water. In males the prepuce was held back and in females the labia were held apart. The patient was then told to pass water and when the stream was flowing strongly a sterile jar was held to catch some of the stream. If the urine was acid, if pus cells were found in it, and if culture yielded a pure growth of coliform bacilli, the case was included in this classification.

Our series consists of eight cases, two males and six females. The two males had been operated upon by one of us (F. A.). In one a stone was removed from the right ureter and in the other an adenoma of the prostate was removed before the infection of the genito-urinary tract was attacked by means of sulphanilamide. The six females suffered from chronic pyelitis or cystitis. Two of them had already contracted phthisis. Skiagrams had been taken to exclude the presence of urinary calculi.

The urine was in every case kept alkaline during the administration of 3 grammes of sulphonamide-P or Prontosil album daily, divided into three doses, for seven days. No case was cured. In one of the females only did the drug appear to have any inhibitory effect on the organisms. None of our patients weighed more than 110 lb. and only two weighed over 100 lb., so that the dose of the drug would appear to have been adequate.

Gonococcal infections

These were diagnosed by the finding of Gram-negative diplococci in stained films of material taken from some part of the genito-urinary tract.

Our series comprises nine cases, three males and six females, all of whom were treated with Uleron.

One male had an acute anterior urethritis of ten days' duration when treatment was commenced. The other two males suffered from chronic anterior and posterior urethritis and chronic prostatitis. The six females all suffered from chronic cervicitis, only one of them was pregnant.

All the patients were under 110 lb. in weight. Each patient was given 3 grammes of Uleron daily, divided into three doses, for four days, as one course. An alkaline mixture was given with the Uleron. No other treatment was employed but the patients were kept at rest. One patient had six courses separated by intervals of one week, one patient had four courses and the remainder had three courses.

No patient was cured. While Uleron was being administered the gonococci disappeared from the films, but on the withdrawal of the drug the organisms re-appeared.

Our thanks are due to Messrs. Havero Trading Co., Ltd., Bombay, who, with great generosity, supplied us with a free sample of 640 grammes of Uleron. It is therefore a matter of deep regret that we are unable to report satisfactory results.

(*Continued at foot of next column*)

INVESTIGATION INTO THE NATURAL BREEDING PLACES OF THE *SIPHUNCULINA FUNICOLA* FLY, IN ASSAM

By C. S. P. HAMILTON, D.S.O., M.R.C.S., L.R.C.P.

Introduction

THE reason for carrying out this investigation into the natural breeding places of the *Siphunculina funicola* fly is twofold. Firstly, because accurate knowledge of the life history of this fly is considered of importance, owing to its probable connection with the spread of diseases, such as epidemic conjunctivitis and possibly yaws, and secondly, because the eye-fly from April to October is a definite nuisance to everyone in this district.

For two years, up to the 24th March, 1937, the writer carried out an investigation, during his spare time, into the question of the breeding habits of the *Siphunculina funicola* fly in the area of the Juri Valley Medical Association, in the district of Sylhet, Assam (Hamilton, 1938) (Sylhet on the map is situated 24° 55′ N.; 91° 59′ E.).

On the 24th March, 1937, this research was started in earnest, as up to that time the investigation had produced no definite result. It was clearly realized that if it was hoped to obtain accurate information the research must be a very thorough and a continuous one.

Epidemic conjunctivitis

There seems little doubt that in this district epidemic conjunctivitis is a contagious disease, and that the contagion whether septic in origin or due to a specific organism, not yet discovered, is carried by the *Siphunculina funicola* fly, or eye-fly, by which name it is commonly known.

In this district we find the disease prevalent from March to the end of September. It is during the same period we find the eye-flies in their greatest numbers. The disease itself is a serious one, not only because of the discomfort and the great pain it causes to sufferers, but also because of the complications arising from the disease. Even amongst those treated we find an 'after complication' rate of 1.8 per cent to 1.9 per cent.

Further, it is a serious economic factor. Each sufferer must have an attendant, and the average number of days of attending hospital over a

(*Continued from previous column*)

Our thanks are also due to Colonel D. H. Rai, I.M.S., Inspector-General of Civil Hospitals, Central Provinces and Berar, for permission to publish these results.

Note.—It is of course important to report failures as well as successes in treatment with new drugs for which claims are made. This series is, however, a small one and a 'mixed' one. Failures are sometimes due to the unsuitability of the cases treated or of the methods adopted, rather than to the inefficacy of the drug. Readers are referred to a note in our Current Topics section (p. 240) in which the reasons for the failure and apparent failure of Uleron in certain cases is discussed.—EDITOR, *I. M. G.*

series of 2,500 cases worked out at just over one week. In the tea industry, this disease occurs at the busiest period of the year, thus the loss of labour, at such a time, causes a good deal of inconvenience. In the year of drought in 1937, there were 2,227 separate cases of conjunctivitis in the Juri Valley from 1st March to 31st September. This figure will give an idea of how serious the problem may become.

Previous investigations

Evidence had been collected from casual observers, such as Indian clerks living in *bashas*, bungalow residents, and the labourers themselves, that the thatch of houses was the most likely breeding place of the *Siphunculina funicola* fly.

Some of the local inhabitants in the district considered this fly to be breeding in soil, others thought it might be in decaying vegetation or ammoniacal soil of cattle sheds. We know that in other districts there is scientific evidence incriminating certain of these breeding places.

Patton (1921), referring to work on the breeding habits of this fly carried out in 1914, stated that large numbers of these flies found on pieces of straw, string, cobwebs, etc., hanging from the roof of the leather factory at Saidapet, Madras, were placed in test tubes. Eventually, some of these flies laid eggs, and, from some of these eggs, adult flies were hatched out. It was then thought that, as the factory was situated close to a plantation of palmyra palms, and on the ground around these palms a number of palm nuts were found rotting, perhaps the *Siphunculina funicola* fly laid her eggs there, and that this was its natural breeding place. However, no egg, larva or pupa of the fly was found there. Patton goes on to say that recently in the Nilgiri Hills, larvæ simulating the eye-fly (*Siphunculina funicola*) had been found amongst decaying banana leaves, but that the fly had not been bred out from these larvæ.

Syddiq (1938) in Hyderabad reports finding the natural breeding place of the *Siphunculina funicola* fly, in that area, to be in contaminated soil. Strickland (1938) also states that Jepson and Pinto of the Ceylon Government Agricultural Service, bred the flies artificially on a variety of dead organic matter. D. N. Roy (1928) found that these flies were breeding naturally in earth of cattle sheds.

Present investigations

In this district we have found no evidence that the *Siphunculina funicola* fly breeds in damp or ammoniacal soil, in decomposing vegetation, or in manure of cattle or horses. We base this observation on the fact that, from the date 24th March, 1937, when this research was commenced, up to the time of writing this article, 1st November, 1938, we have examined hundreds of bottles of specimens and have never found the eggs, larvæ or pupæ of the *Siphunculina funicola* fly in any material except thatch grass. However, we have often found the young forms of other varieties of flies in ammoniacal soil, and bred out adult flies from them. (The specimens examined included ammoniacal soil from cattle sheds, soil from latrines, and drains, decomposing vegetation, and soil found in galleries of ant heaps.)

Since undertaking this research, not only have we found the *Siphunculina funicola* fly on many occasions in its young forms (eggs, larvæ, pupæ) in thatch, but we have succeeded in breeding out the adult fly from these young forms, and often on the original pieces of thatch they were found in, without the addition of any extra media; for purposes of hatching flies in connection with this research, we use a funnel which was suggested to us by Professor P. A. Buxton (Hamilton, 1938)

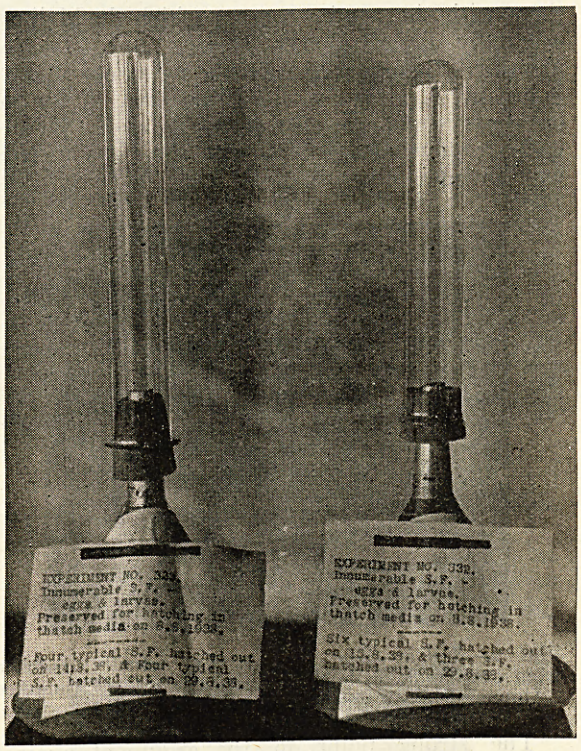

Fig. 1.—Showing funnels suggested by Professor Buxton for breeding flies from various media.

of the School of Tropical Medicine, London (*see* figure 1). Up to August 1938 we had only been able to breed a few adult *Siphunculina funicola* flies at a time, from various collections of eggs and larvæ found in thatch; the greatest number bred from a single specimen of thatch containing the young forms of this fly were nine.

The following important experiment was carried out on the 2nd February, 1938. A sample of ammoniacal soil was divided into two portions, one was boiled for one hour (actual boiling) and the other left unboiled : from the unboiled portion many flies were hatched out, none of these flies proved to be *Siphunculina funicola*. On the boiled portion we put six *Siphunculina funicola* eggs, found in thatch, and from these bred two *Siphunculina funicola* larvæ

and pupæ, eventually one adult *Siphunculina funicola* fly hatched out on 7th March, 1938.

Specimens of these flies were sent to the London School of Hygiene and Tropical Medicine, and our findings verified.

On 29th August, 1938, a few pieces of thatch were collected from a bungalow, and on these we found a number of *Siphunculina funicola* eggs and live larvæ. On this small collection of grass—seventeen live adult flies were bred out, and in addition three freshly hatched but dead ones were found in the tube. A few of these flies were sent to Professor Buxton and identified by him as *Siphunculina funicola*. These same flies were also sent to Dr. Curtis W. Sabrosky in the U. S. A. to be critically examined by him. He wrote to say that he had carefully compared them with the specimen from which de Meijere originally described the species and that he identified them as *Siphunculina funicola*. Dr. Sabrosky is accepted as the leading authority on the systematics of the *Oscinids*. A photograph of one of these flies hatched out in this experiment is given in this article (figure 2).

Fig. 2.—*Siphunculina funicola* fly actually hatched from eggs found in bungalow thatch (note well-marked 'humeral cross vein' joining subcostal to costa).

The strong point in the argument against thatch grass being a natural breeding place for the *Siphunculina funicola* flies was the fact that, up to then, so few adults had been bred from eggs or larvæ found in thatch, so that this experiment is important. When one realizes that in a few strands of thatch grass taken from a bungalow roof, no less than twenty flies were bred, it does not take much imagination to think of the number of flies breeding in the thatch of hundreds of tea garden houses. At the same time as the *Siphunculina funicola* flies were bred we hatched out numerous flies from ammoniacal soil of cattle sheds, however, not one of these flies was a *Siphunculina funicola;* they all proved to belong to the *Borboridæ* family. I sent these soil flies to the London School of Hygiene and Tropical Medicine, and they upheld the identification as being *Borboridæ*.

An interesting fact in the breeding habits of these flies in thatch is that, in the majority of cases, dead flies in disintegrated forms were found together with collections of fly eggs, the whole being laid in a blackish mass entwined in a web. The mass may assume a definite roundish shape, become semi-solid, and eventually act as a 'cocoon mass', harbouring a larva or pupa. The writer has dissected several of these masses and found typical larvæ or pupæ in them; he also dissected out an eye-fly from a pupa found in one of these black masses. This blackish material found on pieces of sungrass is probably formed from excreta or secreta from the flies themselves. At first it was thought to be due to soot, and the strands of grass covered by this material we called sooty strands. However, its origin from sooty deposits was soon disproved, as pieces of thatch covered with the same blackish substance were found in the eaves of a bungalow in which no fires exist, and therefore there is no soot. Pieces of binding wire found in thatch roofs have been seen to be covered with this black substance, and harbouring a number of live and dead *Siphunculina funicola* flies. On one strand of wire we found a typical hard blackish nodule akin to the nodules described above (figure 3), and on

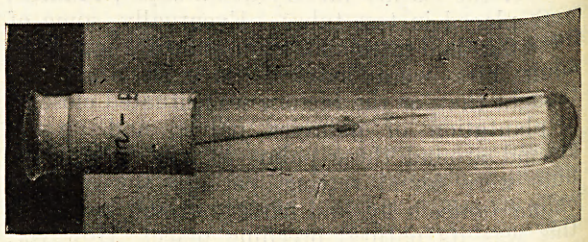

Fig. 3.—Typical 'cocoon type of mass' (black semi-solid) found hanging on a wire outside a bungalow. From many masses, similar to this, *Siphunculina funicola* in young forms have been dissected out. On this actual wire many *Siphunculina funicola* flies were found and the whole wire was covered with a black pultaceous substance.

the same wire, dead and disintegrated *Siphunculina funicola* flies, and many of their eggs were found lying in this blackish substance. One might say the majority of pieces of house thatch examined were covered with this blackish substance, often found to be harbouring the disintegrated forms of the flies, *plus* their eggs, and in many cases their larvæ. It is certainly not necessary for the larval, and pupal stages, to be encased in this black nodule, as they have more often been found to be lying in the folds of the thatch grass; nevertheless, on many occasions we have found them as described above, namely, encased in these nodular masses (figure 4).

On 30th April, 1938, thatch containing *Siphunculina funicola* eggs was collected (8 pieces of thatch averaging $\frac{3}{8}$ inch $\times$ $2\frac{1}{2}$ inches long); from this three adult *Siphunculina funicola* flies were hatched out on 31st May, two on 11th June, and from that date until 1st November no further flies were hatched out. (I think actually the flies must have hatched out on the night of

31st October, as we examined the tube in the morning of 1st November). This means that fly eggs in thatch are viable for a very long period. In the funnel tube in which we hatched out these flies on 1st November, we also found pieces of pupal skin, dried up and dead *Siphunculina funicola* larvæ, and several eggs, some dried up, but some looked quite healthy.

Description of Siphunculina funicola *(eye-fly)*

The species was originally described by de Meijere.

It is an insect about 1/16th inch in length and is almost black in colour except the wings.

Entomological.—This fly belongs to the *Oscinidæ* family. The male fly is to be distinguished from the female one by the absence of ovipositor.

It possesses head, thorax, two pairs of wings and three pairs of legs. On the head there is a pair of antennæ from the third segment of which arise a pair of very finely feathered aristæ. The proboscis has a stout hook-like process at the tip.

The anterior pair of wings is shining in colour, whereas the posterior pair, the halters, are not covered with squamas.

The venations of the wings are as follows :

There are four longitudinal veins; the transverse or cross vein, connecting the costa with sub-costa (humeral cross vein), is very prominent and situated at right angles towards the basal area. The vein joining the second to the third is called sectorial cross vein, and that joining the third to the fourth, the radio-medial cross vein. There are three pairs of legs. In the front pairs the femur is black, the tibia and the tarsi are golden in colour without interruption of any other colour.

In the mid and hind pairs—femurs and tibiæ are black and only the tarsi are golden without interruption of any other colour. The coxa femoral joints are golden in colour in each of the three pairs; but the knee joints are golden in colour in the mid and hind pairs of legs only.

Eggs.—The egg measures about 0.5 mm. in length, is whitish in colour, oval and boat-shaped, one end being bluntly rounded off, and the other pointed (figure 5). One side is slightly concave and the other convex.

The surface of the egg is marked by a number of longitudinal striations.

Larvæ.—A mature larva is about $\frac{1}{8}$ inch in length, yellowish white or creamy white in colour, and consists of 13 segments. The head end is tapering while the posterior end is gradually enlarging and is truncated. The antennæ consist of very small blunt hairy projections only. The anterior spiracles project from the sides of the thorax some distance behind the thorax and each consists of a stalk with five finger-like processes. The posterior spiracles project some distance from the dorsal surface of the eighth abdominal segment.

Pupæ.—The pupa (figure 6) has 10 segments and is slightly shorter in length, but is bigger in size than the larva. It is amber in colour. One surface is comparatively more convex than the other. The anterior end is narrower than the posterior, and the spiracles project from the posterior end.

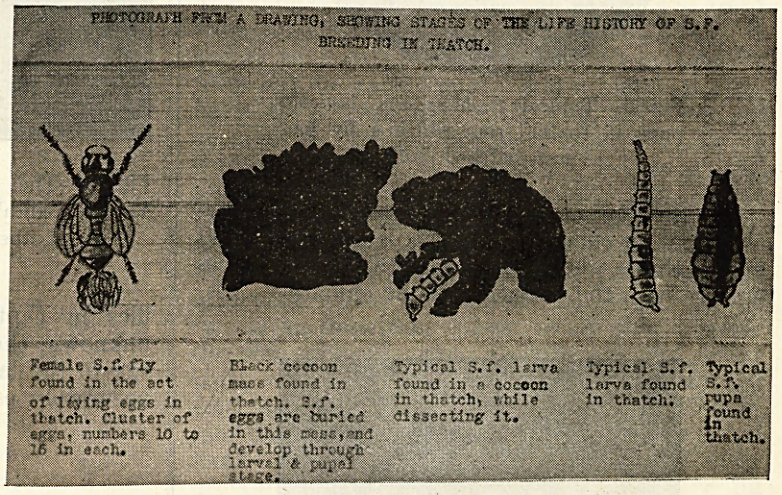

Fig. 4.

Patton says that one fly can lay as many as 60 eggs; up to now we have only been able to dissect as many as 40 eggs from a single fly.

Fig. 5.—Eggs of *Siphunculina funicola* lying *in situ* on thatch grass.

The fact that the females lay eggs in batches of 5 to 10 is obvious. We have a few flies mounted actually in the position of laying their eggs in

thatch grass and in one of them we found 10 eggs laid in one batch (figure 7).

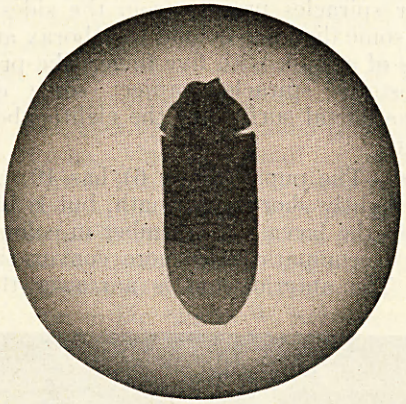

Fig. 6.—Typical *Siphunculina funicola* pupa in thatch from which a fly had just hatched out.

Duration of phases in life cycle.—In favourable weather conditions the whole life cycle takes about three weeks to complete, but it varies greatly with the variation of the climate.

Fig. 7.—Showing batch of 10 eggs laid by the fly.

From larva to adult fly average 7 to 8 days. Actual hatching dates in different experiments were as follows :—

(*a*) From egg to fly .. 24 to 25 days.

(*b*) From larva to fly .. 9 days.

(*c*) From larva to fly .. 7 days.

(*d*) From larva to fly .. 8 days.

(*e*) (Media used here was boiled cow-dung on which were placed eggs hatched in thatch).

(*i*) From egg to larva .. 10 days.

(*ii*) From larva to pupa .. 14 days.

(*iii*) From pupa to fly .. 12 days.

It must be remembered that these hatching experiments—*a*, *b*, *c*, *d*, and *e*—were from eggs found in thatch, and not from eggs laid by

'EYE-FLY HOUSE'.

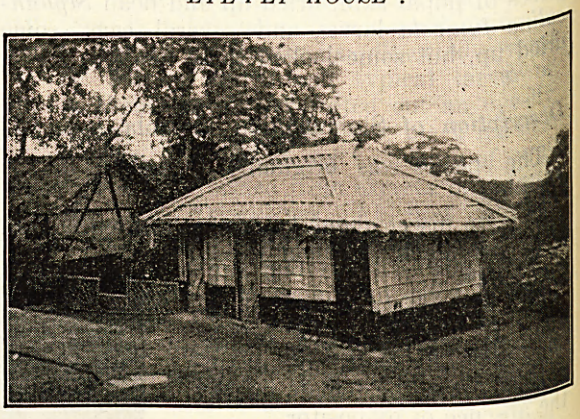

Fig. 8.—The special house erected beside the Juri Valley Medical Association Laboratory, in which some of the experiments were carried out.

flies in captivity. The age of the eggs was unknown, therefore the length of time from the egg to the larva is not given, as it could not be accurately estimated.

Summary

An investigation was carried out into the breeding habits of the *Siphunculina funicola* fly. It was found that in the Juri Valley areas, South Sylhet, this fly breeds in thatch of houses, especially in the thatch of the eaves of these houses. The whole cycle from the egg to the adult fly takes place in the thatch grass. The flies hatched in thatch from eggs after a period of six months.

In ammoniacal soil and decomposed vegetation, it was proved that *Borboridæ* breed in numbers, but no evidence was found of the *Siphunculina funicola* breeding in this type of soil or in decomposed material.

Conclusion

That in the Juri Valley area of Assam, the only place the *Siphunculina funicola* breeds is in thatch of houses. Ammoniacal soil is therefore not a dangerous medium, as far as this fly is concerned, in the Juri Valley.

This research has been brought to a successful climax for two reasons, firstly, because it was a daily investigation and prolonged over a long period; secondly, because it was being conducted on the spot and specimens were therefore available in a fresh condition.

Acknowledgments.—The writer wishes to acknowledge his debt of gratitude to the following :—Professor P. A. Buxton, of the London School of Hygiene and Tropical Medicine, whose collaboration was of the utmost value, Drs. H. N. Chowdhury, L.M.P., K. N. Das, L.M.P., N. C. Deb, L.M.P., for their untiring work throughout varying stages of the investigation. To Dr. S. K. Dutta, L.M.F., L.T.M., Malariologist, Central Laboratory, Juri Valley Medical Association, for his help in examination of the entomological specimens. Last but not least the whole staff of the Central Hospital, Juri Valley Medical Association, and especially the chief laboratory assistant Sreejut Abinash Chakravarty, who was in charge of the preparation of the microscopic specimens.

APPENDIX A

List of total number of specimens examined:—

Material	* Number of specimens
Thatch grass	525
Ammoniacal soil	145
Fresh soil	23
Materials other than thatch grass and ammoniacal soil, *e.g.*, decomposing vegetation, leaves, banana tree leaves, etc.	71
TOTAL ..	764

*Bottles or tins of specimens sent for examination—one bottle or tin often contained a great number—50 or even more separate specimens for microscopical examination. In all some thousands of specimens were examined microscopically, as the investigation was continuous and daily carried on throughout the whole period from 24th March, 1937 to 30th November, 1938.

APPENDIX B

List showing number of times eggs, larvæ and pupæ simulating those of the young forms of Siphunculina funicola *were found in thatch grass*

Eggs found	340 times
Larvæ found	49 „
Pupæ and pupal skin found ..	50 „

In all on 28 occasions adult live *Siphunculina funicola* flies were hatched out from young forms found in thatch, giving a total of 56 adults.

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THE QUALITY OF MEDICINAL COD-LIVER OIL AND ITS PREPARATIONS ON THE INDIAN MARKET

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and
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Introduction

COD-LIVER oil is the fixed oil expressed from the fresh liver of the codfish (*Gadus morrhua*, Linn.) by the application of low pressure steam at a temperature not exceeding 85°C., and freed from solid fat by filtration at about 0°C. It occurs as a pale yellow liquid with a slightly fishy but not rancid odour, and a bland, slightly fishy taste. Amongst fatty oils, cod-liver oil occupies a peculiar position chemically, for it contains, besides the ordinary types of fat, glycerides of very non-saturated fatty acids (largely those of Clupanadonic acid, $C_{22}H_{34}O_2$ and of a highly unsaturated acid containing 18 or 20 carbon atoms), which are not found in other oils. The unsaturated character of the fats is an important factor, as on this depends the comparatively easy assimilation and metabolic oxidation of the oil. The unsaturated fatty acids are therefore considered to be of definite therapeutic value. Apart from these, cod-liver oil contains vitamins A and D and these are supposed to be chiefly responsible for its medicinal importance.

Adulteration of cod-liver oil

The best cod-liver oil is extracted from the fat livers of the sea-cod and other species of cod caught in the early part of the winter when this fish makes its way in from the sea to the west coast of Norway, Greenland and Newfoundland, etc., to spawn upon the banks lying off these coasts. Because of the polar ice cap, the small craft found in the coastal waters of Northern Europe cannot reach the fishing grounds on which the best cod is caught. Special types of trawlers are required for such fishing operations. Many fishing fleets not equipped with such trawlers are therefore forced to carry on operations in areas where, along with the cod caught, large numbers of haddock, ling and other fish are usually present. Under ordinary conditions, all the fish livers are pooled together and boiled for extraction of the oil. If the catch contains a mixture of different types of fish it is naturally difficult, unless special precautions are taken, to ensure the production of a uniform grade of cod-liver oil. Such mixed oil is often offered for sale in bulk by wholesale traders and importers. Commercial brand, 'coast cod oil' for instance, is really a mixed fish-liver oil which may have been obtained from any fish, *e.g.*, cod, shark, dogfish, etc., which the trawlers' nets bring up from the open sea. If such foreign