A CONTRIBUTION TO THE STUDY OF THE POST-
MORTEM APPEARANCES IN THE DROWNED.

By Harvey Littlejohn, M.B., B.Sc., F.R.C.S.Ed., Lecturer on
Medical Jurisprudence, Edinburgh.

(Plates VII.–XII.)

Owing to the proximity of Edinburgh to the sea, and also to the cir-
cumstance that there is a fresh-water canal and several small lakes
within the city boundaries, frequent opportunities are afforded of
examining the bodies of persons who have been drowned in salt
and in fresh water.

In the literature dealing with the subject of drowning, I have
been unable to find any special reference to the effects of immer-
sion in salt water. The classical descriptions of Devergie, Orfila,
Casper, Taylor, and many other older writers, of the appearances in
death by drowning, and of the subsequent changes undergone by
bodies immersed in water for various periods of time, are based,
almost exclusively, upon the material which such rivers as the
Seine or inland lakes have supplied.

The descriptions in modern works on forensic medicine, such
as those of Hoffmann, Brouardel, Strassmann, and Dixon Mann,
are also confined apparently to the conditions commonly seen in
cases of drowning in fresh water.

I do not desire to suggest by this that there is any distinction
between drowning in fresh and in salt water, so far as regards the
diagnostic signs of drowning: these, naturally, must be the same,
no matter what the fluid is.

A comparison, however, of the bodies which have been im-
mersed in the sea, and in fresh water, for some time, has led me
to the conclusion that the changes which bodies undergo as a
result of lying in water of these respective characters frequently
show marked and important differences. For this reason, and also
because certain of the cases present special points of interest, I venture to give the following account of the post-mortem appearances in some of the bodies which have been recently found in salt water. The records of these cases have an additional value from the fact that, in every instance, with one exception, the exact period of immersion was determined on reliable and satisfactory evidence, so that they may fairly serve as data for contrasting the effects of putrefaction after varying intervals of time.

The first four cases refer to bodies which were found in sea water: one in the open sea, and the other three in an old quarry to which the sea has free access, and which appears to be a favourite locality for suicide. The two subsequent cases (5 and 6) occurred in the canal, that is, in fresh water, and are given for comparison, and because they present some features of interest.

One of the most striking appearances presented by bodies which are found in the sea is the rapidity with which the soft parts on exposed portions of the body, such as the head, etc., may be destroyed. At the same time, the body, as a whole, shows a much slower progress of the putrefactive changes than that found in the bodies of persons drowned in fresh water. The destruction of the flesh on the head, hands, and feet (if the latter are not covered), is not due, as a rule, to putrefaction; although no doubt it may, to some extent, be assisted by decomposition producing a softening of the tissues. It arises from the action of fishes, and more particularly of crabs, attacking and devouring the flesh. To a certain extent, also, the detritive action produced by waves, causing the body to be moved to and fro against rocks, or on a stony sea bottom, may tend to the same result. There is no doubt, however, that the chief cause is due to fish attacking the body: the nature of the injuries produced—their frequently circumscribed character, and the appearance of the edges of the parts affected—indicate this mode of causation. In further proof, however, of this point, I will relate a somewhat weird experience which happened to me lately.

The body of a sailor was found in the sea: it was fully clothed, and appeared to be in a comparatively fresh condition, with the exception of the head and hands, which were practically devoid of flesh. After examining these parts so far as I was able, owing to the body lying in its coffin, clothed in the condition in which it was removed from the water, the coffin lid was replaced. On the following day, being anxious to show the body to my students, I again removed the lid, when, to our horror, from beneath the covering pall a large black crab marched out.

It is astonishing within how short a time the disappearance of such exposed parts may take place. I have seen the whole of the bones of the head, face, hands, and feet picked as clean as anatomical specimens, within ten days of death; whereas the rest of the body, which was covered with clothes, was intact, and showed
Fig. 1. — Body recovered from the sea after four weeks' immersion.

Fig. 2. — Case of drowning in fresh water. Body recovered fifteen days afterwards.
Body found in the sea after two weeks' immersion. The photographs were taken on the day after recovery with result that the body and penis have become somewhat distended.
Fig. 1.—Body from Granton Quarry after five months' immersion.

Fig. 2.—Same case, clothes reflected; condition of right hand due to removal of glove.
Fig. 1.—Head of case shown in Plate IX. The cheeks and scalp are transformed into adipocere.

Fig. 2.—Hand after six weeks' immersion in salt water; cuticle on palmar aspect is perfectly whole.
Fig. 1.—Portion of lung from case 1, showing crystals referred to in the text.

Fig. 2.—Crystals from diaphragmatic pleura. These are not so well defined, and have become opaque during the preservation of the tissue.
Fig. 1.—Cuticle from hand after five weeks' immersion in the sea.

Fig. 2.—Cuticle from foot after five months in the sea; foot was covered with stocking and boot.
scarcely the slightest trace of decomposition externally. The ears, nose, and forehead, together with the eyes, are, as a rule, the first parts to disappear; while the wrists and backs of the hands are also attacked before the palmar aspects—no doubt, on account of the greater toughness of the cuticle in this latter position.

There can be little question as to the slower progress of putrefaction in salt as compared with fresh water. This may be explained by the greater purity of the water as a rule, and also by the slightly antiseptic action of salt water. Possibly there are also conditions present which are more conducive to the formation of adipocere than in fresh water.

A third respect in which bodies recovered from the sea differ, in the majority of cases, from those of persons drowned in fresh water, is to be found in the greater frequency of injuries upon them. This is only to be expected, since, although injuries do occur in bodies lying in fresh water from a variety of causes, yet they are the exception, apart from cases of drowning occurring in rapid rivers or places where there is considerable boat traffic. On the other hand, bodies recovered from the sea, more especially near the shore, very often present injuries consisting sometimes merely of abrasions and bruises, at other times of extensive lacerations and fractures. In connection with such superficial abrasions of undoubted post-mortem origin, considerable difficulty may be experienced in deciding the question of ante- or post-mortem infliction, owing to their presenting at first a light red colour or florid appearance, very similar to excoriations caused during life. This is a result, no doubt, due to the salt water. A similar reason may also account for the great frequency with which the skin of the face and other parts of the body, in those drowned in sea water, present a bright red or pink coloration.

Case 1.—Body recovered after five months’ immersion in sea water.—

_peculiar formation of crystals in internal organs._—On 25th May the body of a man was found in Granton Quarry. It was identified by means of certain cards in his pockets, and also by a ring on his finger, as that of a man who had disappeared upon the 23rd of December previous. He had been of intemperate habits, and, before his disappearance, was in a depressed state of mind. From these and other circumstances, there can be little doubt that he committed suicide on or about the day of his disappearance. The quarry referred to is an old disused one, abutting on the sea, and filled with sea water, which has free access to it at high tide. The body was noticed early on the morning of 25th May, lying stranded on the sloping edge of the quarry, partly covered with water.

The body was examined and photographed upon the 26th May. It was completely clothed in thick underclothing, a tweed suit, overcoat, boots, and gloves (Plate IX., Fig. 1).

The body presented the very striking picture seen in the above photograph. The cranium was bare in front, and polished; posteriorly, it was covered with scalp, which was, however, loose, and transformed into a white adipocerous substance, to the external surface of which a few hairs
were still attached; the cranium was uninjured, and the bones were firm and not brittle.

The face presented the appearance shown in Plate X., Fig. 1. The soft parts had all disappeared from it, leaving the bones perfectly bare and clean, with the exception of the orbits and cheeks, which were covered with white adipocere. The external ears were absent, with the exception of small portions of cartilage. On cutting open the clothes, the rest of the body presented a remarkably fresh appearance (Plate IX., Fig. 2). The skin of the trunk and limbs had a pale greenish tint, and was everywhere intact, with the exception of a small area over the shin of the left leg, where it was destroyed down to the bone and muscles. In this situation there was also a hole in the underclothing, which had the appearance of having been eaten away by crabs or fish. There was no putrefactive emphysema.

The scrotum was not distended, but the penis was soft and undergoing decomposition. The cuticle over the greater part of the body was easily detached. The abdomen was somewhat distended. On removing the glove from the right hand in order to obtain possession of his ring, the whole of the soft parts, together with one or two of the phalanges, came away in the glove. This accounts for the appearance seen in the photograph. The glove of the left hand was split at the seams; but the soft parts within it, although macerated and easily broken down, were intact. On removing the boots, the feet were found quite intact and normal, except that the cuticle was bleached and sodden, and easily detachable en masse (Plate XII., Fig. 2) from the ankles downwards.

**Internal examination.**—On piercing the abdominal wall, a considerable quantity of gas escaped, which was non-inflammable, and extinguished a light held in it. A quantity of similar gas was also present in the pleural cavities. The odour given out by the body, previously slight, was now strong, although not particularly offensive. The general tissues of the body, except the subcutaneous fat, were uniformly red in colour, from imbibition and transudation of blood-colouring matter. The lungs were collapsed, and floated in about a pint of blood-stained fluid contained in each pleural cavity: they were soft, and greenish in colour on the surface. Both presented the following very remarkable appearance, namely, a deposit on the pleura of numerous clear crystals, ranging in size from a millet seed to a cherry stone (Plate XI., Fig. 1). These crystals were well formed, and firmly adherent to the pleura. The costal pleura, as also that covering the diaphragm and the pericardium, was likewise thickly encrusted with similar crystals (Plate XI., Fig. 2), and presented an appearance which reminded one of the deposition of crystals from a saturated solution of a salt. The substance of the lungs was breaking down; and in it similar crystals were found on section, although of comparatively small size. The heart was collapsed and empty; the endocardium was deeply stained, of a reddish colour, but the organ showed no other signs of decomposition. In the abdomen, all the organs were remarkably fresh in appearance. The stomach was light green in colour, except the posterior wall, which was blackish brown; it was, however, in as good preservation as is frequently seen in bodies which have only been dead for a few days. It contained a little watery fluid and a considerable number of crystals similar to those
referred to above; only, the majority were of a larger size, and they were but loosely, if at all, attached to the mucous membrane. The intestines had a fresh and normal appearance. The jejunum contained a number of crystals, and some thick, slimy, blood-stained fluid. The liver was slightly green on the surface, but otherwise was well preserved, as also were the other organs of the abdomen. There was no fluid in the peritoneal cavity. On cutting into the flesh of the thighs, it appeared to be undergoing transformation into adipocere.

The crystalline formation in this case must be one of great rarity. I have so far been unable to find an account of the occurrence of a similar condition in any of the works upon forensic medicine which I have had an opportunity of consulting. My friend, Professor Strassmann of Berlin, to whom I wrote on the subject, very kindly gave me references relating to the deposition of phosphates on organs in cases of advanced decomposition, but the crystals in my case are evidently of a totally different character. Another reference I have been unable to consult. I remember seeing a preparation of a crystalline deposit upon an organ in Hofmann’s museum at Vienna, but this, I think, was of the same nature as that referred to by Strassmann, and was in no way similar to the condition under discussion. An analysis of the crystals, kindly made by Dr. Noel Paton, showed them to consist mainly of calcium phosphate. They are therefore insoluble in water, as indeed was indicated by the fact of most of them being immersed in the watery fluid contained in the pleural cavities. I regret that I did not preserve and analyse some of this fluid, and that an illness, accompanied with acute suppuration of the middle ear—the result, I believe, of the post-mortem examination—prevented me from preserving much of the material removed from the body. I must confess to having considerable difficulty in explaining the origin of the crystals. At first I was inclined to believe that they were closely connected with the locus in which the body was found. This was an old disused quarry into which the sea had broken, as already detailed. It therefore contains salt water, but, in addition, in all probability there are certain springs discharging into it, as in most quarries, and these springs are almost certainly highly charged with salts. Against a theory of the water in the quarry exerting any special influence, is, however, the fact that the body in Case 4 was also found in the same place, and must have been dead for at least as long a period as the one in question; while another point is, that the crystals were all formed in the body, and not anywhere upon its surface. These considerations lead to the conclusion that at least one of the constituents of the crystals had its source in the body, and I am therefore inclined to think that their formation was due to the soluble phosphates of the

1 Maschke, "Handbuch," Bd. iii. S. 408; Strassmann, "Lehrbuch," S. 568; Israel, "Pract. der Path. Hist.," Auf. 2. S. 196.
2 Gabriel Corin, Anm. Soc. de méd. legal België.
tissues combining with the calcium present in the sea water. It is well known that in very dilute solutions even the most insoluble salts may crystallise out in process of time, and that frequently such crystals may be of large size.

In the present instance the size of many of the crystals was remarkable—a fact pointing to their slow formation.

An interesting question arises, namely, whether such crystals do not form more frequently than may be supposed in cases of drowning in salt water. The fact of their not having been previously observed may be due to bodies not being dissected, as a rule, when in an advanced stage of decomposition, or possibly owing to the crystals having disappeared, after their formation, from the production of acids as a result of progressive putrefaction and chemical changes. Even a very weak acid solution would quickly cause crystals of calcium phosphate to dissolve.

The photographs (Plate XI., Figs. 1 and 2) were taken several weeks after the post-mortem examination was made, and after the portion of lung and diaphragm had been prepared for permanent preservation in formalin; so that, to some extent, the original clearness and sharp definition of the crystals have been lost.

**Case 2.**—Body recovered after one month's immersion in sea water.—A man, set. 57, disappeared on the 13th of May, and his body was found floating in the same quarry as in the last case, on the 17th of June: it was identified by relatives, and the circumstances all pointed to the case being one of suicide, committed on the day of his disappearance.

The body was fully clothed, and the pockets were filled with large stones, notwithstanding which it was found floating, as above described.

The face was much decomposed, and unrecognisable owing to the nose and upper lip being partially destroyed (Plate VII., Fig. 1); the other soft parts of the face were of a dark brownish green colour, soft and slimy, but the skin was present, although the cuticle had disappeared; the eyes were unrecognisable; the scalp was intact, greenish in colour, and devoid of hair, except behind the ears and below the occiput, thus giving the appearance of being bald, although not so in life. The ears had disappeared, with the exception of small portions of the cartilages; the neck was swollen, and the skin green and soft. On cutting away the clothes, the shoulders, chest, and abdomen were found to be distended by putrefactive gases. The scrotum and penis were enormously distended, but the skin here showed no green discoloration; the limbs were also somewhat swollen from putrefaction. The skin, generally, over the body had a greenish tint, but this was nowhere deep. The subcutaneous blood vessels gave a marbled appearance, more especially to the arms and shoulders. The cuticle everywhere was intact, but was easily detachable. The hair on chest and pubis was present and firm. There was well-marked goose-skin on the front of the thighs. The hands were bleached, and the cuticle becoming detached in a glove-like form, while the dorsal aspects and wrists had
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apparently been attacked by fish or other animals, as the skin was here eaten away in parts, exposing the subcutaneous tissues. Two fingers of the right hand had also disappeared. No internal examination was made in this case.

**Case 3.**—Body recovered after fifteen days' immersion in the sea.—A man, aged 25, fell overboard from a pleasure steamer into the sea. On 6th July, fifteen days afterwards, the body was found floating on the surface, at a considerable distance from the shore. The body was fully clothed, and presented a very striking appearance, inasmuch as nearly the whole of the soft parts of the head had disappeared (Plate VIII., Fig. 2), while, at first sight, the rest of the body appeared to be little altered. The skull was perfectly bare, except for some portions of loose scalp behind the ears and occiput, to which some dark hair was still attached. The bones of the face were exposed, and the orbits empty, the only soft parts remaining being portions of the cheeks, which were detached and loose owing to advanced putrefaction of the subcutaneous structures. The teeth were loose, and some had fallen out. The ears were absent, only remains of the cartilages being left. The tongue was loose, and fairly well preserved, except on the left side, where it had the appearance of having been eaten away. The neck was swollen with putrefactive emphysema, and had as lightly greenish hue. The skin of the trunk was fresh and natural in appearance; there was well-marked goose-skin on the chest and limbs. The scrotum was contracted, but the body, as a whole, was quite flaccid. The cuticle of the hands was bleached, sodden, and becoming detached. On the dorsal aspects of both wrists the skin was destroyed (Plate VIII., Fig. 1), exposing the subjacent structures. The cuticle of the feet was bleached, but intact and firmly adherent. No internal examination could be made in this case.

The appearances presented by the bodies in the two preceding cases are interesting, especially when contrasted with those recorded in connection with Cases 5 and 6, which relate to bodies recovered from fresh water after exactly similar periods of immersion. The outstanding difference between them is, that while, in the latter two, the faces, heads, and hands (in other words, the exposed parts of the bodies) were everywhere intact,—in the two former bodies, recovered from the sea, these parts had been partially destroyed, and, of the ears in both, only small portions of the cartilages remained. Nothing, in my opinion, could represent more typically the difference which, I believe, usually characterises bodies which have lain in salt and fresh water respectively.

**Case 4.**—Body of a man recovered in sea water: time of immersion unknown.—This body was found in the month of May in the quarry already referred to, and was never identified. It presented a most peculiar appearance, inasmuch as the skin and subcutaneous tissues, down to the muscles, had disappeared from the whole of the body. The cranium was quite bare; the soft parts of the face were present, but
merely as a mass of decomposing flesh of a dark brownish green colour; the ribs were exposed, together with the intercostal muscles, as in a care-
fully dissected body; while the anterior coverings of the abdomen had all disappeared, down to the tendinous aponeurosis. The thoracic and abdominal cavities were, however, intact. In many places the bones of the arms were bare, while the hands had the appearance shown in Plate X., Fig. 2; the palmar aspects were still practically intact and covered with cuticle, which could be detached entire in the form of a glove. Both feet were absent, and both legs below the knee were denuded of flesh, nothing but the bare tibiae and fibulae remaining. The scrotum and penis were unrecognisable. What appeared to be a piece of loose rectus muscle lay close to the umbilicus; but on closer examination it proved to be a coil of small intestine protruding through a firm fibrous ring at the umbilicus, which tightly constricted the protruding bowel. On opening into the abdomen, all the organs were found to be in a remarkably fresh condition, and of practically normal colour, except the liver, which was soft and green. The stomach and intestines were collapsed, and they appeared to be adherent to each other, as well as to the liver and other organs, in various places. This appearance suggested the previous existence of a peritonitis; but it was impossible to decide this point definitely, under the circumstances. The stomach was empty. The whole appearance of the abdominal organs was in marked contrast to the external condition of the body. The heart was distended with gas, and contained some thick fluid blood. The lungs were becoming green, and distended by putrefactive emphy-
sema.

This case is chiefly interesting on account of the universal manner in which the superficial coverings of the body, i.e., the skin and subcutaneous tissues, had been removed from the trunk and greater portion of the limbs, leaving only the muscles and deep fasciae. This result was in all probability produced by fish. The presence of the umbilical hernia is also noteworthy, and might have served as a valuable aid to the identification of the body. I thought at first that the loop of bowel might possibly have been extracted from the abdomen through a hole made by crabs in its wall, but the constricting ring was too tight to lend countenance to such a suggestion, while the fact that the protruding coil of intestine showed no trace of injury was also against such a theory.

Case 5.—Body recovered from canal after one month's immersion.—The body was that of a middle-aged man, found floating on the surface on the 4th February. It was identified as that of a person who dis-
appeared on 31st December previous. The body was well nourished and fully clothed; face was dark green in colour, and greatly swollen from putrefactive emphysema, as were also the head and neck. There was no froth at the mouth or nose; the hair on the face and head was loose, and had already partially disappeared. On the vertex there was a lacerated wound 2 in. long, and triangular in shape. The tissues immediately around this wound were uniformly red in colour from
transudation of blood-colouring matter, and it was impossible to say whether the wound was ante- or post-mortem. On removing the clothes there was a slight green discoloration of the lower part of the abdomen, but otherwise the body was quite fresh-looking. The abdomen was somewhat distended. There was no hypostatic lividity, the skin being everywhere blanched. The limbs were rigid; no goose-skin; nipples retracted. The penis was very markedly retracted, so that I thought at first that it had been amputated close to its base; the scrotum also was greatly retracted and empty, no testicles being contained in it. On closer examination, there appeared to be a bubo in each inguinal region, but these turned out to be the testicles, which had been retracted up into the inguinal canal. This was evidently a result of post-mortem contraction, as it was found easy to draw them down again into the scrotum, and to reproduce the normal condition. The penis also could be drawn out, and was then of normal size. There was some fluid at the end of the urethra, and this, on microscopic examination, proved to be semen, containing abundant spermatozoa. On puncturing the abdomen, a quantity of gas escaped, which burned brightly with a blue flame for nearly a minute. The pericardial sac contained a small quantity of blood-stained fluid. The right side of the heart was soft and flabby, and contained a quantity of dark frothy blood; the left ventricle was firmly contracted, and in it there was a small quantity of similar blood. The lungs showed no sign of decomposition; they were distended, and on section were of a uniformly red colour; the blood vessels were engorged with frothy blood. There was a small quantity of blood-stained fluid in each pleural cavity. There was no froth in the air passages; but small particles of weeds were found adhering to the mucous membrane of the trachea and bronchi, which was of a deep red colour. The stomach contained about an ounce of fluid. The abdominal organs showed no trace of decomposition. The membranes of the brain were engorged with blood, the brain itself being soft, and commencing to show a greenish discoloration on the surface.

CASE 6.—Body recovered from canal after fifteen days’ immersion.

A man committed suicide in October by drowning himself in the canal, where his body was recovered fifteen days afterwards. He was completely clothed. The whole face was greatly swollen, and the skin of the head, face, and upper part of the back was dark greenish brown in colour (Plate VII., Fig. 2), and breaking down into a soft putrescent condition. The hair of the head and moustache was firmly attached. There was a slight greenish discoloration at the upper part of the sternum; but below this the skin was quite normal in appearance, and of a rosy hue, giving the body a very life-like appearance. The cuticle everywhere was firm and intact, that on the hands and face being bleached and sodden. Post-mortem lividity was of a light red colour on the dependent parts. The arms and legs were still somewhat rigid; no goose-skin; no retraction of the penis and scrotum. On puncturing the abdomen, some gas escaped, which burnt with a blue flame. The internal tissues were of a uniformly red colour, due to post-mortem transudation of blood-colouring matter. The right side of the heart was distended with gas, and contained some frothy fluid blood; the left
ventricle was firmly contracted. The lungs were distended, and perfectly fresh in appearance; on section, a considerable quantity of frothy fluid escaped from them. The pleural sacs each contained about a pint of dark blood-stained fluid. There was no froth in the air passages; the mucous membrane of the larynx and trachea was of a deep red colour; the false vocal cords and adjacent parts showed very marked oedema. The stomach contained a considerable quantity of food, but no water. The abdominal organs showed no traces of putrefaction. There was no fluid in the peritoneal cavity.

I wish now to give an account of a series of fourteen cases in which drowning took place at the same moment, and the bodies were recovered after varying intervals of time. For convenience of reference, I have denoted them by numbers consecutive to the preceding cases.

On 13th November 1901 an appalling disaster occurred to H.M.S. *Active*, which was lying moored a short distance from Granton Harbour. In the night, about 3 A.M., and during the height of a great storm, the ship was dashed against the breakwater, and immediately sank, causing the death of twenty out of a crew of twenty-three on board. The seas were breaking right over the breakwater into the harbour beyond; and it will be remarked in the following account that some of the bodies were apparently washed over it into the harbour, while others remained in the open sea. I had only an opportunity of seeing fourteen of the bodies, although all were recovered. Unfortunately, it was impossible to make an internal examination in any of them, while the external examination was, owing to circumstances, frequently hurried and imperfect. Notwithstanding this, however, the records are of interest.

**Case 7.**—*Body recovered in the sea within twelve hours.*—The face, head, and neck were uniformly of a florid or light red colour; the hypostatic lividity was slight, but brighter in colour than usual; rigidity very strong; pupils of medium size; penis and scrotum markedly retracted; goose-skin well developed. There was no froth at mouth or nose; the face was excoriated, but there were no severe injuries; the cuticle of the hands slightly bleached.

**Case 8.**—*Body recovered in harbour within twelve hours.*—The face and neck of a bright florid colour; hypostatic lividity slight, but lighter in hue than usual, and on the anterior surface of body several patches of similar colour; rigidity strong; pupils contracted; penis and scrotum flaccid, and not retracted; goose-skin well marked; fine froth at nose and mouth; several superficial excoriations on face, apparently ante-mortem; the hands were clenched, and the cuticle bleached.

**Case 9.**—*Body recovered within twenty-four hours on the rocks of the pier.* It had apparently been much knocked about. The face was of a light red or florid colour, swollen, and cuticle abraded in places; the lips were also bruised and swollen; there was an apparently incised
wound, 2 in. long, running transversely across the chin; a wound of a similar character ran over the occiput from ear to ear, completely dividing the scalp, which was denuded from the skull as far as the supra-orbital margins, leaving the bone bare and as clean as in an anatomical specimen. The feet were bare. On the dorsal aspect of the left foot there was a clean-cut wound 3 in. long, which divided the structures down to the tendons. All these injuries were apparently of post-mortem origin. Hypostatic lividity not specially light in colour. The anterior surface of the body was pale. No trace of rigidity; penis and scrotum not retracted; no froth at the mouth; cuticle of hands bleached and sodden.

Case 10.—Body recovered in the harbour within twenty-four hours.—Very muscular; covered with sand and shingle; a lacerated wound in the right temporal region, 2 in. long; otherwise, body uninjured. Face and neck of uniform florid red colour; hypostatic lividity slight, but several patches of light red discoloration on anterior surface of trunk; rigidity strong; pupils medium; no goose-skin; penis and scrotum retracted; no froth; hands clenched, and cuticle bleached.

Case 11.—Body recovered fourteen days afterwards in the harbour. Completely clothed, except the head, hands, and feet; the face was of a uniform dark red colour, but not swollen; the skin of the face was breaking down into a slimy mass, and the features were scarcely recognisable. The neck showed some green discoloration; the skin of the trunk and limbs, which were covered by clothes, was perfectly fresh and life-like in appearance, having a slightly pink or reddish hue. A wound ran transversely across the forehead from temple to temple, completely dividing the scalp, which was reflected from the whole of the front of the skull, leaving the bones bare and polished; the hair of the scalp was easily detachable; the cuticle of the hands and feet was bleached and sodden, and on their upper or dorsal surfaces the skin had been destroyed, leaving the tendons exposed to view.

Case 12.—Body recovered in the harbour one month afterwards.—Body covered with mud, and naked, except for a pair of woollen drawers. Face of a uniform red colour, and swollen; the neck was swollen, and of a greenish hue. On washing away the mud from the trunk, the skin was found to have a perfectly normal appearance; the abdomen was slightly distended; limbs quite fresh in appearance; hands and feet bleached and sodden, but skin intact; the cuticle all over the body was firm, and not easily detached; the penis and scrotum were normal in appearance.

Case 13.—Body recovered in the harbour one month afterwards.—Features not recognisable, owing to the soft parts and cartilages of the nose being destroyed; the soft tissues of the cheeks and other parts of the face were present, and were dark green in colour; the scalp was divided transversely across the forehead by a wound running from temple to temple, and was completely reflected from the bone, as far back as the occiput, the bones of the skull being perfectly bare, and having a polished appearance. The body was clothed in a jersey and
trousers, and showed more advanced decomposition than the previous case; the abdomen was distended, green in colour, and there was some putrefactive emphysema in the skin of the neck and shoulders; the limbs presented a perfectly fresh appearance. The soft parts on the dorsal aspects of both hands were absent, the bones being exposed to view. The cuticle on the palmar aspects of the hands was bleached, and could be detached almost whole in a glove-like form together with the nails. Some of the front teeth had fallen out, and the others were loose in their sockets. The penis and scrotum were normal in appearance.

Case 14.—Body recovered one month afterwards in the harbour.—Clothed as in previous case; face swollen, and of a greenish hue; neck green; abdomen greenish, distended; no putrefactive emphysema; limbs perfectly fresh; in the scalp, over the vertex, a lacerated wound 2 in. long; bones of the cranium extensively fractured, as also the upper jaw and malar bones on the right side; scrotum and penis retracted. Cuticle of hands and feet bleached and sodden, but intact, except on right hand, where it was becoming detached.

Case 15.—Body recovered one month afterwards in the harbour.—Completely clothed; face green, swollen “gigantic,” of a dark reddish green colour; soft parts of the nose absent; front teeth had fallen out of their sockets; neck swollen by putrefactive emphysema, and green. The trunk and limbs had a fresh appearance, and showed no trace of green discoloration. On the right side of the neck there were two parallel wounds, like incisions, 3 and 2 in. long respectively, extending down to the muscles. The cuticle of the hands and feet was bleached, and easily detachable in a glove-like form. The soft parts on the back of the right hand were destroyed, displaying the bare bones; penis and scrotum were retracted.

Case 16.—Body recovered one month afterwards on the seashore, one mile from Granton.—Body completely clothed; the soft parts of the face were present, and little altered, except the nose, which was absent; the whole scalp had disappeared, leaving the skull bones bare and polished; the trunk and limbs appeared to be quite fresh, except for one or two small patches of greenish discoloration on the former; both hands, below the wrists, consisted of nothing but the bare bones; one or two phalanges were absent; the feet, owing to their being protected by shoes, were intact, the cuticle being bleached and sodden, but not loose.

Case 17.—Body recovered in the harbour six weeks afterwards.—Clothed in jersey and trousers. The face was swollen, and had a white blanched appearance; cuticle easily detached; the soft parts and cartilages of the nose absent. The anterior half of the skull was bare, but the scalp, posteriorly, was present, the hair being loose, and having mostly fallen out. The neck was swollen, and green in colour; the trunk presented a general greenish discoloration, and there was some putrefactive emphysema; the limbs quite fresh and normal, except over the right shin, where the soft parts, in three places, were eaten away
in regular round patches like ulcers. The soft parts of the dorsal aspect of the hands were absent, and the bones bare. On the palmar surface the cuticle was intact, but loose and detachable in a glove-like form. The cuticle of the feet was bleached and sodden, but firm and intact. The scrotum and penis were retracted.

**Case 18.**—**Body recovered six weeks afterwards in the open sea.**—
Fully clothed; face and scalp of a reddish green colour, and swollen; hair loose; skin of trunk green; cuticle soft, easily detached; abdomen not distended; the limbs almost quite fresh in colour and consistence; no injuries; cuticle of hands and feet bleached and sodden, but intact in every way; scrotum and penis retracted.

**Case 19.**—**Body recovered seven weeks afterwards in the harbour.**—
Clothed merely in a jersey; face much less changed than in any of the previous bodies, except the first four, the soft parts present and not swollen; hair intact; no injuries. The body was covered with thick soft mud, and, on removing this, the cuticle was easily detached, leaving the skin fresh and little altered in appearance. The neck and trunk were distended, and the scrotum and penis were also swollen by putrefactive gases. The cuticle of the hands and feet was bleached, but still remained intact and adherent to the skin.

**Case 20.**—**Body recovered ten weeks afterwards in the open sea.**—
Fully clothed; the face was unrecognisable, the soft parts being absent from the nose, forehead, and over the malar bones. Below this the tissues were present, but soft, blackish brown in colour, and stinking. All the teeth were present and firm in their sockets; the whole of the anterior half of the skull was bare, but posteriorly the scalp was present, though loose and detached from the bone. The hair had disappeared; the neck was of a greenish red colour, and swollen; the trunk had a pale greenish tint; the abdomen was distended with gases, which were not inflammable. The limbs presented a fresh and natural appearance. The soft parts of both hands had almost entirely disappeared, leaving the bones bare. Several of the terminal phalanges were absent. The cuticle of the feet was bleached and sodden, but was firm, adherent, and otherwise unchanged. The scrotum and penis were retracted.

In connection with the above cases (7–20), it is interesting to note the time when each body was recovered. All of those who perished in the disaster—twenty in number—were recovered within a period of ten weeks, but I have only particulars in regard to fourteen. Of these, nine were found within the harbour, having been apparently washed over the breakwater at the time of the wreck, while the remaining five bodies were found in the sea, outside; three close to the scene of the catastrophe; and two a considerable distance away. Of the nine found in the harbour, two were recovered by means of grappling irons during the first twenty-four hours; one rose to the surface on the thirteenth day, while two others floated at the end of a month, and two more were apparently driven on shore by the wind, also at this time; but whether these latter had become buoyant or not, I cannot
say. One rose to the surface at the end of the sixth, and another at the end of the following week. In the harbour the water is comparatively quiet, except for such disturbance as the tides and the daily entrance and exit of one or two small steamers occasions. I think we may therefore exclude accidental circumstances as the cause of the variations in time of the floating of these bodies, and regard this as arising from intrinsic conditions.

Among the most striking external appearances presented by the bodies recovered during the first twenty-four hours, were the great congestion of the face and neck, and bright red colour of those parts, together with the very strong post-mortem rigidity present, except in Case 9, which had been much battered about on the rocks, and lastly the severe and peculiar character of the injuries present in this case. In the bodies recovered at a later date the slow progress of putrefaction was noticeable. In all of these the most marked evidence of putrefaction was present in the face and neck. In other parts of the body the external evidence of putrefactive changes was much less than one is accustomed to see in cases of drowning in fresh water after similar periods of immersion. The appearance of the first indications, and the rapid progress of putrefaction, in the head and neck, in drowning is so constant as to afford strong primâ facie evidence of drowning, or rather, to be exact, of the body having been immersed at or shortly after death. The typical appearance presented in such cases is well seen in Plate VII., Fig. 2, in which the head is swollen, deeply discoloured, and the face is becoming rapidly unrecognisable, whilst the rest of the body remains practically unaltered. I have often noticed, however, that this characteristic of putrefaction in the drowned depends upon the time during which the body remains in the water, that is to say, depends upon its remaining immersed for some hours after death. In those cases of drowning in which the body is recovered at once and placed in the mortuary in the usual dorsal position, the first putrefactive discoloration is seen at the lower part of the abdomen, as in ordinary cases of death. This observation supports the view that at least one cause of putrefaction appearing first in the neck and face in drowning is the gravitation of blood which takes place to these parts on account of the head usually occupying a dependent position in the water. Although carefully looked for, I have never been able to confirm the statement, made by several authorities, that the earliest green discoloration in the drowned is usually to be seen at the upper part of the sternum. According to my observations, it is to be found first at the sides of the neck, near the angles of the lower jaw.

A circumstance of considerable interest in connection with both the first series of cases and also the latter bodies, is the frequency with which the presence of goose-skin and retraction of the scrotum and penis were observed at a long period after
death. I am inclined to believe that these conditions, in many cases of drowning, appear first with the onset of rigor mortis, and that, if bodies were examined immediately after death or before rigor mortis had appeared, they would be found absent: such early inspection of the body very rarely takes place, and, as a rule, cannot be made until many hours after death. The above view is based upon cases in which I was fortunate enough to have an opportunity of inspecting the bodies of persons within two hours after they had committed suicide by drowning. At the first inspection, neither rigor mortis, goose-skin, nor marked retraction of the penis and scrotum was present, but, after the lapse of a few hours, all these phenomena were strikingly developed. In connection with rigor mortis in the drowned, a point of some importance is the liability to confound the stiffness and rigidity of the limbs, produced by solidification of the subcutaneous fat, owing to the low temperature, for rigor mortis. An inexperienced examiner might quite easily mistake the rigidity thus produced for true rigor mortis, and draw false deductions from the circumstance. In Case 6 true rigor mortis was present in the limbs one month after death, and, in addition, the nipples were found retracted as well as the penis, testicles, and scrotum—the latter organs, indeed, in a most remarkable manner. In Case 5 rigidity of the limbs after fifteen days’ immersion was also noted. The presence of well-marked goose-skin and retraction of the penis and scrotum were observed in many of the cases recorded, after periods of four, six, and even ten weeks’ immersion.

Amongst the victims of the Active disaster, the frequency with which the scalp was found denuded from the cranium was very striking. This is an appearance, as I have already indicated, which is very common in bodies recovered from the sea, even at a comparatively early stage; while in fresh water, so far as my experience extends, it is rare until a much later period. This condition was present in one of the bodies recovered after twenty-four hours; while it was also found to exist in one found at the end of fourteen days, and in four of those recovered later.

In Case 9 there can be no doubt that the primary cause of this condition was an injury which divided the scalp posteriorly from ear to ear. The reflection of the whole of the scalp and soft tissues from the bone, which was perfectly clean and devoid of any adherent particles of organic matter, as far forward as the supraorbital regions, must have been due to other causes, one of which most probably was the action of the water. It is not, however, easy to account for the absolutely clean and bare condition of the bone, either by violence, or, so quickly after death, from the macerating effect of water. Even severe injury directly applied to the head would scarcely denude it entirely of tendon
and also periosteum; while it is difficult to understand how the constant friction of water could effect this result so soon.

At later periods the disappearance of the scalp, and the clean polished condition of the bones, may be accounted for more easily.

If the person is drowned near the shore during a storm, the head will probably receive injuries similar to that in Case 9, but, apart from such a circumstance, it is evident that after a body has sunk to the bottom it will be kept in constant movement (if the water is comparatively shallow) by the action of the waves, and thus the scalp, either anteriorly or posteriorly, becomes gradually worn away. After this occurs, I believe that fish and crabs play an important rôle in removing the remains of the scalp and subcutaneous structures, and in picking the bones clean.

In the majority of cases it is the frontal region which is first rendered bare, and this is usually associated with more or less destruction of the soft parts of the nose and portions of the cheek immediately adjacent. In the cases at present being considered, the nose was absent, and the nasal bones exposed and bare in five instances. This tendency to early destruction and disappearance of the nose and scalp adds greatly to the difficulty of identification of bodies recovered from the sea. It does not, however, render identification more difficult than the great swelling and discoloration of the face, which is the common result of putrefaction in fresh water after similar periods of immersion. Indeed, except for the loss of the nose, the face often remains in a fairly good state of preservation for a considerable time, in cases of drowning in the sea. A circumstance which strongly supports the theory that fish and crabs have an important influence on the destruction of the soft parts of the face, apart from the effects of violence, is the undoubted evidence of their action on other exposed flesh, namely, the hands and feet.

The effect of water upon the cuticle of these parts is first to render it white or bleached, then to soften it, causing it also to become swollen and wrinkled. After a time the whole cuticle becomes loosened, and may be pulled off the hands or feet in a glove-like form, as shown in Plate XII. Hofmann states that the degree of bleaching of the cuticle on these parts may afford some criterion for an estimation of the time a body has been in the water, especially when it has only been immersed for a short period. This is true; but I would point out that the bleaching and maceration of the cuticle may go on after a body is removed from the water, if the hands are in contact with wet clothes, or the feet are covered with shoes and stockings. Hence, in order to draw a correct inference as to the length of time of immersion, from the state of the cuticle of the hands and feet, these parts should be examined immediately after removal of the body from the water.

To return, however, to the question of the destruction of the
soft parts of the hands and feet, water alone does not cause this, as I have already indicated; and, looking to the positions in which such destruction takes place, that is, not, first of all, on projecting parts such as the fingers and knuckles, but in the middle of the dorsal aspects and round the wrists, I think we must conclude that this is a consequence of the action of fish, and is not due to violence.

In Case 11, which had only been fourteen days in the water, the skin on the back of each wrist and on the dorsum of both feet was already absent, displaying the tendons and deeper structures.

In Case 13 the carpal and metacarpal bones with the phalanges were exposed, while on the palmar aspects the cuticle was quite intact, and could be detached whole in the form of a glove. The same condition was present in the majority of the other cases, while in the last body, found after a lapse of ten weeks, all the soft parts of both hands had disappeared, leaving only the bare bones. This is the final result of the process, so far as the flesh is concerned; the next stage being the destruction of the ligaments and the dropping off of the fingers, or even of the whole hand at the wrist.

In two bodies recovered—one at the end of six and the other at the end of seven weeks—the hands and feet were quite intact, the cuticle being merely bleached and sodden. In the first case this may be accounted for by the body having been driven out to sea, where it was found floating, and where, therefore, it would not be so liable to be attacked by fish.

In the second case it will be observed that the body was plastered with a coating of mud when found—a circumstance which would tend to prevent the flesh being attacked in the manner suggested.

Wherever the feet were covered with shoes—and in many of the bodies this was the case—the feet showed no change from normal, with the exception of bleaching of the cuticle. Very slight covering seems to protect the flesh—a fact which is especially noticeable in the case of the hands, where the thick palmar cuticle, in contradistinction to that on the dorsal aspects, is sufficient for a long time to withstand any attacks made upon it.