt. Commander Vaughan
"Bronchograms"
Major R. L. Smith
"Advances in Radiology"
Dr. W. M. Roy
"Lamiogram"
Dr. S. R. Johnston

11.20 a.m.-12.20 p.m.
Clinical Lectures — "Sulphonamides and Acute Ear Infections"
Dr. H. W. Schwartz
and
"Diagnostic Bronchoscopy"
Dr. D. M. MacRae

AFTERNOON

Chairman—
Dr. H. G. Grant

3.00-4.00 p.m.
Lecture — "The Unconscious Patient"
Dr. Frank Kennedy

4.10-5.10
Lecture—"Asthma"
Dr. Norman S. Skinner

Chairman—
Dr. G. H. Murphy

3.00-4.00p.m.
Lecture—"The Treatment of Benign Uterine Bleeding"
Dr. H. J. Stander

4.10-5.10 p.m.
Lecture — "The Vagaries of Bronchogenic Carcinoma"
Dr. Frank Kennedy

Chairman—
Dr. H. K. MacDonald

2.00-3.00 p.m.
Lecture—"Influenza"
Dr. R. Hare

3.10-4.10 p.m.
Lecture—"The Present Status of Surgery in the Treatment of High Blood Pressure"
Dr. Max M. Peet

4.20-5.20 p.m.
Lecture—"The Handling of Difficult Labor"
Dr. H. J. Stander

Chairman—
Dr. J. R. Corston

2.00-3.00 p.m.
Lecture—"Wound Infections"
Dr. R. Hare

3.10-4.10 p.m.
Lecture — "Fracture of the Scaphoid" with lantern slides
Colonel L. H. McKim

4.20-5.20 p.m.
Lecture — "Surgery in the Treatment of Peripheral Vascular Syndromes"
Dr. Max Peet

Chairman—
Dr. K. A. MacKenzie

2.00-3.00 p.m.
Lecture—"Pneumonitis"
Lt. Col. J. D. Adamson

3.00-4.00 p.m.
Lecture—"The New Knowledge of Tuberculosis"
Dr. A. F. Miller

4.10-5.10 p.m.
Lecture—"Pitfalls in Surgical Diagnosis and Treatment"
S/Ldr. Stewart

Discussion and Questions invited at close of final paper each afternoon

MORNING

Monday, October 11	Tuesday, October 12	Wednesday, October 13	Thursday, October 14	Friday, October 15
D. P. H. CLINIC 9.00-10.00 a.m. Clinics—Paediatrics **Dr. G. B. Wiswell** Tuberculosis **Dr. W. J. Dyer** 10.10-11.10 a.m. Clinics—Eye and Ear **Dr. H. W. Kirkpatrick** Orthopaedics **Dr. J. C. Acker** 11.20 a.m.-12.20 p.m. Clinics—Surgery **Dr. W. K. House** Medicine **Dr. C. S. Marshall** **CHILDREN'S HOSPITAL** 9.00 a.m.-12.20 p.m. Medical and Surgical Clinics **Drs. P. Weatherbe, J. C. Acker, N. B. Coward, A. M. Marshall and J. W. Merritt**	Chairman— **Dr. H. B. Atlee** **VICTORIA GENERAL HOSPITAL** 9.00-10.00 a.m. Medical Clinic **Dr. Frank Kennedy** 10.10-11.10 a.m. Gynaecological Clinic **Dr. H. J. Stander** 11.20 a.m.-12.20 p.m. Medical Clinic **Drs. C. W. Holland and J. W. Reid** **NOVA SCOTIA HOSPITAL** 9.00 a.m.-12.20 p.m. Clinic—"Poliomyelitis" Demonstration of cases treated by the Kenny Method. **Dr. C. E. Kinley and Staff**	**HALIFAX MILITARY HOSPITAL, Trinity Hall, Cogswell Street** 9.00-9.30 a.m. Clinic—"Cardiac Arrhythmia" **Major S. A. Yaffe** 9.30-10.30 a.m. Medical Clinic **Staffs of Halifax Military and Debert Military Hospitals** 10.30-11.00 a.m. Clinic—"A Group of Radiological Abnormalities" **Major R. L. Smith** 11.00-11.30 a.m. Clinic—"The Treatment of Varicose Veins" **Major G. A. Holland** 11.30 a.m.-12.30 p.m. Surgical Clinic **Staffs of Halifax Military and Debert Military Hospitals**	Chairman— **Dr. C. W. Holland** **VICTORIA GENERAL HOSPITAL** 9.00-10.00 a.m. Surgical Clinic **Dr. Max Peet** 10.10-11.10 a.m. Surgical Clinic **Drs. N. H. Gosse and A. M. Marshall** 11.20 a.m.-12.20 p.m. Clinic—"Prostatic Problems" **Dr. Frank G. Mack** **D. P. H. CLINIC** 9.00-10.00 a.m. Clinical Lecture— "Burns—Treatment and Plastic Surgery" with film **S/Ldr. Stewart Thompson** 10.10-11.10 a.m. Paper—"Nutrition" with film **S/Ldr. J. F. McCreary**	**D. P. H. CLINIC** 9.00-10.00 a.m. Lecture—"Allergy in General Practice" **Surg. Lt. Commander H. L. Bacal** 10.10 a.m.-12.10 p.m. Symposium in Obstetrics **Drs. P. A. Macdonald, H. B. Atlee, W. G. Colwell and K. M. Grant**

AFTERNOON

Chairman— **Dr. H. G. Grant** 3.00-4.00 p.m. Lecture — "The Unconscious Patient" **Dr. Frank Kennedy** 4.10-5.10 p.m. Lecture—"Asthma" **Dr. Norman S. Skinner**	Chairman— **Dr. G. H. Murphy** 3.00-4.00 p.m. Lecture—"The Treatment of Benign Uterine Bleeding" **Dr. H. J. Stander** 4.10-5.10 p.m. Lecture — "The Vagaries of Bronchogenic Carcinoma" **Dr. Frank Kennedy**	Chairman— **Dr. H. K. MacDonald** 2.00-3.00 p.m. Lecture—"Influenza" **Dr. R. Hare** 3.10-4.10 p.m. Lecture—"The Present Status of Surgery in the Treatment of High Blood Pressure" **Dr. Max M. Peet** 4.20-5.20 p.m. Lecture—"The Handling of Difficult Labor" **Dr. H. J. Stander**	Chairman— **Dr. J. R. Corston** 2.00-3.00 p.m. Lecture—"Wound Infections" **Dr. R. Hare** 3.10-4.10 p.m. Lecture — "Fracture of the Scaphoid" with lantern slides **Colonel L. H. McKim** 4.20-5.20 p.m. Lecture — "Surgery in the Treatment of Peripheral Vascular Syndromes" **Dr. Max Peet**	Chairman— **Dr. K. A. MacKenzie** 2.00-3.00 p.m. Lecture—"Pnumonitis" **Lt.-Col. J. D. Adamson** 3.00-4.00 p.m. Lecture—"The New Knowledge of Tuberculosis" **Dr. A. F. Miller** 4.10-5.10 p.m. Lecture—"Pitfalls in Surgical Diagnosis and Treatment" **S/Ldr. Stewart Thompson**

Discussion and Questions invited at close of final paper each afternoon

GUEST TEACHERS

DR. HENRICUS J. STANDER - -	Obstetrician and Gynaecologist-in-Chief, New York Hospital, New York. Professor of Obstetrics and Gynaecology, Cornell University.
DR. MAX M. PEET - - - - -	Chief of Neurological Surgery, University Hospital, Ann Arbor, Michigan. Professor of Surgery, University of Michigan.

(The above sent by the courtesy of War-Time Graduate Medical Meetings of United States, under the auspices of the American Medical Association, The American College of Physicians, and the American College of Surgeons.)

DR. R. HARE - - - - - - -	Research Associate, Connaught Laboratories, University of Toronto.
DR. FRANK S. KENNEDY - - -	Department of Medicine, University of Western Ontario.
S/LDR. STEWART THOMPSON - -	Staff Surgeon, Hospital Sick Children, Toronto.
S/LDR. J. F. MCCREARY - - -	Staff University of Toronto.
SURG. CMDR. J. W. MACLEOD - -	Staff of Royal Victoria Hospital, Montreal.
SURG. LT. CMDR. H. L. BACAL - -	Staff of Children's Memorial Hospital and Royal Victoria Hospital, Montreal.
SURG. LT. CMDR. J. W. GRAHAM -	Staff of Toronto General Hospital, Toronto.
SURG. LT. CMDR. D. R. MITCHELL -	Staff of Toronto General Hospital, Toronto.
SURG. LT. CMDR. D. S. MITCHELL -	Staff of Montreal General Hospital, Montreal.
SURG. LT. CMDR. C. E. VAUGHAN -	Radiologist, Hamilton General Hospital and McGregor Clinic, Hamilton.
SURG. LT. CMDR. W. K. WELSH -	Staff of Toronto General Hospital, Toronto.
SURG. LT. W. G. BRECKENRIDGE -	Ex-resident in Orthopaedics, Massachusetts General Hospital, Boston.
COLONEL L. H. MCKIM - - -	M.D.,C.M.,F.R.C.S.(C), Surgical Staff McGill University.
LT. COL. J. D. ADAMSON - - -	M.D.,M.R.C.P. (Edin), F.R.C.P. (Can.), Professor of Medicine, Univesity of Manitoba.
MAJOR G. A. HOLLAND - - -	B.Com., M.D., C.M., F.R.C.S.(C), Surgical Staff McGill University.
MAJOR R. L. SMITH - - - -	B.A.,M.D.,C.M.
MAJOR S. A. YAFFE - - - -	M.D.,M.R.C.P.

Atypical Pneumonia Found Related to Pneumonia in Cats

The atypical pneumonia cases that have puzzled physicians for the past several years are related to or perhaps the same as a pneumonia that has afflicted cats during the same period. Evidence for this is reported by Dr. James A. Baker, of The Rockefeller Institute for Medical Research at Princeton, in *Science*, November 20. During the past year or so in the northeastern United States, when atypical pneumonia was attacking human beings, cats have frequently been attacked by an infection variously called "nasal catarrh, influenza, or distemper," Doctor Baker reports. The atypical pneumonia in human beings has also masqueraded under symptoms suggesting influenza, grippe, or some similar ailment other than pneumonia, and has often missed being diagnosed as pneumonia, medical scientists believe.

The infection in cats, Doctor Baker found, is due to a virus that forms elementary bodies. Human atypical pneumonia is not caused by the pneumococcus, and medical scientists have believed it is due to a virus. The cat pneumonia virus, Doctor Baker found from tests with human and cat blood during and after the illness, "is the same as or closely related to the one causing some of the so-called atypical pneumonias in man." Whether the human beings contracted the pneumonia from the cats, or vice versa, is not as yet clear.

"A number of instances of contact between sick cats and people who subsequently developed atypical pneumonia have been brought to our attention," Doctor Baker states. "For example, Dr. Francis G. Blake, of Yale University, observed an atypical pneumonia in a rural family in Connecticut that occurred where cats were sick with a pneumonia. Dr. C. W. Barber, of the New York State Veterinary College, noted the reverse, where a child sick with atypical pneumonia played with a kitten that later became sick. It may be of epidemiological interest that the disease in man and in cats is occurring simultaneously."—*The Diplomate*, February, 1943.

Prevention of Blindness from Injuries Has Not Kept Pace with Prevention of Disease-caused Blindness

Reduction of blinding eye injuries has not kept pace with the progress in the past twenty years in reducing blindness from disease, Lewis H. Carris, director emeritus of the National Society for the Prevention of Blindness, charged at the recent dinner of the St. Louis Society for the Blind. The Leslie Dana Gold Medal for outstanding accomplishments in the movement for protecting eyesight was presented to Mr. Carris at the dinner.

"Industry as a whole has been slow to realize that investment in eye protection pays dividends both in eyes saved and in lowered cost of production," Mr. Carris declared. As a happy exception and an example of what can be accomplished, he cited the record of the Pullman Company, where in ten years not one worker of the 25,000 employed has lost an eye.

Greatest progress in saving eyesight has apparently been made through laws requiring the use of a prophylactic in the eyes of all newborn babies to prevent ophthalmia neonatorum. In 1906-1907, Mr. Carris reported, over one fourth (28.2 per cent) of new pupils enrolled in schools for the blind were blind because of this disease. By 1941-42, the number had dropped to about 7 per cent.—*The Diplomate*, February, 1943.