DEATH AND SUDDEN DEATH.

DEATH

AND

SUDDEN DEATH.

BY

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TRANSLATOR'S PREFACE.

A WORK by Dr. Brouardel, whose name and position are so well known in this country, does not stand in need of much introduction or recommendation. However, a few words may be said with regard to the motive for translation.

In the first place, as there is no such office in this country as Dr. Brouardel holds as Director of the Morgue, it is not an easy matter over here to obtain the amount of experience of medico-legal cases that he possesses.

The book, which consists of part of a course of lectures on Forensic Medicine, treats of a subject which is hardly touched on in English medical literature.

The substance of the first part—on the phenomena of death—is certainly dealt with more or less fully in all works and lectures on medical jurisprudence; but this somewhat dry subject is here presented in a more attractive form than is customary, and there are several novel and practical features displayed in it.

The second part consists of what may, with some excuse, be styled clinical lectures on the various forms of sudden death, particularly in those aspects which have a legal or

practical bearing. This subject occupies an intermediate place between Forensic and Systematic Medicine, and consequently is usually ignored or slurred over by both. In works on Forensic Medicine it is only alluded to in the most general way; and in text-books on medicine it is mentioned only briefly and incidentally. Yet the subject is one of vast interest and importance, and there is distinctly room for a special treatise on the subject, especially as it concerns every member of the medical profession.

But not the least charm of the book is its attractive, lucid, and forcible style, which recalls in many ways Trousseau's classical clinical lectures. It is interesting as well as instructive. I venture to hope that by turning it into plain English the spirit of the original may not be altogether lost, and pains have been taken to render it as accurate as possible.

The French original is accompanied by a very lengthy appendix of illustrative cases, derived from many sources, some of which are of considerable interest and value; but the records are not all equally complete, and consequently they vary in merit. To have added them would have swollen the book to a very great and inconvenient bulk; and it has been deemed expedient to omit this portion altogether. There are, however, numerous striking and vividly-described cases inserted in the lectures, which serve to illustrate the text, and will deeply impress on the memory the doctrines and facts that they are intended to exemplify.

A chapter on the laws of France dealing with the disposal of the dead has been retained. Though these, of course,

differ from our own, and therefore have no direct practical bearing for us, yet it may be of use to many to learn in some detail what these laws are, both in theory and practice, that we may contrast them with our own; as it has been urged by authorities, worthy to be listened to, that we should introduce them, or some of them, on this side of the Channel.

F. L. B.

December, 1896.

AUTHOR'S PREFACE.

THE danger of premature burial and the unforeseen nature of sudden death have occupied public attention at all times.

I thought that I might advantageously exhibit to the students of the Faculty of Medicine the actual state of these questions, by utilizing the works of different authors and the documents which the numerous medico-legal autopsies made by myself and my fellow-workers, MM. Descoust, Vibert, and Socquet, during the last twenty years at the Morgue, have furnished to us.

I have attempted to show that the uncertainties which sometimes arise at the moment of death, and in the hours which directly follow, may be removed by the physician; that his intervention is often necessary to establish the reality of a person's death, and that this alone can remove every apprehension that may be entertained of premature burial.

Furthermore, the causes of sudden death are but ill understood. They are very numerous; they often cause the suggestion of crime or of suicide to be raised, and give rise to medico-legal inquiries.

No medical man can ignore them; the expert ought to know how to search for them, and how to avoid the numerous errors that it is easy to make. Sudden death is one of the most complex chapters of medical jurisprudence.

The physician is well acquainted with the pathogeny of

unforeseen death which may befall patients whose diseases oblige them to take to bed or to enter the hospital. These are accidents which are anticipated or dreaded—they cannot take anyone by surprise; but the physician knows much less of the causes of that form of death which seizes a man unawares, without any previous warning, even while he is apparently enjoying perfect health.

I have shown that, in spite of an excellent outward appearance, sudden death is the termination of very different diseases, which develop secretly, quite unknown to the patient and those around him: such are certain affections of the kidneys, arterio-sclerosis, diabetes, etc.

In order to keep this volume from attaining extravagant proportions, I have been obliged to limit myself to a brief summary of the lesions which are studied in treatises of pathology and pathological anatomy; on the other hand, I have laid stress on the circumstances which demand the intervention of justice.

These lectures were intended for the students of the Faculty. Dr. Reuss considered that they might be profitably consulted by doctors also. He has compiled them with very great care, and has undertaken the material part of this work. If the reader derive any profit from perusing these pages, he will be indebted for it to my excellent colleague, Dr. Reuss.

P. BROUARDEL.

PARIS,
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PART I.

THE SIGNS OF DEATH.

LECTURE I.

THE MOMENT OF DEATH.—APPARENT DEATH.

GENTLEMEN,—To the medical jurist the study of the causes of death, of the phenomena which precede the examination of the corpse, is of great importance; in more than half of the medico-legal examinations that you will be called upon to make, whether the question raised is one of suicide, murder, sudden death, or survivorship, it is with the study of the dead body that you will have to begin.

Activity does not entirely cease at the instant of death. Vital phenomena are replaced by cadaveric phenomena: it is requisite that you should become familiar with these last, for inexperienced medical men have ascribed to poisoning lesions which have been really produced after death by the normal processes of decomposition.

In order that you may be able to pronounce an opinion as to the cause, I am going to investigate with you the possibility of determining the exact instant of death. I shall then study apparent death (which will lead me to speak to you of premature interment), the real signs of death and the

legal questions which have to do with the proof of death. I shall finish this course with an inquiry into the causes of sudden death.

DETERMINATION OF THE MOMENT OF DEATH.—AT WHAT MOMENT DOES LIFE CEASE?

That is a question which looks very easy to answer. There is not one of us, Gentlemen, who has not been present, at least once, at this final scene of every human existence, who has not seen a dying man draw his *last breath*. The stoppage of respiration, or, to use the customary expression, the last breath, is, as a matter of fact, considered by the public as the unequivocal sign of the disappearance of life. This is a grave error, Gentlemen, for many persons who no longer breathe have been recalled to life by means of care and skill. The moment of death cannot therefore be assumed to be identical with cessation of respiration.

It has been thought possible to find a more exact criterion in the pulsation of the heart. The *cor ultimum moriens* has been regarded as the rule since the time of Galen; physiologists have agreed upon it. In their laboratories stoppage of the heart is looked on as the end of life: as soon as the heart of an animal that is being experimented upon ceases to beat, physiologists admit that the animal is dead.

Can we accept this criterion in forensic medicine? I do not think so. In certain medico-legal cases, the value of the sign may be disputed; the judge may ask you to say at what precise moment death took place, and that for several reasons. Here are some examples:

A man is murdered: several individuals have been seen to strike him; these individuals are arrested; the judge may ask, and will ask, the expert to determine which of the blows inflicted has actually been the fatal one. Need I tell you of the importance of this decision from the point of view of the responsibility of each of the assailants?

In a railway accident an entire family is killed and disappears in the course of a few seconds; suppose that the husband has his head separated from the trunk, and that the body of the wife does not show the mark of any injury.

Which of these two expired first? This question of survivorship, which will be put to you without fail, is of extreme importance from the point of view of inheritance.

When a case of murder has to be dealt with, the investigation is usually entrusted to a single medico-legal expert. When questions of survivorship and inheritance are raised, there are at least three of them; there is often an expert to give evidence on the opposite side; sometimes the conclusions of the second expert are at variance with those of the first. The Court of Appeal sometimes orders a report by a third expert. This single example will suffice to show you what difficulties you will have to combat.

We cannot admit, in forensic medicine, that stoppage of the heart is a certain sign of death.

Recall to your mind the crime of the Rue Montaigne, the case of Pranzini, which has been included among the *causes célèbres* of our time.* Pranzini killed Marie Regnault, her maid, and her little girl, who may have been the child of either of these women, but who had at all events been adopted by the former. Marie Regnault had her throat cut and the carotids were severed, but the vertebral column was intact; she had fallen at the foot of the bed, but her hand retained hold of the bell-rope; she had doubtless been attacked while in bed. The maid had heard her mistress's bell ring, and had had time to put on a petticoat; then she had been struck in her turn: she fell with her neck deeply cut, the vertebral column was opened behind, and the posterior columns of the spinal cord were divided. Pranzini lastly killed the child in her bed, no doubt because she cried out. The last victim was literally decapitated, the vertebral column was completely divided, and the head was only united to the trunk by a strip of skin along the front of the neck.

The magistrate directed me to proceed with the autopsy of the bodies, and to determine the circumstances of the crime. The question of survivorship was necessarily raised: its elucidation was specially interesting, as the rights of

* Brouardel, 'Affaire Pranzini: Triple Assassinat—Relation médico-légale' (*Ann. d'Hyg.*, 1887, tome xviii., p. 305).

inheritance and succession depended upon its solution. Evidently Marie Regnault was the first to be struck, then the maid, and lastly the child; but which of the three victims was the last to die? What criterion could be relied upon to fix the exact moment of death in the case of each: Marie Regnault, whose carotids were opened, died of hæmorrhage; the maid had a lesion of the spinal cord; the little girl was beheaded.

Some time before this, Drs. Regnard and Paul Loye had been present at an execution at Troyes; they even rode in the van which carried the body from the scaffold. One hour after the execution the heart still beat; yet this man's existence was over; he had lost his personality, and yet his heart was beating! Well, to us and to everyone a decapitated person is a dead man, although his heart does continue to contract!

My experiments in conjunction with Dr. Paul Loye* had shown me that, when a dog is decapitated, movements of the heart persist for fifteen, twenty, or twenty-five minutes afterwards; but they had also demonstrated that it was quite the same when the animal died of hæmorrhage.

So when this question of survivorship was put to me in the Pranzini case, I sought the opinion of our most eminent physiologists: Brown-Séquard, Vulpian, MM. Franck and Marey. Gentlemen, they declared themselves quite unable to solve the problem; moreover, that was my own view, and I gave as my conclusion that I could not say which of the three victims had died the last.

Allow me in connexion with this matter to give you a piece of advice. When you have not a scientific demonstration of the facts, always say, in giving your opinion, that you do not know. Not only will you be speaking the truth, but it is much better to say at the preliminary examination, 'I do not know,' than to be forced at the trial to say, 'I did not know.' In these matters the law allows the magistrate to apply simply the Articles of the Civil Code, which enable him to settle the difficulty. That is, you will say, purely con-

* P. Brouardel and P. Loye, 'Recherches expérimentales sur la Mort par Submersion brusque' (*Archiv. de Physiologie*, 1889).

ventional; I admit that it is, but it is a legal convention, and the arrest of the heart as a sign of death is also a convention, but one belonging to physiology and disputable.

I am anxious to narrate another instance to you. M. R—— and his wife went for a row in a boat. The boat upset; the rowers saw M. R—— rise several times, struggling on the surface of the water; no one saw Mme. R—— again. They had each left a will bequeathing their respective fortunes to the survivor. The experts at Dijon (the accident happened in the Côte-d'Or), admitted in their conclusions that M. R—— had died last, because he was seen several times on the surface. On the other hand, the experts of Marseilles, where one of the families lived, pronounced the opinion that an individual who rises to the surface will be drowned more surely and more rapidly than another who sinks to the bottom and remains there in the state of syncope; according to them, Mme. R—— must have survived her husband. A third expert opinion was ordered, which was entrusted to me; I declared that I could give no reply to the question which was put to me, because I did not know absolutely which of the two had survived the other. This view was finally accepted, and the two families shared the fortunes of both deceased. They might have saved themselves the expense if they had only begun where they left off.

At present, then, gentlemen, we have no absolute criterion at all to determine the precise moment of death, even when we believe that the concomitant circumstances afford strong grounds of probability. These proofs are no more than merely *probable*.

Finally, sensitiveness varies very much, according to age and sex and the states of surprise and sudden awaking from sleep. As a result of strong emotions, certain persons may be seized with syncope, others may pass into the contrary state of excitement. Between these two extremes there are complex cases in which the character of the emotion undergoes great changes or variation.

Besides this, it is known in medical jurisprudence, though it has only been learnt recently, that blows, even though

slight, which fall on certain parts of the body, may cause instantaneous death. I will relate to you, in illustration of this, a very typical example. A priest, whose conduct was not as immaculate as it might be, was obliged to remove his mistress from his vicarage. 'The day had passed very sadly,' said Abbé Delacollonge. 'Everything was got ready for her departure; the sorrow had broken my heart, and I said to her: "We should be happier if we were dead." "Yes," said she, "if we could die together." I then said to her jokingly, for I could find no other way of expressing myself at the moment: "Could you bear me to cause you much pain?" "Try," she replied. We were both standing up. I took hold of her neck; it was intended as a harmless piece of fun on my part, and she showed by a smile that she regarded it as such. All at once she made a sign of pain and shook her hands, but without uttering any cry. I relaxed the pressure, and she fell down. I picked her up, but she was dead.'

The medico-legal experts neither accepted nor rejected this hypothesis completely; they spoke of asphyxia, syncope, etc.

During the hearing of the case,* an ex-officer, M. Bouré, made the following deposition: 'We were at Tarbes, staying in garrison. Among our number were Captains Lalande and Surugues. In a moment of friendly mirth, Captain Lalande seized Captain Surugues by the neck by way of a joke. "Now, old fellow," said he to him, "I am going to put you out of the way!" (This was only said playfully.) Captain Surugues, however, staggered and fell in a state of unconsciousness. Owing to the skilful attention we bestowed upon him, he soon returned to life,' etc.

The parts of the human body, contusion of which may induce sudden death, are the laryngeal and epigastric regions, the genital organs and the nostrils; even irritation of these parts sometimes suffices to provoke a catastrophe. During the reign of Louis Philippe, a Danish physician professed to cure, or at least to check, attacks of asthma by cauterizing the pharynx with ammonia. He had acquired

* Assize Court of the Côte-d'Or, March 1, 1836.

a considerable reputation, and the King's sister wished to submit herself to his treatment. It happened, however, that a maid of honour, who was asthmatic herself, died suddenly at the moment the physician touched her pharynx with the ammonia. From that time there was no more talk of the Danish physician or of his wonderful cures.

It is consequently necessary in forensic medicine that we should be aware that violence, or even irritation, of but slight apparent intensity, applied to certain regions of the body, may determine sudden death, even without our being able to discover any visible traces of contusion, such as ecchymoses. The fact is, that when a blow has ruptured the capillaries, provided that the heart continues to beat, the blood-stream will continue to reach the spot, and there will be an extravasation; but if, on the contrary, the heart's action has ceased, there is no more onward movement of the circulation; the blood may escape so as to form a small thin patch, but there is no effusion, no ecchymosis.

What is the explanation of these cases of sudden death? It used to be said that the individual died of syncope. M. Brown-Séquard, who has thoroughly studied all these matters, says 'death is due to *inhibition*.' What is inhibition, gentlemen? It is a term which you hear repeated again and again in scientific discussions; perhaps you do not thoroughly understand its meaning and importance.

Your physiological studies have taught you that nearly all vital acts are reflex nervous actions. A peripheral excitation propagated through the system will evoke reflex action which will give rise to movements. Sneezing is the type of reflex movements; irritation of a very small point of the nasal mucous membrane is transmitted to the corresponding reflex centre; this one transmits to other centres the excitation it has just received; immediately, a certain number of organs endowed with special functions react, and you have then that inspiratory and expiratory perturbation, those movements of the face, shoulders, arms and chest, that flow of tears and of nasal mucus—in one word, all that group of phenomena which constitutes sneezing.

Well, gentlemen, suppose that under the influence of a

violent physical or moral excitation, instead of reflex movements taking place, these are arrested; suppose that the excited centre paralyses the action of other centres which are already in activity; that paralysis is *inhibition*. When the pneumogastric nerve is excited, the heart stops; when the cervico-dorsal region of the spinal cord is excited, the activity of the stomach ceases; the irritation of the bulb caused by the pneumogastric *inhibits* the heart; excitation of a certain part of the spinal cord *inhibits* the stomach.

Reflex centres can therefore act upon one another either so as to excite them or so as to inhibit them; so that we are now in a position to define inhibition as the arrest of a function provoked by an excitation of a distant part of the nervous system. If this excitation is violent enough, the functions may cease, never to return, and if these functions are necessary to life, death will of course be the consequence of their cessation.

M. Brown-Séquard assigns to death by inhibition three peculiar characteristics: (1) It takes place without a struggle, without convulsions—in fact, as calmly as possible; (2) the venous blood remains red for a very long time without turning black; (3) finally, the temperature of the corpse falls very rapidly.

The medico-legal expert, when called upon to make an examination of a body, arrives too late to witness all these phenomena; therefore I do not want to discuss them before you to-day; I shall only say this, that you ought always to ask yourselves whether an individual in the state of apparent death might not return to life, notwithstanding the cessation of the movements of the heart and of respiration; whether the suspension of life is temporary or absolute; and I think that it will be possible in a great many cases to save the individual and restore him to life, for the simple reason that, as a result of inhibition, the blood retains its vital properties for a fairly long time.

APPARENT DEATH.

Other difficulties also contribute to justify our reserve.

When an individual dies, there is no interruption in the chemical changes which go on in his body. This continuity of changes constitutes the chief difference between inorganic substances on the one hand and animals and vegetables on the other. There is in these latter a continual exchange of used-up matters and assimilable matters; inorganic bodies are in a state of chemical repose.

These phenomena are continued energetically after death, and even, in certain infective diseases such as small-pox or rabies, with such a degree of energy that the temperature of the body is raised from 2° to 4½° F., although the movements of the heart and respiration are arrested. These are chemical changes of a very active kind, but they obey different laws from those which prevail during life.

This is not all: there is also the *independence of the functions and of the tissues*. You know that in the lower animals independence of the functions is carried to an extreme; you have seen that the heart may continue to beat in a man, even after decapitation. Claude Bernard and Longet agree in saying that the liver of a dead animal, placed on a table, retains its glycogenic function for some hours. M. Bouchard and I separately performed identical experiments on the production of urea, and obtained the same result. Need I remind you that muscular excitability persists for a certain time in an amputated limb? The unity of the living being is therefore only apparent, and we are therefore justified in saying that an individual does not die in every part in a single minute.

Another important point is the *suspension of the organic functions* during life. In hibernating animals the functions of respiration and circulation are reduced to the *minimum* during their winter sleep. Submit them while in this state to a reduction of temperature of 9° to 18° F.; the vital phenomena, already nearly imperceptible, are absolutely arrested, so that, if you were to cut one of the animal's paws,

you would have a little oozing of blood, but not a stream; tap the heart with the end of your scalpel, and you will not induce a contraction, and it will be equally impossible to arouse muscular contractility.

Take these animals now; warm them gradually for an hour up to an increased temperature of 18° F., and they will resume their vital functions; they were therefore in a state of apparent death. Is there not room for reflexion, when we see how closely these phenomena apply to the case of human beings?

Captain Ross, in his expedition to the North Pole, took with him a box containing silkworms; he exposed them on the bridge of his ship to a temperature of −43·6° F. and froze them; these silkworms, while in this condition, resembled little bits of dry wood, and could be broken into several pieces with the greatest ease; Captain Ross had these silkworms warmed again, and the greater number revived; he repeated the experiment three times, and after the third time of freezing the last survivors still produced moths, the appearance of which he has described, but they were imperfect; he had formed monsters.

It is possible, then, in certain animals to suspend life and restore it; those which enjoy this faculty have been called 'resuscitating animals'; certain vegetables possess similar properties, such as the grains of wheat found in the coffins of Egyptian mummies, which, when sown after thousands of years, have germinated and fructified.*

Is there any condition then, Gentlemen, in the range of our pathology, in which we, as human beings, resemble these hibernating animals? Yes, there are certain—I do not say all—hysterical states which present similar phenomena. There are many malingerers among hysterical subjects; but it is no less true that in certain patients of this class nutrition and excretion are reduced to the *minimum*. They maintain their nutrition on two or three figs *per diem*, and excrete less than half an ounce of urine and scarcely any fæces

* M. Casimir de Candolle read an interesting paper on 'Latent Life in Seeds' at the meeting of the British Association for the Advancement of Science, 1896.—TRANSLATOR.

at all. The observations of Empereur demonstrated also that these hysterical patients did not excrete one-fifth part of the normal amount of carbonic acid. The conclusion may be drawn from these facts that there exists a group of women in whom the nutritive changes are at the *minimum ;* their life is almost *latent.*

If this condition is pushed to a farther degree, these women may remain for a time, which we can measure in cases of lethargy and catalepsy, in a state of apparent death ; their life is *entirely* latent.

We may, without being hysterical, be able to reduce or arrest the movement of circulation. Donders and M. Chauveau have succeeded in doing so. M. Chauveau, whose stature you know, managed, after preparing himself by taking a deep inspiration which caused 4,850 to 5,800 cubic inches of air to enter his chest, to stop his heart for a whole minute. It was not merely by auscultation that this could be proved : the sphygmograph applied to the radial artery gave a perfectly straight line corresponding to this space of time. Some persons, therefore, can arrest their circulation for an instant.

An Englishman, Colonel Townshend, asserted that he could arrest the movements of his heart for half an hour. Cheyne relates that this Colonel, who had been ill a long while, took it into his head one day to send for Drs. Cheyne and Baynard, who were in attendance upon him, and for Mr. Skrine, his apothecary, to beg them to witness a singular experiment which he was anxious to repeat in their presence ; it was to cause himself to die and to return to life. The patient lay on his back ; Dr. Cheyne kept his finger on the pulse, Dr. Baynard placed his hand over the heart, Mr. Skrine held a mirror before the mouth. Shortly after, no arterial pulsation or cardiac movement could be felt, and the breath did not dim the glass. This spectacle having lasted for more than half an hour, the spectators were about to withdraw, persuaded that the patient had pushed his experiment too far, when they perceived some movement, then they felt the beats of the pulse and of the heart return by degrees, and respiration recommenced ; in time the

patient began to speak, and left the spectators equally astonished at his death and resurrection. When they had gone away, the Colonel sent for his attorney, added a codicil to his will, and expired peaceably eight hours after the experiment.*

Certain special predispositions and certain peculiar circumstances must also be taken into account : blows in the epigastrium give rise to an inhibition ; this is especially true while the process of digestion is going on. Experiments on dogs are conclusive as to this. A Polish physiologist has made some very curious observations on frogs by aid of Marey's recording apparatus. He used a little hammer, weighing 45 to 60 grains, with which he struck the frog's stomach ; when the animal had been eating, the pulse became slow and the apparatus registered scarcely two or three beats per minute : when the animal was fasting, the pulsations underwent no change.

Finally, I ought not to leave you ignorant of certain idiosyncrasies, which I entitle *unfortunate ;* such is the case of certain women who may die suddenly after the introduction of a uterine sound.

When we have studied the phenomena of death, and when I come to speak to you of putrefaction, you will see that the decomposition of a body does not resemble in any way that of any other substance. When an individual dies from an accident and the body is entire, putrefaction goes on rapidly, and gaseous infiltration may invade the whole body. On the contrary, if the limbs are removed, they may be preserved for a tolerably long time in a fresh condition. Butchers know this peculiarity well, and cut up their animals as soon as they are slaughtered.

You should be familiar with the fact also, for it is of importance in forensic medicine.

At the time of the crime of Lébiez and Barré, the first experts who were called, on seeing the limbs separated from the trunk, stated that the crime had been committed quite recently, for the portions of the body which were shown to them looked fresh. I stated, on the contrary, that the state

* Cheyne, 'The English Malady.'

of preservation of these remains was not sufficient proof, and that they might well belong to a woman who had been killed a week before. I was right; for, when the remainder of the body was brought from Le Mans, the limbs accurately fitted the trunk, which was decomposed.

You understand, then, gentlemen, that it is sometimes extremely difficult to say whether such and such a person is or is not dead. You will meet with insurmountable difficulties when you have to fix the time that has elapsed between the moment at which the fatal blow was received and that at which life ceased. Suspension of the heart's action in particular is not sufficient proof. Nevertheless, in acute diseases, the moment when the heart ceases is evidently, to within a few minutes, the moment of death. But it has not been shown scientifically that an individual whose heart no longer beats cannot be recalled to life. On the contrary, it is certain that some conditions exist which may be styled *the state of apparent death.* We might definitely choose some sign as a distinction between life and death, and use it in a conventional way; but I am very much afraid that, however elastic this convention might be, whatever sign might be proposed to denote the moment of death, this sign and this convention will always remain useless in doubtful cases, and we are obliged to acknowledge that we have no sign or group of signs sufficient to determine the moment of death with scientific certainty in all cases.

LECTURE II.

THE UNCERTAINTY OF THE SIGNS OF DEATH, AND PREMATURE BURIAL.

GENTLEMEN,—All these matters have a very close bearing on the question of *premature interment*. In speaking of this subject, I shall purposely leave on one side everything that is at all legendary. Stories of miracles and resurrections are to be found at the origin of every religion. These are articles of faith, which it does not concern me to discuss here. Nor shall I linger any more over the tales of the fakirs of India. You know that these fakirs, by practising rapid rotation, or by howling, get themselves into such a peculiar nervous condition that they appear to be destitute of life, and successfully withstand a certain number of tests. One of these performances, and by no means the least of them, is to allow themselves to be buried for two or three weeks. At the end of this time the fakir is disinterred and returns to life. I can neither affirm nor deny anything about them, as I have not seen them myself.* I shall not occupy myself with them any longer. We have many other matters awaiting consideration.

* The apparent death of the fakirs is the subject of an interesting report presented by Dr. Kuhn to the Anthropological Society of Munich. From his report we extract the following passages:

'*Fakir* is an Arabic word signifying *beggar*. This term has been applied later to Indian conjurers as well.

'Although one may be led to believe that the fakirs practise the simulation of death on a large scale, the author of the report is none the less of opinion, with a knowledge of the facts, that authentic cases are

UNCERTAINTY OF THE SIGNS OF DEATH.

The uncertainty of the signs of death has occupied universal attention for a very long time. Parrot* has set forth the history of the question with many details.

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comparatively rare. He has had the opportunity during his extensive travels of observing two undoubted cases. These were the cases of two fakirs, one of whom had remained alive under the ground for six weeks, the other for ten days. The reporter is convinced that the state of the fakir, which he induces by artificial means, is in all respects identical with that known as catalepsy.

'The cataleptic state may last for hours, days or months.

'Catalepsy may constitute one of the phases of hypnotism. . . .

'In the fakirs we have nearly always to deal with this last form of catalepsy, when we have to explain the phenomenon known as *apparent death.*

'To attain to this condition, the fakirs, who are evidently confirmed hysterical subjects, employ every means of exciting a condition of ecstasy, mortification of the flesh by a special dietary, the internal use of different vegetables known only to themselves, and a special posture of the body maintained for many hours. (All the rules prescribed by religion to gain the power of entering into communication with the Divinity are to be found in the Indian book, "Hathayoga pradipikâ Srâtmârâmas,' translated by Dr. H. Walter.) When the fakir has had sufficient practice, he is put into the ground, takes one of the doses prescribed by the sacred book, and falls into a state of hypnotism by means of fixedly regarding the end of his nose.

'The fakirs appear still to use hashish to lessen the energy of respiration, and that hypnotic, combined with other vegetable drugs, and employed in a particular fashion, compensates the want of air and nourishment.

'At the beginning of hypnosis the fakir has hallucinations. He hears sounds and sees angels, his face expressing a feeling of beatitude. But little by little consciousness vanishes, and the body acquires a special rigidity in proportion as "the spirit goes to join the soul of the world."

'Dr. Schrenk-Notring has replied to the narrator, adding that in the picture drawn by Dr. Kuhn he has dealt simply with auto-hypnosis in hysterical persons wrought up to a sufficient pitch of excitement. His conclusions agree with those of Dr. Kuhn in considering that narcotics play a large part in bringing about the state of hypnotism in fakirs.

'In studying the hypnotic state, adds Dr. Notring, we frequently meet with cases and facts which afford an explanation of the Indian miracles' (*Zeitschrift für Hypnotismus*, Berlin, 1894, and *Ann. de Psych. et d'Hypn.*, May, 1894).

* J. Parrot, 'De la Mort apparente,' thesis for the Fellowship (*agrégation*) of the Faculty of Medicine of Paris, March 5, 1860. Paris, 1860.

The first philosopher whose opinion on the subject has come down to us is Democritus, who averred that there was no certain sign of the cessation of life. Paul Zacchias and many others coincided with this view. But it was not till 1742 that the public at large began to take an interest in these discussions. Winslow had just declared that he had actually been put into his coffin twice, and he has recorded, in a memoir that has been celebrated ever since, the anguish that he felt at the time. Bruhier, a physician living at Poitiers, who commented on Winslow's work, gave his support to the view that the signs of death are uncertain, and based his arguments on a considerable number of cases. His book made a great stir; but Bruhier had accumulated all the descriptions and tales that he could get hold of, and derived some fantastic statistics therefrom; he reckoned, for example, that 52 persons had been buried prematurely; 4 had had their bodies opened during life, in the course of autopsies made by over-hasty physicians; 102 had returned to life after a more or less prolonged period of apparent death.

Let us say at once that one fact is found to be almost constantly present: viz., in the immense majority of cases the persons died without having been seen during their illness by a physician, and were buried without a physician having had the opportunity of verifying their death.

You know that each row of bodies in a cemetery is dug up every five years to make room for fresh interments. The corpses thus disinterred are all put together in a single trench. It was under such circumstances that Tourette, who was Professor of Medical Jurisprudence in this University, found in the charnel-house of the Innocents sundry remains which occupied a different position in their coffins from that in which they had been placed: the idea of premature burial naturally came into his mind.

One thing is wanting in these accounts, viz., a history of the patient, with notes of his illness; some diseases that we are well acquainted with—cholera among them—are followed by *post-mortem* contortions and convulsions which may attain a considerable degree of force: displacement of

the limbs from this cause does not prove that a person has survived burial. As to those stories of *post-mortem* examinations having been practised by anatomists, when in too great a hurry, on persons still alive, though in a state of apparent death, I believe they are false, or invented for amusement. I will cite two. One of them has for its hero the illustrious Vesalius. Happening to be at the Court of Philip II., he wished to perform an autopsy on the body of a gentleman, who awoke under his scalpel. The affair was noised abroad, the Grand Inquisitor, it is said, arrested and imprisoned Vesalius, who was finally condemned to go on a pilgrimage to Jerusalem to expiate his offence.

When this story was again investigated some years ago by a biographer of Vesalius, it was discovered to be false. Vesalius was never thrown into the dungeons of the Inquisition, and he himself applied to Philip II. for leave to visit the Holy Land.

The second case is that of Abbé Prévost, who fell down dead in the woods of Clamart ; a medical man, who did not employ sufficient delay, opened the abdomen to discover the cause of this unexpected death, whereupon Abbé Prévost awoke. He is said to have been cured, and to have lived many years after.

Now, this Abbé had been tutor in the family of Firmin-Didot ; M. Tourdes,* who is now the Honorary Dean of the Faculty at Nancy, was closely connected with this family ; he has interrogated the members of it at length, yet no one was found who remembered that Abbé Prévost had ever related this episode of his life, although it was so unique that no one could help preserving the recollection of it.

What has generally given rise to these legends is that the persons who have been the chief actors in them have been buried without any medical man having verified the fact that life had actually ceased ; if a mistake has been made, it is a popular blunder, not a medical one.

As a result of the outcry raised by Winslow and Bruhier, whose opinions gained a great hold even outside France, the

* Tourdes, 'Dictionnaire encyclopædique des Sciences médicales.'

so-called *mortuary chambers* were instituted in Germany. What is a 'mortuary chamber'? A person dies: he is carried to an apartment called the 'mortuary chamber,' where he is surrounded with flowers, and a bell-rope is placed in his hand; moreover, an attendant visits the place from time to time to inspect the corpse. Gentlemen, from the time that mortuary chambers were instituted—and that at Weimar dates from 1792—neither at Weimar nor at Munich (these are the mortuary chambers that I have personally visited), nor anywhere else, I believe, has anybody ever rung that bell. It may be, and has been, said in reply, that the dead bodies brought to these places have always been seen by medical men, and that the safeguard which has been conferred upon them is superfluous; we do not deny the force of this objection, but we are perfectly justified in concluding that cases of apparent death must be very rare indeed.

The mortuary in Germany is a place whither corpses are carried in order to make sure that death has really taken place. In France mortuaries exist also, but with quite a different purpose. There are two of them in Paris.* They have been established in order that persons might be removed there who, having only one room for themselves and their family, die in the same apartment where the members of the family will have to perform all their natural duties by the side of the corpse, greatly to the detriment of health and morality. I remember, as an instance of this, the following occurrence: A man died of small-pox; his family and friends watched the body; they ate and drank by its side, and when I came to see the man, of whose death I had not been informed, there were bottles everywhere, even on the abdomen of the deceased. Do not take this as an isolated case; it is, on the other hand, very frequent, and the cause of demoralization. It is the chief

* Decree of April 27, 1889, on the conditions applicable to the different modes of burial. 'ART. 5.—It is lawful to establish funeral chambers intended for the reception before burial of the bodies of persons whose death has been caused by an infectious disease; the funeral chambers are to be established on the demand of the Municipal Council,' etc.

reason which has urged us to demand the institution of mortuaries; they are necessary, as a matter of fact, to insure proper respect towards death, and observance of the precepts of hygiene.

Orfila, Fodéré, and Michel Levy, all believed in the possibility of premature burial, and it is certain that it cannot be denied absolutely. Against the partisans of the uncertainty of the signs of death we may set some authors who affirm that the signs of death are unmistakable. At the head of them I will place Celsus, whose criticism of Democritus I quote here: 'If the apparent identity of certain signs deceives an unskilful physician, an experienced and intelligent man cannot be mistaken; and the case of Asclepiades, who recognised, on meeting a funeral procession, that the person whom they were going to bury was still alive, is a proof of this. The faults of an artist are not defects of the art.' I will also cite Lancisi, and above all Louis, who in a voluminous memoir concludes in the following terms: 'The opinion that the signs of death are not certain is too dangerous to be true.' Notwithstanding all the respect that I have for the memory of Louis, his conclusion seems to me a singular one, and as unscientific as that of Celsus. It is much better to acknowledge one's ignorance than to mask it by an aphorism of this sort. Louis adds: 'I know of only one doubtful instance. It was that of a woman who was delivered of a child at her own home, and who was afterwards removed to the Hôtel-Dieu. There was no room for her there, so she was directed to go on to the Salpêtrière, which she did on foot. On the way she fainted three times, and careful note was taken of the places where these attacks of syncope occurred. She reached the Salpêtrière, and immediately died, or at any rate was taken very ill for the fourth time. She was carried to the dead-house. The house-physician under Louis entered the vault some time after to practise surgical operations, and found the woman half extricated from the covering that had been thrown over her, and struggling on the slab whereon she was placed. He called out, and Louis himself ran up and found that the unhappy woman had

one foot off the slab, and one arm out of the sheet. She was still warm, but by this time she was quite dead.

Are there any cases in which medical men themselves have failed to recognize a state of apparent death, and do these cases, if any such exist, entitle us to demand a reform in the law of burial, or may we rest satisfied with the present arrangement of things?

Here is a case to start with: Dr. Rigaudot, in practice in the suburbs of Douai, and a thoroughly honourable man, was summoned to a woman who was about to be confined. On his arrival he was told that the woman had been dead two hours. Thinking that it might be possible to save the child, Dr. Rigaudot ruptured the membranes, and brought into the world a child, which was raised to life with some difficulty. It took him half an hour to accomplish this. He asked to see the mother again, to whom no one was paying any more attention, and who had been already laid out; he noticed that the body was warm, and then went away. Some hours later, in the evening, that woman returned to life; but as a result of the accident she remained deaf, nearly blind, and almost an idiot. This physician, therefore, whose report may be believed, was confronted by two cases of apparent death, viz., that of the mother and that of the child.

In 1866 a petition was presented to the Senate with reference to premature burials. Cardinal Dounet, in a sermon which made a great impression, assured his hearers that he himself had rescued two girls from the grave; moreover, he narrated the following history, which roused profound emotion: 'In 1826 a young priest, while preaching in a crowded cathedral, suddenly sank down in a swoon in the pulpit. A physician pronounced that death had taken place, and drew up the form for his burial the next day. The Bishop of the cathedral where the occurrence happened had begun to recite the *De Profundis* at the foot of the bier, and the body had been measured for a coffin. As night approached, the agony of the young priest may be imagined when his ear caught the sound of these preparations. At length he heard the voice of one of the friends

of his childhood; this voice excited him to make a superhuman effort, and a marvellous result ensued. The next day he was able to reappear in the pulpit. To-day he is in your midst (*sensation*) entreating you to demand of your representatives, not only to take care that the provisions of the law are complied with, but, furthermore, to enact additional ones that shall prevent these misfortunes which are too frequent and irreparable.'* In this case, had an attack of syncope, or an inhibition caused by the violent emotion of preaching in a cathedral, been mistaken for apparent death? I do not know, but the story must be accepted as true.

Other cases have an equal title to be put on record.

Dr. Roger, of Plougonven (a suburb of Morlaix), relates the following incident: In 1866, while cholera was raging in the department of Morbihan, a young woman, aged 26, was suddenly seized with pain in the head and various other symptoms, and her condition rapidly became serious. The people around her believed that she had got cholera, and before many hours had elapsed she died. She was laid out and placed in a coffin, and sixteen hours after death her burial took place; a noise was heard inside the coffin which attracted attention. Dr. Roger was summoned; he had the coffin opened, and found that life remained; he had the woman removed into the church, as it was impossible to carry her all the way home on account of the distance; he was unsparing in his attentions, but she died in the course of the night and was buried in earnest the following day.

'This observation,' says M. Tourdes, 'seemed to us a well-authenticated case of the burial of a living person. To make quite sure, we communicated with Dr. Roger, the witness of the incident, and received from him the following reply, dated July 30, 1874: "Yes, I was present at the exhumation of a woman buried in a state of apparent death. I did not hear the sounds of the heart distinctly, though on auscultation I plainly perceived some faint rhythmical movements in the præcordial region; I am *positive* that the woman was still alive when I examined her, it is not a mere

* *Moniteur*, March 1, 1866, p. 238.

probability. Here is a *verbatim* copy of the notes taken the same evening: 'Plouigneau, Oct. 1, 1867, midnight.—I exhumed at 8 *p.m.* Philomèle Jonetre, aged 24, buried at 5 *p.m.* in a grave 6 feet in depth. Several persons heard her tap distinctly against the lid of the coffin; these blows appear to me to have left visible marks, but I did not hear them myself. There was no smell, no evacuation, but abundant evidence of respiration. Distinct rhythmical sound in the region of the heart. No *rigor mortis;* muscular contractions of the arms present, as well as in the lower jaw; heat and colour of the skin normal; no film on the cornea; tissues of the hand transparent to the light of the candle I held. Ammonia was applied to the nose; alternate compression and relaxation applied to the chest. She was not dead, but like a candle the flame of which has been extinguished, though the wick continues to glow. No definite sounds of the heart; the eyelids moved in my presence. I kept her unburied until the following day.'" It is out of these notes that the account has been compiled; it is an authentic case of burial during life. Without doubt, if a physician had seen her at the commencement of her illness, if the supposed death had been properly verified, if the body had not been placed in the coffin within an hour of the supposed death, and if burial had not been proceeded with within sixteen hours (though this was contrary to law), the mistake would not have been made; but the same set of circumstances may happen again, during an epidemic in the provinces, where verification is not systematically carried out, and it is useful to have it demonstrated, by a fresh case, that the danger of being buried alive is not chimerical.'

Without being as confident as M. Tourdes, it cannot be denied that the fact is within the range of possibility.

The case of General Ornano is well known. During the retreat from Russia General Ornano had his head grazed by a bullet while in the act of charging the enemy at the head of his squadron; he fell from his horse, and his orderly, Captain Tacher, ran to his assistance, but found that he showed no signs of life, and buried him under a heap of snow, having no time to afford him a more becoming inter-

ment. The orderly then went to announce the death to Napoleon. Two hours afterwards General Ornano came to report himself to the Emperor; he lived a long time after, and was one of the pall-bearers of his old orderly Tacher, who had in due course become a General.

The following case is probably one merely of syncope or prolonged nervous commotion: In 1848, as Louis Philippe was leaving the Tuileries to go into exile, the bodies of three National Guards were lying at the gates of the garden, near the Place de la Concorde; wishing to spare the King any fresh grief, some persons good-naturedly buried these bodies under a heap of sand. When they were extricated, some hours after, one of these men was still alive.

These cases have great probability, but perhaps they are not altogether beyond dispute; about two of them, gentlemen, there can be no doubt at all, for they were under the supervision of medical men. The first is related in Parrot's thesis, of which I lately spoke to you; here it is in full; it relates to an individual who was hanged at Boston in 1858, and was observed by Drs. Clark, Ellis and Shaw:

'The executed man weighed 130 pounds, was 28 years of age, and very robust. The hanging took place at 10 *a.m.* It is stated that there was neither any struggling nor convulsion. We must remark that, while admitting that the spectators may have been too much affected to have been able to study what took place with all necessary attention, it must be allowed at any rate that death took place without any *very obvious* convulsions, for if there had been such, no degree of emotion could have prevented them from being seen. Their absence is an interesting feature which shows that death was not brought about by rapid asphyxia, a condition which is always attended by violent convulsions.

'In this man who was hanged at Boston, the lungs and brain were found to be normal. How, then, did death take place? Without the slightest doubt its primary cause was sudden syncope from emotion or from excitation of the brain produced by the drop (7 or 8 feet) at the moment of hanging; while the body was still hanging, seven minutes from the commencement, the sounds of the heart could be

heard, beating at the rate of 100 per minute. Two minutes later the rate was 98, and three minutes after only 60 and very feeble. In two minutes afterwards the sounds had disappeared.

'At 10.25 *a.m.* the body was taken down: there was no more sound or impulse of the heart; the face was purple, although a small space near the ear probably allowed the passage of blood. The tongue and eyes did not protrude; the pupils were dilated. The rope had been applied just above the thyroid cartilage. At 10.40 *a.m.* the rope was untied, as well as the pinions which bound the arms to the sides. This done, the face and body gradually became pale. The vertebral column had not been broken. There was no emission of semen—a fact in harmony with the absence of asphyxia and of lesions of the spinal cord.

'At 11.30 *a.m.* a regular pulsation was noticed in the right subclavian vein (? artery). On putting the ear close to the chest, one could make certain that this depended entirely on the heart, and a single beat could be heard 80 times per minute, regular and distinct and accompanied by a slight impulse. The thorax was then opened, a proceeding which did not excite any pulsatile movements. The right auricle was contracting and dilating with force and regularity.

'At 12 *m.* the number of pulsations was 40 per minute; at 1.45 *p.m.* 5 per minute. The spontaneous movements ceased at 2.45 *p.m.*, and irritability persisted till 3.18 *p.m.*, more than five hours after the hanging.'

Although Dr. Clark does not say so, it is infinitely probable that the sound heard on auscultation before the thorax was opened was due to movements of the right auricle, and not of the ventricles.

That is the first case. I must point out, in passing, the strange, cool manner in which these Boston physicians performed their experiments on a living man. But it cannot be denied that this man was hanged, his death was witnessed by medical men, and yet this man showed indisputable signs of the persistence of life.

The second case resembles the first; it happened at

Pesth, and is reported by Hofmann ;* it also happened in a criminal sentenced to be hanged ; he had round his neck enlarged glands, which probably partly neutralized the constriction of the slip-knot which encircled it. However that may have been, the body remained suspended for twenty minutes, a medical man certified that death had occurred, and the body of the executed man was transported in a van at a rapid pace to the *post-mortem* room ; there was some distance to go, and when the van arrived, the physicians, who were expecting a corpse, were greatly surprised to see instead of a corpse an individual who raised himself up before them, and looked at them with a scared expression : the executed man had returned to life. A telegram was sent to the Minister of Justice to ask for instructions, and the Minister in reply told them to wait and see what happened. It was not necessary to wait very long, for three or four hours afterwards the man died of pulmonary congestion, evidently a result of the hanging.

In both these cases the error was a medical one : it is impossible to doubt that a blunder was made, precisely because examination by a medical man had not been omitted.

There is yet a third series of cases of more or less apparent death, concerning which I must say a few words to you. Gentlemen, the child that is born into the world in a state of apparent death is not always still-born ; you are well aware that many of these 'still-born' infants may be recalled to life. Depaul, who has left a minute and careful record of such cases, succeeded in restoring new-born children by means of pulmonary insufflation, an hour and a half, two hours, or even three hours, after the heart had ceased to beat.

It is necessary, therefore, to remind you that apparent death is tolerably frequent at the moment of birth, and that, with prolonged care, by means of insufflation, and also of rhythmical traction of the tongue, which has answered well in the hands of M. Laborde, you can bring back to life infants that are apparently dead.

* Hofmann, 'Nouveaux Éléments de Médecine légale,' avec introduction et commentaires par Brouardel. Paris, 1880.

To form a just judgment, Gentlemen, on so difficult a question as that of apparent death, it is essential to eliminate every source of error. The chief of these arises from the persistence of muscular contractions after death, as in cholera. One might even say that movement continues after death. In the bodies of persons who have died from this disease, we may actually meet with rhythmical contractions of the abdomen and of the muscles of the thigh, strong enough to produce flexion of the limb, etc. These phenomena have sometimes made people doubt the reality of death.

Gentlemen, when you happen to be alone by the side of a corpse at night-time, observe it well; you will notice a singular persistence of movements in the muscles of the face and of the hands. Abduct the thumb from the forefinger; in the course of a few hours they will be approximated again; but do not conclude from these facts that life remains. I may say the same about contractions of the diaphragm; they may be energetic, causing an expulsion of gas, and often of liquids (the watchers call this the 'emptying of the body'), or abrupt, in which case they may evoke a hiccough, or sometimes an inarticulate sound or cry.

The expulsion of semen has been considered to be a proof of life. When cadaveric rigidity sets in, it appears to start from the vesiculæ seminales; the semen, owing to this particular contraction, is discharged into the urethra, and may perhaps escape externally, according to the position of the penis. This escape is therefore no proof that life remains.

Identical stories are told of pregnant women being delivered on the tables of the mortuary. The observations which have been made by Depaul and myself clearly demonstrate that in women who have previously been confined, and who die when again six or seven months advanced in pregnancy, the development of gases in the intestines may lead to the expulsion of the fœtus, because the uterus becomes inverted; it is a mechanical phenomenon of putrefaction.

Sometimes the outward appearances of life are preserved in death. When the Opéra-Comique was burnt down, twenty-nine bodies were found near the refreshment bar

which showed no marks of burning or violence ; the dresses, and even the finest lace, were intact; these persons had succumbed to asphyxia by carbonic oxide. When their faces had been cleansed from the black and grimy coating which the smoke had deposited, three of them were found to be young girls. In the case of two of them, their relatives could scarcely believe that they were dead when they saw them ; for their complexions were rosy and the lips red, because the carbonic oxide had preserved the scarlet colour of the blood ; even when putrefaction had set in, a few days afterwards, these girls still had a rosy look, because the red blood was propelled towards the head and face.

Predisposition to Apparent Death.—Can we enumerate and classify cases of apparent death ? In by far the majority of cases, the approach of death is known to those who have to do with the patient. You have seen that danger of apparent death is especially great in new-born infants ; it has been said to be possible in the case of the old ; it is possible in the case of a large class of persons if they are placed in special conditions.

First of all must be reckoned those hysterical persons who live on the scantiest supplies of food, and who are prone to fall into lethargy, and may remain in the state of apparent death for a considerable time. I do not believe that a physician would commonly be mistaken over them, for auscultation of the heart would reveal the true state of things; but ordinary people might be deceived. Allow me to insert a parenthesis here : In France, except in those towns where there is a municipal organization for the verification of death, entrusted to medical men, the registrar of deaths is the sole person who is charged with proving the reality of death. He does not, as a rule, perform this duty in a thorough-going manner, and if he does take pains to do so, he cannot perform it satisfactorily, since he is not a medical man. There are, then, under these conditions, and particularly in the country, many opportunities for making mistakes.

I next call your attention to syncope, or inhibition. A mass of literature, comprising more than a thousand volumes

or memoirs, has been founded on this subject, and the immense number of cases embarrasses me not a little. One reads therein of soldiers wounded in battle and dying of hæmorrhage, who have been restored to life after two, three, four, or even twelve days!

I do not know how long life may be prolonged after a fatal hæmorrhage; I know that it may be for an hour, because I have seen instances of it. Am I entitled to deny that it may be prolonged still further? Just remember, then, that death by hæmorrhage, by syncope, or by inhibition, may be a source of fallacy. Cases have also been related of individuals who have been buried for two or three days, and yet have returned to life. The fact may sometimes be explained; *e.g.*, the layer of sand or of earth thrown over the body may be permeable to air, so that a sufficient quantity for respiration and the support of life may be admitted.

As to submersion, we know that drowned persons are resuscitated every day by means of diligent and well-contrived efforts. But when we are asked to say how long these persons may have been submerged, we cannot be too cautious in expressing an opinion. It is a matter of estimating probabilities. Some assert that resuscitation may be effected after submersion for two, three, or five hours; but people who are present at the scene, and take part in the exertions that are being made, have no idea of time. They will tell you that they have been there an hour, although it may really be only a quarter of an hour since they reached the place.

With regard to freezing, Gentlemen, there are certain cases which I am bound to accept. A story is told of a grenadier belonging to the Strasburg garrison, who was found frozen in the river Ill; he was taken to the hospital, warmth was applied, and he survived. At Strasburg, on another occasion, also, a hospital attendant was found frozen, was resuscitated, and still continues his duties, which he has now performed for many years.

The after-effects of lightning stroke have not received sufficient attention. Out of seventy-seven instances related by Sestier,* there are six or seven in which apparent death

* Sestier, 'De la Foudre.' Paris, 1866.

lasted for five or six hours. Boudin quotes the case of a sailor who was restored after having been apparently dead for an hour and a half. I believe that the death-like state may be ascribed in these cases to inhibition, caused by a *maximum* degree of stimulus, a possibility which cannot be gainsaid.

Finally, Gentlemen, I come to cerebral commotion, and I will at once cite to you two typical cases.

At the siege of Constantine, General Trézel, who commanded the division, was struck by a ball on the back of the neck, and fell down. The troops continued their assault on the town, which presently fell into the hands of the French. Search was then made for the General's body. It was found, and placed on a stretcher. While being carried on the ambulance, the General returned to life and warmly thanked the porters, but he did not recollect that he had been wounded. How long did apparent death last in his case? I do not know; but I can state positively that it lasted during the time necessary to take the town, which must have occupied some hours at least.

The second case came under my own eyes, and took place while I was house-physician at La Pitié. At that time the resident staff were not on good terms with the administration. A little bricklayer, aged 13, was brought in one day, who had fallen from the sixth story on to the pavement. The accident happened in the Rue de la Tournelle. The boy had been taken to a chemist, who pronounced him to be dead, and sent him on to the hospital. The director refused to admit him, as he was dead. Now, either by intuition or else to bamboozle the director, I stated that the lad was alive, although the sounds of the heart could not be heard on auscultation. I had him put into a mustard bath, and, to my delight, he came to. He had received no wound or any definite injury, only he remembered nothing. Gentlemen, I presume that an hour and a half had elapsed between the time that he fell and that when he entered the hospital. Just think that he had first been carried to the chemist's, who had examined him; next, that a stretcher had to be procured; and then there was a good deal of

parleying at the hospital door. That lad suffered from cerebral concussion, whence he emerged suddenly without any outward trouble. He might have been buried alive; he might perhaps have returned to life beforehand. I hope he would have done so, though I dare not feel sure.

Some authors have described poisoning by the fumes of charcoal as being capable of inducing a state comparable to that of apparent death. Dr. Harmand (of Nancy) relates that he was called to a coachman, who gave no sign of life, and that another medical man who had been called in before had pronounced that the patient had succumbed to cerebral congestion. Noticing the peculiar odour which pervaded the room, Dr. Harmand had the windows opened, and devoted his full attention to the restoration of the patient, who returned to life and still survives. He attributes the coachman's illness to poisoning by charcoal fumes.

Gentlemen, when a person is killed by charcoal fumes, he is poisoned by carbonic oxide, not by carbonic acid. When anyone is placed in an atmosphere of carbonic acid, death happens, not from poisoning, but because the atmosphere has become irrespirable.

I can relate to you some curious experiments under this head. A Commission in which I took part, with MM. Schutzenberger, du Mesnil, and others, was charged to give an account of the poisonous nature of the gases contained in the soil of cemeteries.* We caused graves to be dug 13 to 16½ feet deep. In some of these graves we had corpses buried; others we left empty as control experiments. We wanted to measure the amount of carbonic acid and other gases liberated in these graves. In the soil of Paris, saturated with animal matter, and still more with vegetable matter in a state of decomposition, we detected as much carbonic acid in the empty graves as in those which contained the corpses. One grave, 16½ feet deep, was full of carbonic acid in five hours. Graduated candles burned in them for only ten or fifteen minutes at the bottom; at the upper part they

* Brouardel, 'Projet de Création d'un nouveau Cimetière à Boulogne-sur-Seine' (*Ann. d'Hyg.*, 1886). Brouardel et du Mesnil, 'Conditions d'Inhumation dans les Cimetières : Réforme du Décret de Prairial sur les Sépultures' (*Ann. d'Hyg.*, 1892, p. 27).

burned for two, three, four, or five hours. It is to this rapid liberation of carbonic acid that the well-sinkers succumb who pursue their trade in Paris and the suburbs.

We likewise placed cages of birds and of guinea-pigs in the graves. The birds in those cages which we let down to the bottom died; those in the cages placed nearer the surface were in a state of apparent death when they were drawn up. When placed on their backs in the open hand, they came to life suddenly and flew away.

There is, then, in these cases a state of anæsthesia which is dissipated suddenly, without leaving any traces, and which can be compared to that produced by nitrous oxide. Dr. Harmand had to do with a case of this sort. The phenomena which he described could be produced by immersing a person in an atmosphere saturated with carbonic acid, but not with carbonic oxide.

Drunkenness may also produce a condition of apparent death. M. Bourneville cites the case of an old woman found in the street, who no longer breathed or gave any sign of life. She was conveyed to the hospital. The rectal temperature was 77° F. Energetic treatment restored her to life. M. Laborde mentions an individual picked up in a lifeless condition at the gate of the Bicêtre. He was carried into the hospital. His rectal temperature was 75° F. In some little time he revived, and eventually recovered. In both these cases the cause was drunkenness.

Anæsthesia, and especially chloroform or ether anæsthesia, may cause a state of apparent death. This state gives way when appropriate treatment is quickly administered. But this is a question which rather concerns surgery; I shall not go farther into it, except to say that in fatal cases of chloroform anæsthesia the palpebral reflex is the last to disappear (Boudin).

In some years' time, Gentlemen, it will be possible to make a more complete and more scientific classification than in the outline I have just sketched to you; for I can only make a rapid review, a somewhat dry nomenclature, at the present moment. But what has now been known for some years about the toxic principles which are formed in

the human body—you may call them toxines, ptomaines, or leucomaines—entitles us to divide them into two groups, according to their physiological properties; we are able now to distinguish them either as *convulsives*, analogous in their action to strychnine, or as *anæsthetics*, reminding us of chloroform. The experiments which I performed in 1878 with Boutmy showed that ptomaines extracted from the bodies of those drowned, and injected into frogs, produced phenomena of both classes.*

It is impossible to deny that in individuals whose processes of nutrition are slackened, as they are in hysterical patients, or whose nutrition is profoundly altered, as it is in alcoholic subjects, toxic substances may be produced, giving analogous results. But in the present state of our knowledge it is not possible to affirm anything more.

It has been insisted strongly, in reference to this matter, that in certain acute diseases, such as cholera, plague, or typhoid fever, there may be prolonged attacks of syncope, which are easy to confound with apparent death; M. Dieulafoy's thesis was devoted to this subject. It seems to me that there need be no fear of confounding these attacks of syncope with apparent death. In these cases the myocardium is altered; the heart stops because its muscle is affected and has yielded: it seems to me difficult to admit that any state can be met with in those diseases that might be mistaken for apparent death.

As to syncopal attacks from which persons may and do revive, they are not usually of sufficient duration to stand the chance of being mistaken for apparent death.

PREMATURE BURIAL.

There is, then, such a thing as apparent death; that is to say, certain conditions may simulate real death. It is impossible to say how long such a condition may last, and we can affirm that it is possible, in a certain number of cases, to

* Brouardel et Boutmy, 'Développement des Alcaloïdes cadavérique, Ptomaïnes' (*Ann. d'Hyg.*, 1880). 'Des Ptomaïnes, Reactif propre à les distinguer des Alcaloïdes végétaux' (*Ann. d'Hyg.*, 1880). 'Conditions du Développement des Alcaloïdes' (*Ann. d'Hyg.*, 1881).

restore to life persons who have been believed to be quite dead.

Having said so much, I add that in the immense majority of cases we die after a struggle, by suffocation, by bronchial over-secretion, but after a more or less long and painful scene. In these cases death does not raise any doubt.

Allied to this question of apparent death, which has excited men's minds ever since Winslow raised it, there is another which is grafted upon it, and which has always occupied public attention. Petitions have been presented to the Chambers, elaborate reports have twice been issued, and I myself am entrusted at the present time with the preparation of a third. The question is this: Can an individual, after being buried while in a state of apparent death, come to life again in the grave? Except Dr. Roger's case, which I have narrated already, none of the cases reported as such are very conclusive. The newspapers describe them; but no medical man has been present. When I read of such a case in the newspaper, I make an inquiry — as Bouchut, M. Tourdes, and M. Armaingaud used to do; I write to the mayor or to the medical officer of health, and ask him if the facts are genuine. The reply I am wont to receive is that the story is quite unknown in that part of the country whence it is supposed to have come, or that the person mentioned is not dead and has not been placed in a coffin.

Nevertheless, I should not like to affirm that a person in the state of apparent death could not be buried. If he were to return to himself, how long could life be maintained in the coffin? In an ordinary coffin, with a glass lid, a dog lived for five or six hours; but a dog occupies much less space than a man; the latter, after being once shut up in his coffin, has scarcely $3\frac{1}{2}$ cubic feet of air; he might therefore be able to breathe for twenty minutes. I do not wish anyone to pass such a dreadful twenty minutes.

This calculation is based on the average respiratory activity; in persons whose nutrition is conducted more slowly than in others, such as the hysterical subjects of whom we have spoken, survival might be much longer.

LECTURE III.

THE SIGNS OF DEATH.

GENTLEMEN,—We come now to the study of the signs of death, those signs which will enable us to avoid the errors which I have pointed out to you as possible; how can they be determined, and whose duty is it to prove their existence?

I shall divide these signs into two classes: those which show themselves immediately after death, and those which do not appear for some hours afterwards, such as *rigor mortis* and putrefaction.

Gentlemen, every author who has taken up the question has endeavoured to bring to light a pathognomonic sign which shall enable us to certify death in the earliest moment after life has departed. There is no more any pathognomonic sign to determine the moment of death than there is to establish the diagnosis of typhoid fever. Just as in the latter it is a combination of symptoms observed (headache, epistaxis, fever, diarrhœa, rose spots, etc.) which make the diagnosis sure, so in the case of death it is a collection of signs which gives the physician absolute certainty, and he alone can estimate their value. Let us see what the different signs are, so that we may examine them *seriatim*. In the first hours we have only *negative* signs, we notice the abolition of the bodily functions; *intelligence* is abolished after death, but so it is in syncope.

INSENSIBILITY.

This is general and complete, but certain hysterical subjects, or persons in whom there is general anæsthesia, present the same phenomena. Here, then, is one cause of error,

which is all the greater inasmuch as Charcot has shown that these anæsthetic individuals may be pricked with pins without a drop of blood escaping, unless a large vein be pierced.

Josat invented a pair of forceps with claws, with which he proposed to pinch the nipples of persons whose death has to be ascertained. Josat obtained the first prize of the Academy, but Briquet, repeating the same tests on the hysterical subjects under his care, proved that they did not react under Josat's forceps any more than the dead.

Analogous experiments have been made on all the senses.

Hearing.—It has been the custom for women to be placed around the dead man's bed, to cry and howl, with the object of waking the dead if he were so only in appearance. This custom, which dates from the remotest antiquity, is still practised in some of the departments of the South of France.

Smell.—By passing beneath the nose of the body the vilest and strongest perfumes. (In this respect allow me to remind you that a small drop of ether, thrown high enough up into the nostrils, rouses a person from tolerably profound syncope.)

The reactions of the *eye* have been closely studied. Even quite recently a learned man discoursed at the Institute about a certain sign of death, viz., the immediate lessening of tension of the globe of the eye at the moment of death, due to the cessation of circulation and emptying of the vessels. It proves that the heart is not beating, but not that the person is dead. The iris undergoes modifications. During the death-struggle, and at the moment of death, the pupil dilates, even so as almost to disappear completely, then it gradually returns to its normal midway position ; and as the eye loses more and more of its tension, the iris is thrown into folds. Bouchut, who has taken great interest in these questions,* has observed that atropine and eserine have no effect after death. Too much importance must not be attached to these signs; if the ocular tension persist, it is not necessarily because life remains. For in the drowned, owing to the imbibition and absorption of water, tension is often increased, the eyeball being harder than in the normal condition.

* Bouchut, 'Les Signes de la Mort et les Moyens de prévenir les Inhumations prématurées.' 3rd edition. Paris, 1883.

A method of recognizing death has been borrowed from the saleswomen at the markets. When these women buy a fowl or a fish, they look at its eye; it shows a speck on the sclerotic which gives the eye the appearance of parchment, and this is all the more plainly visible the longer the time that has elapsed since death. A man dies with his eyes half shut, and an attendant closes them completely. If the lids had remained open, you would see that the conjunctiva and sclerotic presented a very characteristic brown hue. M. Larcher,* of Passy, has insisted strongly on this sign.

Allow me to say a word or two about a plan that was urged on a particular occasion, and which made some stir in forensic medicine. It was suggested that in persons dying suddenly the eye preserved the impression of objects which were in front of it. Photographs of the retina of a person supposed to have been murdered were shown to the Society of Legal Medicine. It is said that these photographs reproduced the figures of a man and dog in the act of springing and making the attack to which the individual had succumbed.† These images, which were said to be so clear, were really extraordinarily vague, and yet in his report, M. Vernois was quite positive about them. Kühne of Heidelberg has repeated the experiment. I have seen some of his photographs, and some of them are very distinct. He placed a grating in front of a rabbit, then killed the animal rapidly and removed its eye, exposed the retina and photographed it. In the print the transverse and vertical bars of the grating may be recognized. He has endeavoured also to reproduce a fence and a chair; but even when set in the full sunshine these objects gave only very indistinct images. Many obstacles besides stand in the way of these experimental results ever having a practical use in forensic medicine; the animal must, as a matter of fact, be killed rapidly, and the retina must be photographed immediately after death. These conditions are hardly to be realized in forensic

* Larcher, 'De la Rigidité cadavérique et d'un nouveau Signe de le Mort (Tache sclératicale)' (*Ann. d'Hyg.*, 1869, tome xxxi., p. 468).

† Vernois, 'Application de la Photographie à la Médecine légale: Rapport sur une communication de M. le Dr. Bourion' (*Ann. d'Hyg.*, 1870, tome xxxiii., p. 239).

medicine; and though these results in animals may have some little weight, we cannot admit that we should find, twenty-four or forty-eight hours after death, any copy on the retina of a murdered man of the last scene of the fatal drama.

MOTILITY.

The *immobility* of death has been considered a classical sign; and the same importance has been attributed to the falling of the lower jaw, which immediately follows the moment of death, and the occurrence of which is prevented before *rigor mortis* sets in by the application of a bandage round the head. This sign is not constant; death may take place with the mouth closed in tetanus, poisoning by strychnine and hysteria.

A young man called one day at a chemist's, whose identity, happily for him, has never been traced, to ask for some strychnine to kill his cat. The chemist supplied him with the strychnine; but the young man changed his mind when he reached home, and no longer wished to kill the cat. Before shutting up the strychnine which the chemist had given him in a drawer, he thought he would like to see what the powder tasted like; so he wetted his finger, dipped it in the powder, and licked it; he died in the midst of horrible convulsions, with the jaws closed and the biceps and psoas muscles globular and contracted.

Gentlemen, when a person dies he usually falls flat on the ground, though not invariably; the exceptions have nearly all been observed on the field of battle. When the cervical part of the spinal cord is injured a little below the bulb, the individual struck may preserve his attitude, so as to be, as it were, transformed into a statue, if, at the moment of being struck, he is in equilibrium. I can give you as an example the case of an English Colonel charging at Inkermann at the head of his regiment, sword in hand. His head was carried away by a cannon-ball; nevertheless he continued the act of charging, firmly seated on his horse, which bore him into camp with the rest of the regiment. The fact was published at the time, but some doubts were raised as to its authenticity, whereupon one of the military surgeons who was

present at the battle of the Alma produced the photograph of a Turk who was killed when he was in the act of saying his prayers, and who had been found on his knees with his hands joined together, fixed in the position in which he was struck.

During the American War of Secession, a trooper from the Potomac was surprised at the moment of mounting his horse; he was hit by a ball, which injured the spinal cord in the neck; he remained upright and motionless in the position in which he was struck, with one foot in the stirrup and his hand on the mane of his horse, which had not stirred. He was photographed in this attitude.

A French soldier was found, during the war of 1870, sitting on the edge of a stream drinking out of his can. This soldier had been beheaded by a cannon-ball; the lower jaw was disarticulated and hung down on his neck.

Wounds of the cervical cord may therefore induce complete rigidity of the corpse, and stability in the position which the wounded man occupied at the moment of his death.

The same fact happened at Bazeilles, but from a different lesion. A Prussian foot-soldier was photographed while about to shoot, his gun being supported on an iron bar. This soldier had a large wound in his belly, but the spinal cord was untouched. He had doubtless died by inhibition; it is the only instance of the kind that I know.

We ought to collect all these cases, for they may have their application in forensic medicine.*

It is stated by some old authors that an individual sometimes dies wearing on his face the expression of the sentiments he felt at the moment of death. Fodéré has gone much farther. He has attempted to distinguish between suicide and murder by means of this test. I have often wished to verify the fact, Gentlemen, but I have never been able to find the slightest proof of such a thing. There probably are psychical phenomena in these cases, but they

* 'The Soldier in Battle,' by Frank Wilkeson, has an interesting chapter, 'How Men die in Battle,' which bears closely on this subject.—TRANSLATOR.

are on the part of the medical man, not of the victim. This is especially true when an execution takes place. Owing to the circumstances of the case, the local surroundings, the displacement of property, the blood spilt, and the attitude of the victim, a singular sensation is aroused which impresses the event on the mind of the physician.

I have spoken to you of the Pranzini case (*vide* p. 3). When I saw the victims, it seemed to me that the countenance of Marie Regnault had an expression of indescribable horror; she simply had her eyes open, and their fixity was most impressive. It is necessary to warn you, Gentlemen, against relying too much on this first impression when you are summoned to make a medico-legal examination. In such circumstances have a photograph taken of the victim, for by photography only will you be able to get the magistrate and jurymen to share your opinion, and it will enable you to review your first ideas coolly. Photography has now become a very commonplace art. Get a photographer to accompany you in your proceedings whenever you can. A photograph gives the exact appearance of a wound better than all technical descriptions.

Muscular immobility is attended with relaxation of the sphincters. Muscular contractility lasts for some time yet; then it disappears, and cannot be aroused again even by means of electricity. When Ruhmkorff invented his coil, it was thought that this might perhaps serve to furnish a certain sign of death; the Senate was flooded with petitions that experiments should be instituted; people even went so far as to demand that the priests might keep a Ruhmkorff's coil in every church, and test the muscular contractility of every corpse before proceeding with the funeral ceremonies. These experiments would have serious inconveniences, the least of which would be the ignorance of the priests charged to carry them out, and I do not want to insist on the childish and uncertain character of the test.

Dr. Collongues* attaches great importance to 'dynamoscopy'; he affirms that, when you put into your ear the finger of a living person, two noises can be heard distinctly, two

* Collongues, 'Traité de Dynamoscopie.' Paris, 1862.

slight rolling sounds produced by the muscular system. When these sounds disappear, the individual is dead.

Gentlemen, leaving aside the fact that it is not very pleasant to introduce a dead person's finger into one's auditory passage, there are two sources of error: (1) When you put a living finger into your ear, you can hear a number of sounds which I would compare to the humming or buzzing which is produced by holding a shell to the auditory meatus; (2) when the finger is dead, these noises may be almost the same if the finger is not placed in the right position.

RESPIRATION.

Abolition of respiration is the most untrustworthy of all the signs which have been invoked. You know the test of placing a mirror before the lips of the corpse; perhaps you do not know that of the glass of water, full to the brim, placed on the hollow of the epigastrium, which was extolled by Winslow. He held that if the water ran over, the individual was not dead.

Winslow either forgot or did not know that rhythmical contractions of the diaphragm persist after death; these may provoke evacuation of gases, and even hiccough, as a result of which the mirror becomes soiled and the glass upset.

CIRCULATION.

I come now, Gentlemen, to the two signs or the pair of signs which are of chief importance, *i.e.*, the cessation of circulation and the temperature phenomena which ensue upon death. In former times one used to feel the pulse of the dying man, and when the beat of the radial artery could no longer be felt, it used to be said, 'It is all over; the patient is dead.' Bouchut,* who has studied all these questions with great care, has rightly said that one must not be satisfied with feeling the pulse, but must go

* Bouchut, 'Les Signes de la Mort et les Moyens de prévenir les Inhumations prématurées.' 3rd edition. Paris, 1883.

higher, and consult the heart also. In a memoir published by him, and submitted to the Academy of Science, he states that an interruption of the action of the heart lasting for two minutes was sufficient to render the diagnosis of death certain. Andral, who was appointed to report on Bouchut's memoir, believed that this interruption should be prolonged for five minutes. Later on he was obliged to acknowledge that even this length of time was inadequate, since in the interval he had met with a woman who returned to life some hours after the action of the heart had ceased to be perceptible; it is true that a few contractions could be perceived from time to time, but they vanished, to reappear later.

Bouchut thinks the heart should be listened to for half an hour. There are at least two sources of error there, Gentlemen; you cannot listen to a heart for half an hour continuously. Try to do so; in five or six minutes you will hear buzzings and murmurs of all sorts, and at last you will hear the beating of *your own* heart. A second source of error is as follows: When an animal is dying, and you practise auscultation, you hear very plainly the two sounds of the heart, then only one sound, which presently disappears also. If the animal is opened, the heart is found still beating. Therefore it is essential that the heart should beat with a certain degree of energy in order that its beats should be heard. And lastly, without suspecting the talents of my fellow-practitioners, it is evident that certain physicians will be able to perceive the beats of the heart after others can no longer do so. Sharpness of hearing is not the same in everybody; and when auscultation is in question, the education of the ear is a very important factor. It is certain that all of us require to repeat our apprenticeship in auscultation when we have not been engaged in practice for a time—when we return from a holiday, for instance. It is a question of the force of daily habit. I am sure that none of us has an auditory nerve as delicate and susceptible as that of any clinical professor at Paris. We must not pay much heed to those experiments, which may be all very well as tests in the laboratory or in the hospital, but are not always feasible in the course of practice.

Moreover, the principle itself is merely an assumption; for we know that an individual whose heart no longer beats may survive (*vide supra :* the two men hanged at Boston and at Buda-Pesth). The absence of the beats of the heart may be considered as a sign of apparent death, but not of real death.

You know the following experiment as it is performed in the laboratory or in the course of lectures; M. Middeldorf has ventured to extol it as a certain sign of death. A needle with a small flag at one end is thrust into an animal's heart; this flag waves as long as the heart beats. M. Middeldorf wished to introduce this experiment into practice, and called it the 'akidopeirastic' method, and he devised for employment in this way needles 4 inches long, which the physician was to thrust into the heart of the person whose death he had to verify. This method seems to me to be scarcely applicable in family practice; objections would be raised and resistance offered, which seems to me to be very natural.

While still making use of the stoppage of circulation, other authors have proposed *section of the temporal artery*. If the heart were beating, this section would be followed by a flow of blood; there would be none in the contrary case. I think it would be useless to repeat before you the discussion already set forth on the subject of the movements of the heart.

Phlebotomy was formerly considered the classical procedure to determine the reality of death; the family, and sometimes the deceased himself, have expressed a wish to have a vein opened, in order to make sure that no blood would flow.

Gentlemen, venesection of a person just dead yields no blood. But if, after opening the vein, you do not take the precaution of fastening a firm bandage over the wound, the vein will yield some blood in the course of a few hours.

The explanation of this apparently abnormal fact is very simple. When the individual dies, chemical processes continue; fermentation develops gases in the intestines, which, if the temperature is high, may acquire in twenty-four hours a tension in the abdomen of an atmosphere and a half.

Under the influence of this tension the diaphragm is pushed up as far as the third rib, and the blood in the heart, great vessels, and lungs is driven towards the periphery in the veins. It is an actual posthumous circulation. At the moment of death the skin is white. Putrefaction begins; the outline of the veins may be seen in blue under the skin, and if venesection is performed blood escapes, sometimes in abundance, though it will not coagulate. That is a very important fact, and in the Middle Ages a singular interpretation was drawn from it.

You know what was called 'the judgment of God'? When a corpse was found near a village, and it was impossible to detect the murderer, the inhabitants were made to file before the corpse; if blood and gas escaped from the wounds, the person who stood before the body at that moment was arrested; that man, it was said, was the assassin, because the corpse revolted at the sight of him. This custom prevailed until the reign of Charles V., who instituted the first medical jurists.

Other difficulties also crop up with respect to phlebotomy. If bleeding is performed on anyone who has just died, the blood ought not to coagulate, it is said. When blood flows from a wound made on a person who has just expired, it may coagulate, but the clot thus obtained resembles currant-jelly; it will be treacly, and flow as a liquid on the scalpel. Between a clot like this and a firm, well-cupped coagulum obtained from a case of pneumonia, there is an infinity of degrees, according to the greater or less consistence of the meshes formed by the network of fibrin. When you perform phlebotomy thus at the request of the family or of the deceased himself, who thought that he would in this way elude the danger of being buried alive, always place a tight ligature on the arm after opening the vein, so that the blood expelled by putrefaction may not escape afterwards.

Ligature of the finger has been considered by some to furnish a certain sign of death. If the individual is alive, the finger becomes blue; if he is dead, it does not alter its colour. This sign indicates whether circulation persists or not.

The same applies to *cupping* and *leeches* as to bleeding. Leeches may suck blood when the posthumous circulation, of which I have just been speaking, is established. Here is an example: M. Tourdes pronounced that a certain person was dead; however, leeches were applied; the leeches took, and the next day, when M. Tourdes returned, three leeches still held and had drawn a little blood.

These are delicate tests, subject to many fallacies; precisely for this reason I do not think they deserve the semeiotic value which has been attributed to them.

Decoloration of the Retina, due to the absence of circulation, is a very difficult sign to get evidence of in private practice.

CADAVERIC SUGGILLATIONS.

These are a consequence of the abolition of circulation; I do not hesitate to attach great importance to them, without, however, going so far as to say that they constitute an infallible sign. When we examine a body, we find in the dependent parts that the skin is covered with violet patches which have been called *cadaveric suggillations* or *lividity*.

To what can these patches be attributed? When they are cut through, it is seen that the little capillary vessels of the skin are gorged with livid blood; if, at the end of four or five hours, a fresh section is made, it will be evident, not only that the veins contain blood, but also that the colouring matter of the blood has exuded into the tissues around.

Could these suggillations be confounded with any other lesions? When there is merely venous congestion, it is very difficult to mistake it for an ecchymosis. Ecchymosis is due, in fact, to an extravasation of blood; but even when in a suggillation there is some effusion of colouring matter of the blood, you must be but very little acquainted with these phenomena to mistake it for an ecchymosis. When blood has escaped, the serum, stained by the colouring matter which has left the corpuscles, is absorbed by and colours the neighbouring tissues.

In the instants which immediately follow death, these

suggillations have a great value; when they are recent, they may be displaced by turning the body over. The distribution of these patches of lividity indicates the position the body has occupied for some hours. But if we turn the body over, the suggillations alter their situation; they always show themselves in dependent parts. If death is not recent, and the tissues are stained by the colouring matter of the blood, the suggillations no longer shift their place.

Suggillations are constant. In an interesting work published by Dr. Mollaud, an inspector of verification of death in Paris, he has summarized 15,146 cases observed by him; suggillations were not absent once.

Nevertheless, difficulties present themselves here also; in the first place, it is not always easy to determine the existence of lividity; when there has been abundant hæmorrhage there may be none. M. Molland affirms that he has seen them in women who have died of *post-partum* hæmorrhage, but in these cases they were not well marked. M. Devergie is of the same opinion. It is therefore a matter requiring skill to estimate.

The patches of lividity do not always appear at the same moment; in persons who have died of hæmorrhage they appear late, and are only slight; they show themselves five or six hours after death, when the debatable point is already settled, and the proof of death is no longer wanting.

On the other hand, they may appear before death in cholera, uræmia, and asphyxia. In persons attacked with cholera, for example, the peripheral circulation has ceased. Magendie was unable to withdraw a single drop of blood from the radial artery of a cholera patient who lived for several hours longer. Lividity which appears before death is due to stasis of blood, *i.e.*, to gravitation, not to an alteration of the corpuscles.

In spite of these reservations, the presence of suggillations is an important sign.

TEMPERATURE *POST-MORTEM.*

I come now to the phenomena of *heat* which ensue after death. The evidence afforded by the temperature is a sign of great importance and value. It has been much studied both in France and abroad, and has been taken up again within the last few years by M. Bourneville, who has already written much on the subject.

As everyone knows, when a person dies his body becomes cold. Nevertheless, De Haen had already remarked that in the moment of death there was sometimes a rise of temperature. In certain infective diseases, such as small-pox and cholera, the rectal temperature may rise from $3\frac{1}{2}^{\circ}$ to 7° F. This rise of temperature proves that chemical activity lasts after life has departed; then, as a sequel to the rise, there is a lowering of temperature. I do not insist on the chemical theories which have been formulated to explain these phenomena; they are of no consequence. Taylor and Wilks, in England, have tried to find by observation of the laws of cooling some certain sign of death.* They noticed that six or eight hours after death the temperature varies from 60° to 80° F., and that twelve hours after it varies from 56° to 79° F.

Gentlemen, when a man dies, he may do so under one of two conditions: either he dies at home or he dies in the hospital. If he dies in his bed, as soon as he has breathed his last the bed-coverings are drawn over him, candles are lighted by the side of his bed, and a fire is kept up for the sake of ventilation. He remains in the bed wherein he died; the mattress, pillows and coverings preserve the heat for a longer or shorter period of time, and the cooling of the body is reduced to a *minimum*.

At the hospital, on the contrary, the dead man is removed at the end of an hour; he is enveloped in a shroud, and his body is laid on an iron table or marble slab in the dead-house; the rapidity of cooling is at its *maximum*. Between these two sets of conditions there is complete opposition.

* Taylor and Wilks, 'Guy's Hospital Reports,' 3rd series, pp. 180-183.

It is necessary also to take into account a large number of circumstances which Taylor and Wilks have examined.

1st. The external temperature; the higher this is, the slower is the cooling, which thus becomes extremely variable.

2nd. The disease which caused death; if it has been of long duration, cooling is slow; if death was due to hæmorrhage, cooling will be rapid; if it was from an infective disease (cholera, tetanus, small-pox) there will be an initial rise of temperature.

When Alvarenga* published his thermometric observations, he drew a curve—a somewhat diagrammatic one—of these variations. Wunderlich† attributed the *post-mortem* rise of temperature in zymotic diseases to *rigor mortis;* he thinks that there are produced at this time thermo-chemical phenomena identical with those which accompany muscular contraction. It is useless to discuss this question now.

In 1872 M. Bourneville‡ found in a person who was picked up in the street one evening, and carried to the hospital, a temperature of 81½° F. It was 11 o'clock at night. The man was kept warm, and at 1 *a.m.* the rectal temperature was 83° F. He died at 8 *a.m.*; five minutes after death the thermometer rose suddenly to 99° F. This man was not in a state of drunkenness.

Thus, there are persons who, from drunkenness or from some other cause, have their peripheral circulation impeded or abolished; when these persons die, the spasm which hindered their circulation gives way, and the temperature rises again. This fact distinctly depreciates the value of the sign.

In 1878 Dr. Guillemot§ made a study of the same facts in an excellent thesis which has not as yet had very practical results. He proved that the axillary and rectal temperatures did not take the same course: the axillary temperature, which may be regarded as an index of the external or

* Alvarenga, 'Précis de la Thermométrie générale,' 1871, p. 129.

† Wunderlich, *Archiv. der Heilkunde*, tome ii., p. 547.

‡ Bourneville, *Gazette des Hôpitaux*, 1872, p. 32.

§ Guillemot, 'Thèse de 1878.'

surface temperature, falls, while the rectal or central temperature remains the same, or at any rate falls but slowly; at the end of some hours there is a tendency to equalization, and Guillemot has found that it was nearly complete at the end of thirty hours.

We are all familiar with Marey's paradox. A person placed between two others gives one of his hands to each, who may disagree about the temperature of the hands they hold. One of these two persons finds the hand very warm; the other one finds it cold. Which is the one who feels it cold? It is the warm hand which is chilled, and the cold one is warmed. After death the periphery of the body becomes cool, and the cooling is most perceptible in the axilla. When, therefore, owing to the tension of the gas which forms in the abdomen, the blood is driven towards the periphery, this part gets a little warmer; as I have just told you, Guillemot assures us that in thirty hours equilibrium is established between the temperature of the rectum and that of the periphery; I do not of course speak here of the case of corpses exposed to the air out of doors.

On October 28, 1893, M. Bourneville stated, and published with a series of illustrative cases, that the rectal temperature was lower than that of the surface at the end of twelve or fourteen hours. These are hospital observations, extremely interesting and necessary, but which require, in order to obtain their full value, to be compared with observations made elsewhere than in the hospitals. It would be necessary to take another series of persons who die in their own beds; if this second series gave the same results as the first, a certain sign of death would be invented. I am well aware that there are in practice certain material difficulties which would have to be overcome, the nature of which you can readily guess. But I add that this sign must be placed in the front rank; it is only capable of application in the hands of a medical man, and it ought to be resorted to in doubtful cases. Only it will be necessary to take the temperature twice, at an interval of some hours.

Necrometers or thanatometers have been constructed on this principle. They are graduated instruments which

indicate certain death, probable death, etc., according as the column of mercury rises or falls to points fixed beforehand.

These instruments cannot be managed by non-medical persons: it is the same in using them as in taking the temperature of patients; you all know how difficult it is in practice to take a patient's temperature, and how untrustworthy are the figures when it has been taken by the patient himself or by one of his friends.

PARCHMENT PATCHES.—BURNS.

I wish also to say a few words on the search for *parchment patches*. When the epidermis is removed from a greater or less extent of the skin of a dead body, the exposed cutis becomes like parchment in about eight hours, and yields a sharp sound when tapped with a scalpel. This is not an easy sign to obtain except in a hospital, and consequently is not of much practical value.

I shall say as much with regard to *burns*. Stress has often been laid on the difference between burns made during life and those made after death. During life a burn produces a blister surrounded by a reddish areola, and containing an albuminous liquid. When the blister breaks, there is seen beneath it a network of small dilated vessels. Are these phenomena constant during life? Is there always albumen in the serum? No. When an individual dies at the moment he is burnt, blisters are produced, but no congestion. When the explosion occurred in the Rue Béranger, in Paris, Mme. Mathieu perished in an atmosphere the temperature of which exceeded for a moment 3,600° F. The body was blistered all over, but it was impossible to recognise any reddish areola or congestion of the skin, or any albumen in the blisters.* That means, in plain terms, that the individual must have lived longer for these phenomena to be produced.

In the dead body a burn may cause a blister, but it will not form an areola. Let a drop of melted sealing-wax fall on to a limb that has just been amputated, and you will succeed in producing a blister.

* Brouardel, 'Étude médico-légale sur la Combustion du Corps humain' (*Ann. d'Hyg.*, 1878, 2e série, tome l., p. 509).

The test of burning is therefore a doubtful sign, and one against which I would put you on your guard. Consent is readily given to its employment by the public, and burns are made—often very severe ones—by applying heated flat-irons to the heels of dead persons of whose death it is desired to obtain assurance. On the other hand, revulsives sometimes take no effect, even while the individual is still alive; do not the attendants on a patient say, 'Oh, he is dead; the mustard-plasters and blisters do not take any longer!' A sign quite as uncertain is that of M. Marteno of Cordova; he advises us to apply the flame of a candle at the distance of half an inch from the extremity of the fingers or toes; if death is real, the epidermis of that part of the finger exposed to the flame dries up and separates from the cutis; it forms an air-blister, which bursts suddenly with a disengagement of gas which is sometimes strong enough to blow the candle out. This is an elegant experiment to perform in a course of lectures, but it is scarcely conclusive. The explosive blister may also be produced during the last moments of life.

I prefer to use 'Mayor's hammer.' It is an ordinary hammer, which has to be wetted with boiling water, and is then applied, after being dried, to the hollow of the epigastrium. It is an excellent means of reviving a person who has fallen in a state of syncope. The worst that can happen is that it forms a bulla on the place where the hammer touched. This plan may be always tried; but I should not like to popularize Marteno's explosive blister.

What conclusions may be drawn from this exposition?

There exist many excellent signs which enable a medical man to say: 'This man is actually dead.' However little doubt a physician may have, still he ought to make use of the various tests that have been passed under review, and, if need be, to wait and not pronounce an opinion until absolute certainty can be obtained.

But when there is no medical man to verify death, it may happen that persons only apparently dead may be taken to be really dead. It is therefore necessary, on all grounds. to entrust the duty of deciding whether a person is dead or

not to a medical man ; for he alone is capable of estimating the value of the signs, and to make an exact diagnosis, as he would in the case of a disease.

The conclusion to be drawn from all these facts that we have established, Gentlemen, is that the combination of signs of death gives us almost complete certainty of death, if we are physicians, if we have thought the question out, and if we make a diagnosis such as we are not accustomed to make unless we have learnt to do so in the hospitals. But I believe that it is right to remain in a state of philosophic doubt ; we know that apparent death may last for a longer or shorter time, and that in three cases at least (viz., the men who were hanged at Boston and Buda-Pesth, and the woman who was buried, as described by Dr. Roger), persons considered to be dead have been recalled to life. In the German mortuary chambers, some of which have been in existence for more than a century, where every precaution is taken, where every corpse has a bell-rope placed in its hand, only once has the bell been rung . . . the hand of the corpse shook the cord of the bell at the moment when *rigor mortis* passed off, so that the arm fell down.

The verification of death should therefore always be entrusted to a physician, who alone is competent to estimate the value of the different signs that we have just been examining together ; I believe that accidents will then be, if not impossible, at any rate infinitely rare, and I am obliged to add that though there is a great improbability of a living person being buried alive under those conditions in which verification of death is, or rather is not, performed, still, it is impossible to assert that that direful contingency might not happen.

We thus at last arrive at the same conclusions that were formulated by the Academy of Medicine with regard to the competition instituted by the Marquis d'Ourches in 1874.* In short, said the Academy, the signs of death are certain enough to render all mistakes impossible, provided that verification of death by a medical man is made universal throughout the communes of France, and if the medical

* Devergie, *Ann. d'Hyg.*, 2e série, tome xxvii., p. 293.

man has skill enough to make the diagnosis. But we are compelled to acknowledge (1) that in 25,000 out of 36,000 communes (two-thirds of the population) this verification is not performed at all; (2) that this portion of science is too much neglected, and that the attention of medical men is not called with sufficient insistence towards this branch of diagnosis. Dr. Armaingaud* adopts the same conclusions.

* 'Œuvre de l'Enseignement élémentaire,' April, 1893.

LECTURE IV.

RIGOR MORTIS.

GENTLEMEN,—We have to study two other signs of death, *rigidity* and *putrefaction*, which appear at a later period. These two signs are almost incontrovertible.

When we meet with putrefaction, there can no longer be any doubt at all as to the reality of death.

With regard to *rigor mortis* we shall have to make some reserve, just as we did for the cessation of circulation and the fall of temperature. When a person is dead, not much time should be wasted before covering the body with the burial garments. *Rigor mortis*, as all nurses know, would soon make it impossible to put them on.

Is *rigor mortis* a constant sign of death? Louis, who would have thought it a dishonour to medicine to be unable to determine the reality of death, states in one of his memoirs that he found *rigor mortis* in every one of five hundred bodies that he had examined. And yet a great many authors have disputed its constancy.

Haller, who watched by the body of his daughter for forty-eight hours, declared that he could not discover *rigor mortis* in her at any moment. Those who maintain the constancy of the phenomenon have replied as an objection that Haller was not really in a proper mood for observing. Other authors have shown that in still-born children and in the fœtus *rigor mortis* is often wanting. The partisans of its constancy have not failed to give as an explanation of this that rigidity had existed while in the uterus, and that the fœtus had only been expelled when rigidity had passed away.

Bichat, who was a first-class observer, stated that rigidity did not occur in persons suffocated by charcoal. He must have met with cases in which it was really absent, or in which it was so slightly marked as to escape detection. In all the cases of asphyxia by carbonic oxide, or by the fumes of charcoal, as it is commonly called, on which I have been called to pronounce an opinion, I have always found very marked *rigor mortis*.

Bichat had expressed the same opinion about individuals struck dead by lightning. M. Tourdes, who has happened to meet with three cases of death by lightning, has testified to the presence of rigidity in all of them. We may say, then, that *rigor mortis* is a nearly constant phenomenon in adults, but it may be so slightly marked in certain cases as to escape the notice of the most painstaking observer.

When rigidity is complete, the corpse may be moved like a plank; the body takes a characteristic position: the lower limbs are extended, the upper limbs semi-flexed, the hands clenched; this is the attitude which Devergie has called 'the attitude of combat.'

Rigor mortis is often of extreme intensity; it is sometimes impossible to flex the thigh on the pelvis, or to separate the jaws.

Two interesting points must be noted. The rigidity and muscular contraction may be so great that, even without making extension, the muscular fibres are ruptured here and there; it is a tearing of isolated bundles of fibres. When, on the contrary, the limb of a frozen body is forcibly stretched out, ruptures of the muscular tissue are produced likewise, but these are ruptures of larger masses of muscle, of irregular shape. M. Tourdes, in order to measure the intensity of rigidity, introduced discs of stearine between the jaws of persons just dead. When *rigor mortis* became established, the teeth dented the two surfaces of these discs, and often left marks one-eighth to one-fifth of an inch deep. This experiment shows that there is a violent contraction during the production of rigidity.

Murderers sometimes try to take advantage of cadaveric rigidity. They place a knife or a revolver in the hand of the

victim, which is about to close. The magistrate who has to take the first evidence has great difficulty in withdrawing the weapon from the hand stiffened in death; the presumption of suicide appears natural. This is a species of simulation of which it may be useful to forewarn you.

When it is important to know whether the stiffness of a body is due to *rigor mortis*, or to any other cause, the best plan is to attempt to extend the limbs. If rigidity has but recently set in, the extended arm contracts again and returns to its former position. If rigidity is passing away, the arm remains straight and contracts no more. This secondary contraction does not occur in frozen muscles.

At what moment does *rigor mortis* appear? That is an important question for the medical jurist. How many times have I not read with regret this phrase in medico-legal reports: 'Death must have happened within the last five or six hours, because *rigor mortis* has not yet appeared.'

Or this other phrase: 'X—— must have been dead at least twelve or fourteen hours, since *rigor mortis* is present.'

Gentlemen, when we have to do with a corpse, uninvaded as yet by *rigor mortis*, all we can say is that death happened not long ago; it is impossible to fix the time that has elapsed with exactitude.

Nysten asserted that rigidity appeared as soon as the bodily heat had disappeared. This is not correct; it appears much sooner. Niederkorn found that in 103 corpses observed by him it appeared:

			2 hours after death in		2	cases.
From	2 to	4	„	„	45	„
„	4 „	6	„	„	24	„
„	6 „	8	„	„	18	„
„	8 „	10	„	„	11	„
„	10 „	13	„	„	3	„
				Total	103	„

In a general way, therefore, it is from the third to the sixth hour that *rigor mortis* first appears.

Other authors have made interesting remarks. Brown-

Séquard, for example, in 1848, met with rigidity affecting the jaw in a patient suffering from typhoid fever a quarter of an hour before he died. Immediately afterwards it spread over the whole body; but it disappeared at the end of thirty minutes, and did not return.

Gentlemen, when one is performing the experiments of injecting guinea-pigs and rabbits with septic substances, capable of setting up fermentation, *rigor mortis* may be found setting in a quarter of an hour or longer before death. This fact should be borne in mind.

Remember, also, what I told you about persons dying suddenly from injury of the cervical spinal cord; they preserve in their rigidity the attitude they were in at the moment they were struck. I did not give you any explanation of this fact, and will not attempt to do so to-day, either. Lastly, as my own experience has shown, after poisoning by a large dose of strychnine, *rigor mortis* follows immediately upon the phenomena of contracture which existed at the time the patient died.

With regard to the duration of rigidity, we are also obliged to make allowance for different influences. It lasts on an average twenty-four to forty-eight hours. It may, however, last for a few hours only; at other times it persists for five, six, or seven days. Our *data* with reference to this subject are very scanty. We know that in exhausted individuals, such as those dying of cancer or phthisis, *rigor mortis* appears early, but does not last long; on the contrary, in an individual dying while in good health, it appears late and is of long duration. These facts are of importance in forensic medicine. Cadaveric rigidity appears first in the muscles of the lower jaw, then in those of the neck and eyelids, then the lower limbs, and lastly the upper limbs. Too great importance must not be attached to this particular order. The only thing needful to remember is this: that the duration of *rigor mortis* is nearly the same in each of the members invaded; also that the part which was invaded last will keep it last. Experience has taught us that the muscles of the fingers, as a matter of fact, preserve their rigidity latest. It is possible to infer from these facts

an indication, but no positive evidence, of the moment of death.

The muscles of vegetative life are affected like the rest. Rigidity of the muscles of the skin, which is, however, of short duration, gives to this structure the appearance of *cutis anserina*. Rigidity of the *dartos* is very plain. I do not know what made Casper assert that retraction of the *dartos* took place only in those who have been drowned ; nothing is further from the truth.

The muscles of the intestinal walls may present a certain degree of rigidity. That of the *vesiculæ seminales* is constant and early. Half an hour after the execution of the anarchist Henry, the two vesicles were as hard as small chestnuts. Their contraction induces the expulsion of the spermatic fluid which they contain. When the individual has died in good health, the spermatozoa contained in the expelled semen may retain their movements for twenty-four hours.

The muscle of the heart does not escape rigidity. Gentlemen, all the treatises on medical jurisprudence contain regrettable errors on this subject. The results of experiments conducted in the laboratory have been falsely applied to the results of medico-legal autopsies. It has been attempted to compare the facts of experience with the results of ingenious experiments.

In a laboratory, an animal is killed by means of some toxic substance or other, the body is immediately opened, and it is found that the heart is either in systole or diastole. In a singularly inconsequent way, medical jurists have attempted to make this same procedure apply to the human corpse, and have claimed that they can determine, according as the heart is in systole or diastole, whether there has been poisoning by any given substance. But an autopsy is never performed immediately after death, especially in medico-legal cases. When there is a question of poisoning, the time which elapses between the decease and the *post-mortem* examination far exceeds twenty-four or forty-eight hours. A suspicious death gives rise, as a matter of fact, to rumours that are more or less definite. The attention of the public prosecutor is drawn to the matter, but he cannot

intervene at once. He has to obtain evidence before putting the law in motion. The autopsy does not take place, in nine cases out of ten, for three weeks, or sometimes a year or more, after death occurred. When the medical jurist endeavours, therefore, to draw decided conclusions from laboratory experiments, he makes a mistake.

When an individual dies, the heart is sometimes in a state of rigidity. That of the anarchist Henry was in a state of absolute rigidity half an hour after his execution. It is then in systole. When the rigidity has passed away, it is in diastole. In an autopsy which I performed, in conjunction with M. Vibert, eight hours after death, the heart was in complete rigidity. When rigidity seizes the cardiac muscle, this contracts, and expels the blood which is within its cavities. As soon as the rigidity is gone, it is filled afresh, because it has become distensible.

Refer to the trial of La Pommerais.* Physiologists and physicians were called to give evidence at the Assize Court. The president put this question to them: 'When a person dies from poisoning by digitalis, what appearances does the heart present?' Claude Bernard, Vulpian, H. Bouley, and others, did not agree. None of them made any allusion to the normal rigidity of the heart muscle. You know the facts of that notorious case. Mme. de Paw was ill. One evening Dr. Blachez returned home; his hall-porter and the porter from a neighbouring house told him that a woman was dying in the house opposite, and begged him to go and attend to her. Dr. Blachez, after some hesitation, decided to go upstairs to see the patient. He saw her, came downstairs again, and went to find a police officer, to whom he communicated his opinion that this woman was dying from poisoning by digitalis. It is possible that he took into account, in making his diagnosis, certain information that was supplied to him by those in attendance on the patient. Thus, a formal deposition had been made before a magistrate, which is very rare. It was known, besides, that

* Tardieu, 'Relation médico-légale de l'Affaire Couty de la Pommerais, empoisonnement par la Digitaline' (*Ann. d'Hyg.*, 1864, tome xxii., p. 80).

Mme. de Paw was the mistress of a medical man, La Pommerais, who had effected an insurance on her life some months before. The law took up the case then with exceptional rapidity. A *post-mortem* was made twenty hours after death, and the heart was found contracted rigidly in systole.

Many animals die with the heart in systole, even without having been poisoned by digitalis. It is the same with animals into which suspected products obtained from corpses have been injected. In the discussion which followed, M. Hébert, head dispenser of the Hôtel-Dieu, made the remark that frogs and rabbits into which a maceration of scrapings of the floor had been injected, died with the heart in systole likewise. This experiment of M. Hébert is not understood yet. Gentlemen, it contains the germ of the recent researches on ptomaines. La Pommerais was found guilty. I am convinced that he was so; but the scientific discussions which took place during his trial prove once again with what reserve we ought to make our affirmations before the magistrate. The heart behaves after death like an ordinary muscle; it undergoes *rigor mortis*. This rigidity ceases after a certain time; but it is quite impossible for us to assert what its duration is.

It often happens that the magistrate will ask you how long it is since death occurred. This is a very important question, for it may serve to assign responsibility. Never say in your reports, as I have seen done, alas! too often: '*Rigor mortis* is complete, therefore death took place five hours ago.' You can say, if rigidity is complete, that death is recent, but it is difficult to say any more; and in support of your assertion you can refer to Niederkorn's table. The conditions have been studied which affect the development of *rigor mortis*. When it is cold, it is said rigidity appears late and is prolonged; with heat it is, on the contrary, early and brief. Such is the formula which you will find in books and treatises; it is properly contradicted by Brown-Séquard. Claude Bernard, who was not satisfied with words, placed rabbits in chambers heated to 77° F. Rigidity appeared slowly, and was prolonged for more than forty-eight hours.

Claude Bernard's experiments* are thus in apparent contradiction to everyday experience. We shall find the explanation when we come to study sunstroke and heat-stroke.

Practical experience shows us that in the *post-mortem* theatre, with a warm and moist atmosphere, rigidity is early and short. I admit the truth of this general statement, but I do not dispute Claude Bernard's experiments. When a dog dies in consequence of sunstroke, it is already in a state of rigidity, even while it still breathes. It dies when the heart stops, and this organ becomes rigid immediately. M. Vallin† relates that when he was in Algeria he opened the bodies of dogs dying from this cause, and that their hearts yielded a sound when cut like that of a piece of wood. When people die from sunstroke in India, or even in Europe—for example, in the case of troops who go into a wood to rest, where the air is hot and close—rigidity appears very late.

In the face of these contradictory results, we must conclude that other factors are concerned, which we already suspect, and which I will indicate to you directly. Devergie had a formula concerning the duration of *rigor mortis* which I must repeat to you. He said: Winter and summer alike, the figure remains the same; only in winter it stands for days, in summer for hours.' Remember this formula, but do not apply it too rigorously.

Rigor mortis may be produced experimentally in a muscle by loading it with a weight. Take a dog that has just been killed, and hang a weight to one of its paws: rigidity will appear sooner in that paw than in the others.

When animals are fatigued, rigidity appears with rapidity. It is often noticed in hunting, and in cock-fights where the animal is exhausted, that rigidity follows immediately upon death. Some sportsmen maintain that the driven animal stops stiffened in death. Thus, in overwork rigidity is precocious and brief, and it may be added that putrefaction follows quickly.

* Claude Bernard, 'Leçons sur la Chaleur animale.' Paris, 1876.

† Vallin, *Archives de Médecine.*

I believe that *rigor mortis* can teach us nothing of scientific value in cases of poisoning. The results of different observations do not agree, and they vary of course according to the poison that is used, its dose, and the accompanying circumstances. We have seen that in poisoning by a large dose of strychnine rigidity may be immediate; but when the dose of strychnine absorbed has not produced death speedily, but has caused a succession of convulsive attacks, with more or less well-marked intervals of quiescence, and the individual dies during one of these periods of calm, *rigor mortis* does not take place. It would seem that in such cases the muscles had spent all their force in convulsions. Well-contrived experiments could alone give us the key to these variations.

Laennec states that rigidity lasts a long while in cases of sudden death. You will see in the course of these lectures that the causes of sudden death are too numerous to permit us to accept this formula. In paralysed persons it is more marked in the paralysed than in the healthy muscles. In childhood and old age, rigidity would appear earlier and last longer (Louis).

What is *rigor mortis*, then? What is its nature? I will not say anything about the discussions to which these questions gave rise in bygone times. Amongst our contemporaries, Kühne of Heidelberg, a former assistant of Claude Bernard, believes that rigidity is due to the coagulation of myosin, an albuminous substance contained in the muscular tissue. Brown-Séquard has raised objections to this theory on the ground that the coagulation of an albuminoid substance, however complete it might be, could not produce in the contracted muscle a rigidity equal to that of *rigor mortis*.

MM. Tourdes and Feltz have examined microscopically muscles in the state of rigidity, but they have found nothing which distinguishes them from others. Some observers have shown that muscles present an acid reaction during rigidity (lactic acid had already been detected in the muscles of over-worked or over-driven animals); the conclusion has been drawn that the production of rigidity is due to the

transformation of alkaline substances in the muscle into acids; but Achtakaweski has proved that in tetanus the muscles are not acid, and that the injection of an alkali into the muscular tissue does not prevent rigidity.

Béclard tied all the vessels of a limb, and made the posthumous circulation, of which I have spoken to you, impossible, yet rigidity takes place all the same; moreover, the nerves have been divided, and rigidity appears nevertheless.

M. Achtakaweski has shown that muscles in tetanic contraction had no acid reaction; M. Laborde has reached the same conclusion by thrusting steel needles into muscles in a state of rigidity; these needles did not become oxidized, although they did so rapidly under the same conditions during life. Brown-Séquard removed the spinal cord from an animal, and found that rigidity was not produced in such a case. He has drawn from this experiment, which I have not repeated, conclusions which absolutely contradict those of Béclard; is not division of all the nerves equivalent *a priori* to removal of the spinal cord?

Rigor mortis is probably only one of the first phenomena of putrefaction, not as regards the sense of smell, but as regards the chemical processes which cause the muscles to contract. Herzen* has proved that there is found in the muscular tissue of a dead animal an acid which he calls 'sarcolactic acid'; it is to the action of this that he attributes muscular contraction. By injecting some drops of this acid into the muscles of dead animals he caused *rigor mortis* to appear in cases which had not as yet exhibited it.

To sum up, we may conclude that *rigor mortis* is an almost constant sign of death, that it manifests itself in from three to five hours after death, that it lasts on an average twenty-four to thirty-six hours, and that it sometimes is present in an extreme degree of intensity. But the actual *data* of science do not allow us, from a medico-legal point of view, to deduce any positive conclusion. The mode of production and the causes of rigidity are still almost unknown to us; it is probable, however, that the muscular tissue is invaded after death by micro-organisms, to the secretions of which rigidity is due.

* Herzen, *Semaine médicale*, 1886.

LECTURE V.

PUTREFACTION.

GENTLEMEN,—The study of putrefaction is of great importance in forensic medicine. It is caused by the persistence of the chemical phenomena which take place in the human body after death ; its effect is to alter to a singular degree the appearances of the lesions resulting from disease or from wounds.

It produces alterations in the colour, and transports the blood into regions of the body which were not at all congested during life. There are, then, sources of fallacy for those medical men who are not accustomed to make autopsies, and which we must take pains to explain.

Lastly, we may be able, thanks to what we know to-day of the phenomena of putrefaction, to say to the magistrate : ' The individual, whose body you have laid before me, died at such and such a time.' The observations of M. Mégnin, who has carefully studied the insects which prey on dead bodies, and which he has picturesquely styled ' the labourers of Death,' sometimes allow us to fix the dates with almost mathematical exactitude.

GENERAL THEORY.

From a theoretical point of view, the study of putrefaction is based on the well-known experiments of M. Pasteur. It is he who has actually proved to us the non-existence of spontaneous generation, which F. A. Pouchet, of Rouen, maintained with much authority. M. Pasteur experimented

on blood and urine, *i.e.*, the most fermentible or putrescible of organic liquids. He obtained them from the veins and the bladder, quite out of contact with the air, by means of pipettes that had been passed through the flame of a lamp and then hermetically sealed. These liquids might be preserved for an indefinite time without ever becoming tainted by putrefaction. M. Pasteur's experiments date from 1854, yet the tubes containing blood and urine, which he took from the animals forty years ago, still exist in his laboratory, and their contents have undergone no change. We are authorized to say, therefore, that organic material derived from a healthy animal, so long as it is sheltered from the air, does not putrefy.

Gentlemen, when an individual dies, putrefaction may affect his body in different ways, according as it takes place in the open air, underground, in the water, or in a privy.

In order to give an account to you of the phenomena which follow when putrefaction occurs in the open air, let us first see what takes place in a blood-clot which has been obtained by venesection. The clot contracts, and soon becomes greenish on the surface. Take a drop of this clot and examine it. You will find in it micro-organisms which will have the effect of liquefying the clot progressively from the outside to the interior; you will find evidence of the existence of colonies of micro-organisms, only able to live in the presence of oxygen, which are called aerobic. These aerobic organisms produce carbonic acid, and then they disappear. They are replaced by a second colony of micro-organisms, able to live either with or without oxygen, *i.e.*, aerobic or anaerobic, and to which M. Bordas, who has written a masterly thesis* on the subject, calls 'amphibious' (*facultatifs*); these also produce carbonic acid, but hydrogen and hydrocarbons as well. Lastly, there comes another category of micro-organisms, the anaerobic class, which do not live in oxygen, and which produce hydrogen, nitrogen, and more or less compound ammonias. Remember this triple evolution; we shall often refer to it subsequently.

How do these organisms disappear? They nearly all

* Bordas, 'Putrefaction,' 1892.

secrete a substance in the presence of which they are unable to live. Then they disappear, and are replaced by other colonies, which again are aerobic. The destruction of the organic substance itself is hastened, moreover, by fungi, and the different species of insects which have invaded it.

If it were desired to comprise the phenomena of putrefaction in a general formula, it might be said that these processes constitute the return of organic matter to inorganic matter, to the mineral kingdom. The aerobic, amphibious, and anaerobic micro-organisms produce carbonic acid, hydrogen, nitrogen, and amines. The quaternary or nitrogenized matters have a manifest tendency to be transformed into ternary or fatty substances, and these tend to return to binary compounds. Place a corpse in the water, and by the end of a certain time you will find that it has undergone a fatty degeneration. If its sojourn in the water is prolonged, the body will assume the appearance of a mummy, because it will have borrowed from the water part of its mineral constituents.

Daily experience in the laboratory has for a long while familiarized us with certain facts which may appear singular: everyone who has occupied himself with bacteriology knows that according to the *media* the colonies do or do not multiply; it is enough to alter the conditions of the soil, sometimes in the most insignificant way, in order to put a stop to the proliferation of the bacilli.

When these facts are known, it can be readily imagined that there may be considerable variations in the phenomena of putrefaction, according to the temperature, and according to the nature of the medium in which the organism is undergoing putrefaction. Let us take an everyday example: If we watch what goes on in a piece of meat exposed to the open air, we shall see aerobic and amphibious micro-organisms appear on the cut surface, and these will penetrate by degrees into the interior of the meat; then the aerobic organisms disappear; the amphibious and the anaerobic organisms secrete diastase, which soaks into the meat and liquefies it, and putrefaction becomes established. If, on the contrary, we place the meat *in vacuo* under a bell-glass

in which there is a capsule containing sulphuric acid, it will be preserved for a very long time, for it is withdrawn from the contact and influence of the external air.

PUTREFACTION IN THE OPEN AIR.

When the body of an adult putrefies in the open air, it is very evident that the micro-organisms contained in the atmosphere, which settle on the epidermis, can penetrate through this and commence the work of putrefaction. Nevertheless, the epidermis resists their entrance for a long time, always much longer than the epithelium placed at the natural orifices.

It is through the alimentary canal that putrefaction chiefly takes place.

M. Duclaux, who has paid much attention to the vibrios of the intestines, has succeeded in determining the part they play in putrefaction. At death they swarm; they penetrate into the intestinal glands, come into contact with dead epithelium, which they destroy, find their way into the veins and peritoneum, and produce gases there, and secrete diastase which liquefies the tissues. What is the consequence of this formation of gas and diastase? The quantity of gas produced is considerable; its tension is sometimes equal to that of 1½ atmospheres; it also pushes up the diaphragm to the third intercostal space, and drives the liquid contained in the deep vessels towards the periphery; that is what I have called the posthumous circulation, which I have already mentioned to you.

Putrefaction is, therefore, especially a function of the processes which take place in the intestines.

Have these facts any bearing on forensic medicine? Certainly. I have quoted once before the case of Barré and Lébiez. These two individuals, as you know, had murdered a milk-woman in the Rue d'Hauteville. Lébiez cut off both the thighs of the victim, and concealed them in a cupboard in his room in the Rue de Poliveau, near the Salpêtrière; the trunk of the body was found at Le Mans. MM. G. Bergeron, Delens, Tillaux, and Farabœuf were consulted by

the magistrate, and all thought that the thighs, when they saw them, had been but recently removed; they had not even begun to putrefy.

Gentlemen, it was more than a week after the murder had been committed. Barré and Lébiez had separated the thighs before the micro-organisms of the intestines had had time to act; we are therefore authorized to say that the rapidity of putrefaction is in direct proportion to that with which the gases of the intestines circulate in the organism.

When we have to do with a new-born child, who has swallowed nothing, do we find the course of events to be the same? According to the experiments of MM. Ogier and Bordas, the course of putrefaction does not follow the same rules in still-born infants as in adults; the still-born infant has not breathed. On the contrary, in a child who has breathed, and who dies twenty-four hours after coming into the world, the phenomena of putrefaction are closely similar to those which are seen in the adult.

There are also some accessory phenomena. Our tissues contain oxygen, and the quantity of oxygen favours the development of the first (aerobic) colony.

But when a person dies suffocated by carbonic oxide, his tissues no longer contain much oxygen, and this first colony will have great difficulty in gaining a foothold. And thus we sometimes find in these particular cases astonishing phenomena of preservation.

Here is an example: An individual hired a room with an adjoining dark closet, and suffocated himself in that closet. The owner of the house was not very much astonished at the disappearance of his lodger; but, seeing that he did not return, he decided to let the room anew, after giving it a thorough cleaning. The new lodger went into the little closet on the night of his arrival, and found there the body of his predecessor.

Death had taken place two months previously, and yet the body did not present any trace of putrefaction. It is true that it was winter, and that the temperature of the closet had always been low.

The phenomena of putrefaction vary also, according to

whether or not there was food in the stomach at the time of death; and in cemeteries they are different, according as the body has been placed in a badly-closed coffin placed in loose soil, or in a tightly-closed coffin deposited in a moist soil; they differ also according as the corpse is placed in a lead coffin or in one of wood.

Gentlemen, at the Morgue the bodies are sometimes swollen with gas, especially in the months of May and June. The bodies of the drowned present these phenomena particularly; the swelling and distension may be extreme.

When these gases are diffused abroad they create an abominable smell. To avoid this infection of the atmosphere, I prick the bodies to let the gases escape; then I set light to them at the pricks, and long bluish flames start forth, like those of a blowpipe. After a time they are extinguished, either because the tiny orifices become blocked, or because there is no more inflammable gas.

When putrefaction is more advanced, and there is no further distension, the gas does not take fire; in summer they may be lighted at the end of the first day, and burn for two, three, or four days. Then the combustibility of the gases ceases.

What has happened, then? It is very simple, Gentlemen. At the beginning of putrefaction we have the aerobic colonies, which produce carbonic acid chiefly; their period corresponds to the phase of uninflammability of the gas; then come the anaerobic and amphibious colonies of M. Bordas, which produce hydrogen, carbonic acid, and hydrocarbons, which are mostly inflammable; finally, the reduction becomes more and more complete, and gives rise to nitrogen, hydrogen, and compound ammonias, the greater part being incombustible.

Thus we meet in the *post-mortem* theatre with the three clearly defined phases which we have already distinguished in bacteriology.

I ought to call your attention, while dealing with these inflammable gases, to the possibility of the formation of phosphoretted hydrogen. Before the time when refrigerating apparatus were employed at the Morgue, that is

to say, prior to 1882, phosphorescence was often noticed there, especially in warm weather, Will-o'-the-wisps which ran over and around the bodies. It was a very impressive spectacle.

The development of the gases, and the tension which they cause in the interior of the body, place the medico-legal expert in a very difficult position when he wishes to discover the existence of lesions which have preceded death, or those which have immediately followed it. The colouring matter of the blood abounds in the corpuscles, stains the serum, and passes through the vessels and diffuses itself in the adjacent tissues: hence arise those spots on the mucous membrane of the stomach which have been taken as evidence of poisoning, and that infiltration of the posterior parts of the body which has been taken for ecchymosis.

I have already said something of the liquefaction of the blood; I have spoken to you of what was called in the Middle Ages 'the judgment of God.' The following example will suffice to put you on your guard against a fallacy of the importance of which I need not remind you.

A corpse was found in the river Gave at Lourdes; it was carried into a shed; the hour was 11 o'clock *a.m.*, and the weather was very warm. The medical man who examined the body noticed some wounds on the head, which he thought were caused by stones rolled down by the torrent. The public prosecutor was notified of the case, and the law was put in motion; some hours had passed since the first observations were made.

From each of the wounds of the head there now flowed a little liquid blood, and the physician who accompanied the officers of the court concluded that these wounds were recent. Investigation showed, on the contrary, that the man had thrown himself into the Gave (it turned out to be a case of suicide) the morning before, and that he had been taken out of the water twenty-four hours after death.

The flow of blood was due to the posthumous circulation induced by the formation and accumulation of gas in the abdominal cavity. This development took place only after the removal of the body from the cold waters of the Gave.

When there is no wound by which the blood can escape, a tolerably well-marked congestion is produced in all the peripheral parts. Devergie, formerly a pupil of Bichat, who remained faithful to his master's theories to the very last, has accumulated a large number of medico-legal cases. In the introduction accompanying those dealing with submersion, he says that when a man is drowned he dies either by the brain, by the lungs, or by the heart. Devergie has included in the category of those who died from cerebral congestion all the drowned in whom there was this post-humous circulation, and yet Devergie was a scientific man and a very learned and conscientious observer.

PUTREFACTION IN DIFFERENT *MEDIA*.

When putrefaction takes place in the ground, the epidermis becomes covered with blebs, filled with bloody serum, just as in putrefaction in the air; then the epidermis separates in flakes; the grave-diggers sometimes think that they hear a noise in the grave three weeks after burial; this noise is due to the bursting of the abdominal wall when distended by gas. The tension of the gas in the intestines would not in itself be sufficient to lead to the bursting of the belly, if the micro-organisms had not already liquefied the tissues, and so diminished their resistance.

When the body putrefies in the water, the first green patch which appears does not show itself in the region of the cæcum, as it does when the body putrefies in the open air, but over the sternum; I cannot explain to you the cause of this variation. It is much more important to know that, in spite of the difference of the *medium*, the phenomena of putrefaction, as far as the production of gases and their order of succession are concerned, are nearly the same, since these phenomena are determined by what takes place in the intestines. Only, as the body sooner acquires the surrounding temperature in the water, the phenomena of putrefaction will be hastened or retarded according as the water is warm or cold. Devergie was accustomed to say that in summer a corpse took as many hours to putrefy in the water as it took days in the open air.

Hofmann estimates that putrefaction is twice as rapid in air as in water.

It may be conveniently remarked here that during submersion the water penetrates abundantly into the blood,* that this coagulates but little or not at all, and that the phenomena of posthumous circulation are found at their *maximum* in the bodies of the drowned; also, when the bodies of the drowned are withdrawn from the water, putrefaction takes place with extreme rapidity.

Bodies more frequently undergo transformation into fatty matter in the water than in the open air; this transformation is sometimes complete by the end of five or six months. If it had remained exposed in the open air, the corpse might have been putrefied before so long a time had elapsed; if it had been placed in the earth, it would be necessary to take into consideration the state of the coffin and of the soil; putrefaction might be hastened or retarded thereby. In the water the phenomena of putrefaction follow the same evolutionary course as those of fermentation within the intestines. The Fenayrou case affords a demonstration of this. A druggist named Aubert was murdered in the country by a husband and wife of the name of Fenayrou, assisted by their brother. To get rid of the corpse, they threw it into the Seine, after having enclosed it in a piece of lead pipe. They hoped that thus it would stay at the bottom of the water. Three days afterwards Aubert floated, though still enclosed in the lead pipe.

An enormous quantity of lead would have been requisite to prevent a body from rising to the surface; the only means of keeping it at the bottom would be to open the abdomen and perforate the intestines; in this way the gases would escape as soon as they are produced.

It happens often enough, Gentlemen, that the medico-legal expert is called upon to investigate putrefaction in bodies that have been thrown into a privy; the bodies of new-born children are very often thus met with, though it would be scarcely possible to find records of seven or eight such cases in adults.

* Brouardel and Vibert, *Ann. d'Hyg.*, 3e série, tome iv., p. 452.

When the privy is badly ventilated, and the air is only renewed with difficulty, and when nothing is cast in except urine and fæces, the phenomena of putrefaction go on slowly therein. Bodies buried in a thick layer of such matter are sometimes taken out, at the end of five or six months, intact, without presenting any sign of decomposition whatever; the colonies of microbes seem to have been failures; these facts have been observed especially in new-born infants. But when a good current of air passes through the cesspool, and plenty of water, especially soapy water, is thrown in; when the seat, as is often the case in the country, is pierced with several holes, which consequently allow a free influx of air, putrefaction follows the same course as in the water or the open air. Remember this fact simply: that in certain conditions putrefaction may be retarded, and that Tardieu managed to detect in the body of a new-born child that had lain in a cesspool for three months, spots of ecchymosis on the pleura and pericardium, spots which have been called 'Tardieu's spots,' and which prove, according to him, that death took place by suffocation. The little body was not putrefied.

CADAVERIC ALKALOIDS.

Gentlemen, during the time that putrefaction is taking place, a certain number of toxic products—cadaveric alkaloids—are produced in the interior of the organism.

The first medico-legal researches were made by Selmi of Boulogne, with regard to the supposed poisoning of a General. The medico-legal expert had concluded that there had been poisoning by delphinine. Selmi repeated the experiments, and found that it was sufficient to allow meat to putrefy in the open air in order to obtain from it this supposed delphinine. He pursued his investigations and isolated some other alkaloids; these are very volatile, and consequently there is some danger that they may be absorbed in respiration. In 1872, M. Armand Gautier, studying with quite a different object, and merely as a chemical question, the decomposition of albuminoid matters, had already shown that that decomposition gave rise to toxic substances.

I myself witnessed the following occurrence in conjunction with M. Boutmy, and I was absolutely ignorant at the time of M. Arm. Gautier's experiments:

A woman who sold poultry in the market, having a stuffed hen-turkey that had not been sold, and which she feared would be spoilt, invited her friends and relations to eat it with her. Twelve persons partook of that repast, and no one noticed any peculiar smell or flavour about the turkey. The woman herself, who had not eaten more than her guests, was taken ill in the night and died. Her guests also became ill, but none of them died.

We were appointed by the magistrate to make an investigation. We found in the stuffing inside the turkey a product analogous to conicine, and we met with the same product in the viscera of the dead woman.

I repeat that this woman had not eaten more of the turkey than the rest, but at the autopsy we discovered that the kidneys were diseased, and unable to eliminate the toxines.

Those alkaloids which are found in the body after death are called *ptomaines;* those which are generated in the body before death are called *leucomaines*, and have been described by M. Gautier.

In former times, Gentlemen, when people were taken ill after having swallowed any articles of food, the cooking utensils were always blamed; the copper saucepans were badly tinned, and the acetate of copper set at liberty during the preparation of the food was said to be the culpable agent.

It is a curious fact that this idea of poisoning by copper owes its origin to Jean Jacques Rousseau. You know how fashionable his ideas were for a certain period; you know the infatuation they created. It is not very wonderful, therefore, that the opinions he professed on the injuriousness of copper should have gained acceptance. Nevertheless, it has been forgotten that the ancients did their cooking in copper vessels. The tinning of copper saucepans was only introduced, into the West of Europe at any rate, by the gipsies, who were the first to line the interior of copper

vessels with tin more or less pure. Lastly, at all times, and even to-day, certain culinary preparations are only made in untinned pans. Such is the case with preserves, which have never poisoned anybody yet, and yet which are capable—for example, when preserves of currants are being made—of producing soluble salts of copper.

We know now that copper utensils are quite harmless so long as they are kept in good order.

When the writings of MM. Selmi, Armand Gautier, Boutmy, and myself, had been published,* a German named Brieger made a very complete study of ptomaines. He divided them into two classes : the first in which neurine predominates, and whose action is convulsive ; the second in which other substances are more abundant, and which have a narcotic action.

The important point to remember about this classification is that certain ptomaines come into existence at the same time that the inflammable gases of which I was lately speaking to you are formed, and that these ptomaines produce exactly the same effects as strychnine and its salts. This identity may become a source of fallacy, against which you ought to be on your guard.

A second point, not less important to grasp, is that certain toxic alkaloids, to which M. Gautier has given the name of leucomaines, may be developed during life in the course of certain maladies. Here are some examples :

In 1881, when the cholera epidemic raged in Paris, M. Gabriel Pouchet had arranged a series of experiments on the urine and dejecta of cholera patients. He had succeeded in extracting from these organic substances a certain number of alkaloids, which Vulpian brought before the Institute in his name. At the very moment when M. Pouchet had enclosed the products of his experiments in hermetically sealed tubes to be forwarded to Vulpian, he himself felt indisposed, and became very ill. He had dilatation of the

* Brouardel and Boutmy, 'Sur le Développement des Alcaloïdes cadavériques, Ptomaïnes' (*Ann. d'Hyg.*, 1880) ; 'Des Ptomaïnes, Reactif propre à les distinguer des Alcaloïdes végétaux' (*Ann. d'Hyg.*, 1880) ; 'Conditions du Développement des Ptomaïnes' (*Ann. d'Hyg.*, 1881).

pupils, suppression of urine, aphonia, cramps in the extremities, and, in a word, all the symptoms of cholera except vomiting and diarrhœa. He had been poisoned by the products manufactured in his own laboratory by those alkaloids which he had isolated, and which are very volatile, and not by any substances developed in the intestines. When he became convalescent he had albuminuria and glycosuria, just like patients recovering from cholera.

This is not the whole of the story, Gentlemen, for when M. Pouchet returned to his laboratory, he asked what had become of his assistant and laboratory servant. He was told that both had been suffering from the same sort of illness that he had. Like him, they had been poisoned by the extremely volatile products extracted from cholera dejecta.

There exists a certain class of lunatics, those who suffer from melancholia, who scarcely ever have their bowels moved; their temperature is subnormal, their extremities cyanotic, and their life extremely sluggish, almost vegetative. Their urine contains a considerable quantity of alkaloids.

I will not pursue this subject further, Gentlemen; I only want you to appreciate that there is from the point of view of the future study of mental alienation a very interesting suggestion contained herein, which you will do well to bear in mind, and even to grasp thoroughly.

Here is another case. A druggist, who does not wish his name to be made public, married. During his wedding night, his young wife had an epileptic seizure: the attacks recurred. The husband analysed his wife's urine before, during and after the attacks; when the attack was coming on, the urine always contained an enormous quantity of ptomaines or leucomaines.

Finally, Gentlemen, the existence of these alkaloids has been demonstrated in various kinds of spirits, and not only in those spirits derived from grain, potatoes, etc., whose quality leaves something to be desired, but even in brandy distilled from fruit or grapes. You have heard mention made more than once in medical jurisprudence of cases of poisoning by ingestion of pork in various forms or of tainted

meat. There is something peculiar about these fatalities: wherever they have been observed, whether in France, England, Austria, Belgium, Germany, etc., they take place chiefly from April 15th to June 1st, and from September 1st to October 12th.

How is the production of these accidents to be explained? In certain towns of the North, the working classes are accustomed to eat at their evening meal meat in the form of sausage spread on bread. One day at Lille seventy persons fell ill, and seven or eight of them died, after having eaten some pork that was all bought at the same pork-butcher's. The symptoms observed resembled those of cholera.

Being sent to Lille on a commission of inquiry, I noted in all the patients whom I visited—and there were about fifty of them—dilatation of the pupils, headache, some digestive derangement and extreme prostration. The investigation revealed the following facts: Two pork-butchers had purchased a pig, but whereas the customers of one all fell ill after eating sausages made of the flesh of one half of the carcass, the customers of the other remained absolutely free from anything of the sort. It could not therefore be the previous condition of the pig that was to blame; the shop, the stall, and the workshop of the butcher were clean and in good order. It was necessary to search further. The pig had been killed on a Friday, a day on which the pork-butchers' shops are closed at Lille. The meat had been exposed for sale on Saturday, May 19th, and Sunday, May 20th, and none of the buyers suffered at all. Those, however, who bought sausages on Monday and Tuesday (May 21st and 22nd) were all taken ill, and four of them died. The law interfered, and the sausage-meat was withdrawn from sale on the Wednesday. On that day and the day following the pork-butcher, not wishing to lose his goods, fed himself and his household on the remains of the pork, and no mishap followed.

We find identical facts in a case related by an Irish physician; instead of sausage-meat, pork-pies were in question, but the events occurred in absolutely the same fashion.

The fact is, Gentlemen, that the toxic alkaloids only exist for one or two days (they were not as yet formed on the Saturday and Sunday, and had quite disappeared on the Wednesday and Thursday); there is a temporary virulence; they in no way modify the odour or aspect of the meat, and nothing can reveal to the inspector the existence of any fermentation.

Facts like those which took place at Lille are not rare, and epidemics caused by ptomaine-poisoning, which have lasted only a week or ten days, have been described more than once under the name of epidemics of cholera or typhoid fever.

These alkaloids may be produced before death in animals as well as in man. H. Bouley brought this fact to light some years ago in a medico-legal report. The question arose in a case in which a butcher was accused of having poisoned several people to whom he had sold the meat of a heifer which had formerly been in an unhealthy condition. The facts were that the butcher had bought a heifer; it escaped, had been chased, and died, having been overdriven by dogs. The butcher cut up the carcass, and twenty or thirty of his customers who bought portions of it fell ill. There had been a production of toxic alkaloids during life, by means of the overwork and exhaustion of the beast.

From the point of view with which forensic medicine is concerned, the detection of these alkaloids is extremely difficult. It is actually very difficult to be quite certain whether the poison that we discover is one that has been administered with the intention of killing, or a ptomaine that has been developed in the course of putrefaction. You shall judge for yourselves by the following case: A merchant of stout build, who lived in Paris, bought some colchicine; his wife died shortly afterwards; a foreman who had bought the colchicine on his employer's behalf let it be known that he had done so, and people began to chatter; the coincidence appeared all the more striking inasmuch as the widower started on a journey soon after the burial of his wife, taking with him the chief female assistant in his

shop. The law was set in motion, and the body was ordered to be exhumed.

MM. Gabriel Pouchet, Ogier, and I* were charged with the investigation. You know that the tests for colchicine are colour tests; those which we obtained in this case were distinctly those of colchicine, but we did not dare to conclude that poisoning had taken place, because we were afraid that the reactions of ptomaines, which we did not know much about, might be identical, and their presence in the viscera was possible.

A fresh inquiry was ordered, and M. Schutzenberger was appointed to join us. We had only used one half of the viscera of Mme. X. in our previous analysis. The other half had been placed in jars and carefully preserved. At the time of the first investigation we had had taken to the Morgue the viscera of a body which had died about the same time as Mme. X.; these were preserved in jars also. We started afresh with our analysis, first on the viscera of Mme. X. which remained, then on those of the other body at the Morgue, as a control experiment. The colour phenomena were identical in both. We had acted quite rightly, therefore, in reserving our conclusions, and in not affirming the case to be one of poisoning by colchicine, although we had obtained the proper colour reactions.

Also, Gentlemen, believe what I say: when, in the course of investigating a case, a chemist brings you colour reactions and nothing more, to demonstrate the presence of the poison that is being looked for, do not be convinced thereby; there exist perhaps a thousand ptomaines, though we know of only a dozen. The actual state of our knowledge does not give us the right to be positive; it rather imposes on us the duty of being cautious.

PUTREFACTION OF DIFFERENT ORGANS.

We are now going to examine the progress of putrefaction in particular organs:

The eye undergoes changes that are very important to

* Brouardel, 'Accusation d'Intoxication par la Colchicine: Affaire R., acquittement, Rélation médico-légale' (*Ann. d'Hyg.*, 1886).

know. The patch on the sclerotic, described by Larcher, which I have already mentioned to you, appears first; then the eyeball shrinks; the cornea and sclerotic become wrinkled; the colour of the iris may generally be distinguished for twelve days or so during the intermediate seasons (spring and autumn); then the contents of the eye escape at the end of two or three months. This last-mentioned period appears to me somewhat longer than is generally the case.

A reddish froth escapes from the mouth and nostrils, soiling the face. We have already spoken of the green patch which appears on the skin over the region of the iliac fossa, and the bullæ of sanious reddish fluid into which the epidermis is raised. In putrefaction in the open air the nails become loose about the twentieth day.

When the lungs of an adult begin to putrefy, their anterior and lateral surfaces become covered with blebs of gas; this is the rule. The lungs of an infant which has not breathed are never covered with blebs of gas; putrefaction proceeds in them quite in a different fashion to that in adults; it seems to be necessary for the external air, or the blood of the intestines, to bring the germs of putrefaction into the alveoli in order that they should putrefy, according to the rules which we know.

The posterior parts of the lungs are the seat of well-marked hypostatic congestion. The colouring matter of the blood invades the whole parenchyma, then a certain quantity of serum, coloured by the same material, is effused into the pleural cavities.

The ciliated epithelium of the trachea retains its vibratile movements for twenty-six to thirty hours (Gosselin).

The liver changes into an alveolar mass filled with gas; when a slice of it is thrown into water it floats; that is the best sign of advanced decomposition. If then, in conducting an autopsy, you meet with a liver that will float, you may make a note of it, and conclude therefrom that death must have taken place at a somewhat remote period.

As regards the brain, the progress of putrefaction varies. In adults generally it takes place slowly; in the fœtus and

newly-born child it is more rapid, perhaps because the viscus contains more water; it is a point which requires elucidation.

Of all the organs, the uterus putrefies last: for a long time after death its examination is capable of affording precise information. Casper relates the following instance: The body of a servant-girl, 18 years of age, was found at the bottom of a well. She was buried, but after more than a year had gone by, her master was suspected of having caused her to become pregnant and thrown her into the well, and he was arrested in consequence; however, he denied it strenuously. An exhumation was ordered, and Casper was appointed to undertake the investigation. The uterus eighteen months after burial had still the shape of one that had never been impregnated. The accused man naturally was acquitted.

For my own part, I have had to perform an autopsy on the body of a woman who had been buried in the cemetery of Ivry sixteen months before. A midwife was charged with having neglected to give the woman sufficient care and attention. I was able to determine the measurements of the uterus, and found them to be $6\frac{1}{4}$ inches in every dimension, which was the proper size of the uterus immediately after delivery.

When medico-legal examinations have to be made at a considerable period after death, it is a good plan to soak the uterus in alcohol for some days, renewing the liquid from time to time; by this means the tissues become decolorized and their consistence firmer, and thus the existence of lesions may be determined which would escape notice without this precaution.

The bones last a very long while; the older a bone is, the lighter it becomes; it loses all its organic matter; it preserves its form, but it becomes friable and its weight diminishes.

We may conclude from these *data* whether the bone that we are examining belongs to a person who has been dead five, ten, or twenty years. Remember that this approximate calculation can scarcely go beyond the last figure. Some

time ago I made experiments on this subject with M. Descoust on skeletons found in cellars and procured from bodies buried after the events of May, 1871. There was appreciable loss of weight in these bones. These experiments have been repeated on the skeletons of animals by M. Ad. Carnot, Professor in the School of Mines; but from the special point of view which occupies our attention now, in spite of the curious results he obtained from them, and has recorded, they cannot be turned to any practical use.

PRESERVATION OF DEAD BODIES.

When an exhumation is officially ordered, in cases of presumed poisoning, the exhumed body may be in a perfect state of preservation; must it be concluded, as is too often attempted, that the presumption of poisoning is justified? Gentlemen, there are cemeteries which destroy and cemeteries which preserve: in the first the bodies are rapidly got rid of; they are preserved for an indefinite time in the second. It is necessary, in a medico-legal report on an exhumed body, to note the fact of preservation, but it must only be considered as one of the matters to be inquired into; when there has been poisoning by arsenic, preservation of the corpse is the rule. One of the women poisoned by Pel was found, four years after death, in the exact condition in which she was when put into her coffin.*

Another point which is quite as important is to find out the nature of the soil of the cemetery; it is of hygienic as well as of medico-legal interest. I shall not say very much about it.

There are some cemeteries or portions of cemeteries in which the corpses are exceedingly well preserved. Let us just consider what happens in the case of ordinary corpses placed in shells made of deal boards. Buried seventeen months before in the temporary graves of the cemetery of Ivry, these bodies had all the soft parts completely stripped from the bones. Other corpses, placed separately in deal coffins, buried in a very damp clay soil, the clay of which

* Brouardel et L'Hôte, 'Affaire Pel: Accusation d'Empoisonnement—Relation médico-légale' (*Ann. d'Hyg.*, 1886).

formed a thick coating over the whole of the coffin, were in a state of perfect preservation at the end of the same period; the soft parts remained, but transformed into adipocere.

We know that gases are produced during the destruction of bodies. It had been inferred that these gases were dangerous to health; all the legislation of Prairial relating to cemeteries is based on that theory. It was a matter of serious interest to determine whether it was true; it was especially with regard to large towns that these prepossessions arose. A commission was appointed; I took part in it with MM. Carnot, Ogier, Schutzenberger and Du Mesnil. We contrived numerous experiments: we found that the gases taken at the surface of the cemetery are in no way different from those taken elsewhere under the same conditions; beneath the surface down to the level of the coffin, there was a larger quantity of carbonic acid than at the surface. Whence does this carbonic acid proceed? Is it from the decomposition of the dead bodies? Perhaps, but in my opinion its origin is much more general.*

When an analysis is made of the gases of the soils round populous towns, a considerable amount of carbonic acid is always found; when pits are dug in these soils, these rapidly become filled with carbonic acid, whether there is a corpse at the bottom or not; lighted candles graduated into lengths of 20 inches show this when they are lowered into these pits. Moreover it is notorious that in Paris the well-sinkers are often asphyxiated by the carbonic acid which is given off when wells are being sunk. The soil is saturated with animal, and still more with vegetable, matter, in a state of decomposition, and yielding carbonic acid. The presence of this gas, even in the ground of a cemetery, proves nothing; thus, we must abandon all fear of danger in the air arising from cemeteries. I believe that when the coffins are placed from 5 to 6½ feet deep, and covered with earth, the hydrogen and hydrocarbons which are given off during decomposition are absorbed by that thickness of earth; at

* Brouardel et Du Mesnil, 'Des Conditions d'Inhumation dans les Cimetières: Réforme du Décret de Prairial sur les Sépultures' (*Ann. d'Hyg.*, 1892, p. 27).

Marseilles, where the subsoil is actual rock, so that it is impossible to dig graves more than 20 inches deep, it is necessary to cover them with earth and raise a mound over them, in order to ensure the conditions necessary for the absorption of the gases. When the soil is very loose, and consists of very warm sand like that of Mauritius, or of the desert, bodies are preserved by being mummified. In damp soils, in moist clayey earth, putrefaction is not complete five years after burial (and that is important from the point of view of the re-occupation of the space); the tissues have undergone fatty transformation, and have become adipocere, under the influence of the wet surroundings.

We must not, therefore, infer the probability of poisoning from the preservation of the corpse, without assuring ourselves on the spot as to the preservative powers of the cemetery, and that all the bodies buried there do not present the same characters, or that no portion whatever of the cemetery possesses this preservative power. Those cemeteries whose soils have preservative properties ought to be made sanitary; this is easily accomplished by means of drains placed at intervals of 3 or 4 yards; it is a curious fact that the water does not flow away by these drains, but it is absorbed, and does not penetrate deeply, while the air circulates freely; a non-oxidizing soil is replaced by a soil which allows the passage of abundance of oxygen. The most conclusive instance in reference to this matter is supplied by the cemetery of St. Nazaire: the bodies used not to be destroyed; but when drains were laid down, immediately a new order of things was instituted, and by the end of eight, eleven or twelve months, the corpses had undergone complete destruction.*

There are variations in the rapidity of putrefaction; in Paris it is the usual custom to throw antiseptic powders into the coffins, such as sawdust impregnated with carbolic acid, nitro-benzene, etc.; the commission proved that the use of these substances prolonged the preservation of the bodies greatly. Impermeable coffins of indiarubber have

* Brouardel et Du Mesnil, 'Conditions d'Inhumation dans les Cimetières' (*Ann. d'Hyg.*, 1892, tome xxviii., p. 27).

been invented ; at the end of two years, a phthisical woman, who weighed 69½ lb. when buried in one of these, had lost only 2½ lb. in weight.

In these indiarubber coffins, also, the body is destroyed in three or four years, and there is formed a liquid greasy substance, like black axle-grease, which rolls about in the coffin, and when the coffin is opened gives forth an abominable stench.

The Commission therefore discountenanced, as far as the re-occupation of the burial-ground in the cemeteries of large towns is concerned, the addition of antiseptic substances and the use of indiarubber coffins. It is a fear of the possibility of contagion that has given rise to these practices. It is quite enough to have the coffin firmly closed, and to make sure that no organic liquid can leak out of it during its conveyance from the house of the deceased to the cemetery. This is the only matter of importance, and the result is easily attained by surrounding the body with a layer of plain sawdust, without the addition of any antiseptic.

Moreover, this addition of corrosive sublimate, carbolic acid, nitro-benzene, etc., complicates medico-legal problems quite unnecessarily. These substances are generally impure, and may contain a variety of poisonous principles which at the time of disinterment and toxicological analysis might embarrass the most competent medical jurist.

The process of putrefaction in lead coffins differs from that in wooden ones. Lead coffins are seldom used except when it is required to transport the body for burial a long distance from the place where decease occurred, or where the relatives wish to make a display of luxury. Metallic coffins, whether of lead or zinc, are nearly always enclosed in an oak shell. If one of these coffins is opened at the end of three months, the corpse looks as if it were in a bath of sweat ; it is covered with moisture, and the skin is corrugated. When the first aerobic colonies commence their work of destruction, the coffin is filled with gases, the tension of which may become excessive, so as to make the metallic lid bulge, and even burst. But at the end of six months the surface of the lead is depressed instead of being bulged ; the increased pressure

within has given place to diminished pressure. The tension of gases in the first periods of putrefaction may be formidable.

An English actress came to Paris and stayed at the Grand Hotel; then, in the company of two of her fellow-countrywomen and her maid, she went one day for a walk in the Pré Catalan, and drank a glass of milk there. Almost immediately she became unwell, and was taken to the Armenonville pavilion, where she died. Immediately after her death, the maid returned to the Grand Hotel, carrying all her mistress's clothes with her, and sent a telegram to a personage of high social position in London, who was interested in the young woman. The other Englishwomen remained at the Armenonville pavilion with the body, totally unable to give any explanation of the occurrence (they could not speak French), and the superintendent of police interfered. He found the body of the young woman stretched on a bed, wearing a red silk chemise; but he could obtain no enlightenment.

He decided to send the Englishwomen to the police-station near the Bois de Boulogne, and the body to the Morgue. It was there that I saw the body, and had to make the *post-mortem* examination. I may add that the personage to whom the maid had telegraphed arrived at the very moment when I was beginning the autopsy, and before the Englishwomen had left the police-station; he had therefore made great haste. When the autopsy was finished (I will not say here what results were found), the body was placed with the separate viscera in a lead coffin.

It was late in the day; the workman may not have had enough time, or perhaps he had not received precise directions. I do not know how it was, but at any rate he did not enclose the metallic coffin in one of oak. In the night the lead coffin exploded from the pressure of gas evolved by the first colonies; the metal was extensively split, and yet the abdomen and intestines had been opened.

You see, then, what expansive force these gases may acquire.

I have told you already that the soil of a cemetery is not

injurious to the health of those who are walking about on it. It is highly dangerous to the grave-diggers, who are surrounded by an atmosphere of carbonic acid while digging the graves. But the danger is much greater still when it is necessary to enter one of those sealed-up vaults, known by the name of 'permanent concessions,' which are full of very dangerous gases.

When, as most frequently happens, the oak coffin is placed in the vault without being covered with earth, the decomposition of the body causes a sort of black grease to filter through the seams of the coffin, and to spread over the stone slabs. The smell is much more infectious than that disengaged by coffins buried directly in the earth.

Gentlemen, I have tried to present to you an exact picture of the various forms that putrefaction takes, according to differences of *medium* and circumstance. Well, there are other influences besides which elude us, the causes of which we cannot explain. Certain diseases hasten putrefaction, others—notably cancer—retard it. But there are other things more singular still. When several individuals die at the same time, in the same accident, and are buried together, they still may not putrefy in the same manner.

After the memorable days of July, 1830, some National Guards who had fallen in the combat were buried in the Place de la Bastille. When the excavations for the foundations of the Column of July were dug, five years after, their bodies were found. Some of them were skeletons, clothed with remains of their belts, etc.; others were still in such a state of preservation that their features could be recognized. The fact cannot be explained at present. All sorts of hypotheses are possible. We may assume that all these men had not the same species of micro-organisms in their digestive tubes.

LECTURE VI.

CREMATION.—MUMMIFICATION.

CREMATION.

Until 1889, burial was the only legal means of disposal of the dead. Since then we have enjoyed a wider liberty: we may be burnt to ashes if we choose. Certainly, it may seem preferable to some persons to be oxidized by fire after death, instead of being slowly destroyed underground by successive colonies of micro-organisms and 'labourers of Death'; but, from the medico-legal point of view, cremation has a certain inconvenience. When there is a presumption of poisoning, it is usually only at the end of three or four weeks that exhumation is ordered. If the body of the person suspected of having been poisoned has been burnt, the proof of the crime has vanished for ever.

The extra-Parliamentary Commission appointed in 1889 to study this question of cremation does not seem to me to have thoroughly comprehended the importance of this objection. On the other hand, it was much struck with the fact that in the time of an epidemic cremation might render the greatest service by making the bodies disappear quickly, and with them the possibility of an ulterior contamination of the soil.

I am obliged to make these reserves, which are justified by a case observed by Henri Sainte-Clair Deville. When this learned chemist was Professor and Dean of the Faculty of Science at Besançon (in 1854), he was summoned to make a medico-legal investigation. An entire family had died during an epidemic of cholera. The fact seemed strange,

and certain rumours were flying about, so the public prosecutor ordered the six members, of whom the family consisted, to be exhumed, and M. Sainte-Claire Deville was entrusted with the chemical analysis. Four out of the six had succumbed to poisoning by arsenic, and this happened at the height of the cholera epidemic. The murderer, who would inherit the property, hoped that from the similarity between the symptoms of cholera and those of arsenic-poisoning his crimes would thus remain unknown for ever. If those bodies had been submitted to cremation, the toxicological analysis would have been impossible. Another consideration also deserves attention. Suppose that a person has been wrongly suspected of administering poison to someone. If the supposed victim has been buried, it will be possible for the incriminated person to establish his innocence. If the body has been burnt, it will be impossible for him to remove the stigma, which will be attached to him all his life.

The Commission decided, in order partially to meet these medico-legal objections, that in Paris two physicians should be appointed to visit the corpse which is about to be cremated, and make a report. What will these two physicians manage to see? They would have great difficulty in recognizing poisoning by the aspect of the body. If they are in any doubt, they may make an autopsy. An autopsy, Gentlemen, in cases of poisoning, often reveals nothing definite, and it does not enable us to form a positive conclusion. In order to be quite certain, they will be obliged to demand a toxicological analysis. This analysis will take three months, and during those three months the relatives will be a prey to suspicions and disquietude.

There is here a real social danger, and I should reproach myself if I did not lay stress upon it, especially with regard to the suspicions which may weigh indefinitely on an innocent man, incapable henceforth of proving his innocence.

EMBALMING.

Only two words on a practice which does not prevail much amongst us. I wish to speak of *embalming*. If this procedure were universal, we should have an infinite number of pre-

served bodies. Medico-legal investigations in cases of poisoning would be equally at fault. The regulations prohibit, it is true, the use in these operations of salts of arsenic, corrosive sublimate, etc.; but embalming can only be performed by employing toxic substances. The regulations also enjoin that a phial should be placed by the side of the body containing the same substances that have been used in the process. This precaution, which is intended to facilitate research in case of an inquest, is good, but insufficient.

I am not speaking to you of the preservation of bodies by ice. This procedure, which has found an application in the refrigerating apparatus of the Morgue,* is only applicable in Institutes of Pathological Anatomy.

MUMMIFICATION.

Putrefaction, which is the usual mode by which the body is destroyed, is not the only one. In certain conditions it may become mummified. Mummification was designedly performed by the Egyptians, who wrapped the bodies with closely-applied bandages, impregnated with aromatic, and probably antiseptic, substances. These mummies are very well preserved. You have seen them in museums, and perhaps some of these exhibitions are fortunate enough to possess the representative of a dynasty 2,000 years old!

Besides this intentional mummification, there exists another which is more common. The sandy soils of hot countries, Mauritius for example, mummify the bodies which are deposited in them.

Mummification may take place in the fœtus, in adults, and in the newly born. In the fœtus it takes place when death has happened while the fœtus is still *in utero*, and the membranes are intact. It may then remain for years in the uterus, or in the Fallopian tubes, or in the pelvis if the gestation is extra-uterine. Mummification takes place in the fœtus when the atmospheric germs have no access to the dead body.

* Brouardel, 'Installation d'Appareils frigorifiques' (*Ann. d'Hyg.*, 1879).

Mummification of the bodies of adults is somewhat rare; nevertheless, some cases of it have been recorded.

Five or six years ago the body of a female servant, who had disappeared nine months before, was discovered under a closed brick outhouse at the bottom of a garden belonging to a medical man living in the suburbs of Nantes.

M. Audouard was commissioned to examine the body. The skin was like parchment, shrivelled, and of a buff colour. When it was tapped with the back of a knife, it resounded like cardboard. The body had become very light. M. Audouard found also that the skin was perforated by an infinite number of holes, like a colander, and that dust from within escaped through these little holes. He sent me a thigh and a leg, which weighed one-third of the normal, as is the rule in cases of mummification of adult bodies. I showed the fragments of the body which M. Audouard sent me to M. Mégnin, who has devoted great attention to the study of the natural history of the 'labourers of Death.' M. Mégnin was enabled to determine the time at which the woman had died, and the conditions under which her death had occurred. How did this female, eighteen or nineteen years of age, become mummified? M. Audouard attributed it to the dryness of the chamber in which the body had been placed, the time at which death had occurred (early in the summer), and, lastly, to the layer of wheat and oat straw under which the body had been buried, and which had absorbed all the moisture of the body. It is quite possible. M. Mégnin made the discovery that the body had been devoured by mites, which had somehow or other eaten all the tissues of this woman. In the leg and thigh, which were in my possession, there remained only the aponeuroses and meshes of cellular tissue. All the muscles had vanished. The dust which escaped in clouds from the perforations in the skin was composed of the excretions and *débris* of the antennæ, etc., of the mites.

Mummification of adults is rare in our climates. When it takes place, the viscera are in close apposition; they contain no gas, and the clothes are intimately united to the body. In those cases which I have had the opportunity

of observing, the liver, stomach, and intestines were absolutely inseparable from the stays in the case of a woman, or from the jacket in the case of a man.

Chemical analysis has shown that the alkaloids produced are identical with those observed in the bodies of the drowned.

When a mummified body is found, the law requires the medical jurist to determine the time when death took place. This question is of great importance, for according to the answer to it the prosecuting authorities will know in what direction to turn their attention.

Some years ago a chimney in a house in the Rue de Tournon was pulled down ; the mummified body of a newly-born child was found behind the chimney. A servant was the only person who could be incriminated, but there had been a succession of nurses in that room, and the precise settlement of the period of death was the only means by which justice could fix on the true culprit. I then remembered the work of Dr. Bergeret.

Dr. Bergeret (of Arbois)* was the first to throw some light on the question ; he has an extensive knowledge of entomology. Being entrusted with the examination of a child's body, which he found covered with larvæ of insects and scales, he declared that death must have happened two years previously. His opinion was not accepted by the representatives of the law, who then appealed to Tardieu. The latter sought for information from Alfred Moquin-Tandon, who was at that time Professor of Natural History in the Faculty of Medicine of Paris. Moquin-Tandon confirmed Dr. Bergeret's report.

In the Rue de Tournon affair, which I had to investigate in 1878, I asked M. Périer, of the Museum, to lend me his assistance. M. Périer sent me an interesting note in reply, but informed me at the same time that M. Mégnin had made a special study of the fauna of the dead body, and that he alone could enlighten me on certain points. Since then M. Mégnin has several times given me the greatest assistance in preparing my reports.

* Bergeret, 'Infanticide, Momification naturelle du Cadavre' (*Ann. d'Hyg.*, 1855, tome iv., p. 442).

The body of a child seven or eight years of age was found in a soap-box; how long ago did death take place? It was then the month of July. M. Mégnin proved, by studying the succession of flies and larvæ which were found among the remains, that the body had been placed in the soap-box in the second half of February of the preceding year. The mother, who suffered from phthisis, was accused, and, as she felt her end approaching, confessed voluntarily that the deed had happened on February 23rd.*

You remember the case of Élodie Menetrez at Villemomble. A young girl disappeared in suspicious circumstances; some human bones were discovered in a bed of tulips; several liliaceous bulbs were found by the side of the corpse. As the bulbs of tulips are themselves devoured by insects, I begged M. Mégnin to find out when these bulbs had been buried in the ground; they had evidently been put there at the same time as the human remains which had been discovered. M. Mégnin, without knowing any details of the history of the case, affirmed that the bulbs had been put into the ground at the beginning of March in the previous year, and this was quite true; in the first days of the month of March the girl had been to her solicitor to sign an agreement, and the following day she disappeared.

This is a point to which you should pay particular attention, Gentlemen. I do not ask you, mind, to make these observations yourselves; I should not do so any more myself; only a first-class entomologist is capable of giving such good guidance, and if we were to lose M. Mégnin to-day, I should not know how to find anyone easily to take his place.

M. Mégnin† divides the work of the 'labourers of Death' into four periods: in the first, quaternary compounds are attacked and destroyed; in the second, fatty substances are attacked; in the third, the soft parts are liquefied; lastly, in the fourth period, the dried-up mummy is filled with mites.

* Brouardel, 'De la Détermination de l'Époque de la Mort d'un Nouveau-né faite à l'Aide de la Présence des Acares et des Chenilles d'Aglosses, dans un Cadavre momifié' (*Ann. d'Hyg.*, 1879).

† P. Mégnin, 'La Faune des Cadavres' ('Encyclopédie Leauté,' G. Masson, 1894).

The first period lasts about three or four months. The body is then invaded by numerous larvæ of diptera of the genera *Curtonevra*, *Calliphora*, *Lucilia*, and *Sarcophaga*. Coffins may be literally crammed with them.

The second period has likewise a duration of three to four months. The diptera are replaced by coleoptera, such as *Dermestes*, *Corynetes*, and the *Lepidoptera* called *Aglossæ*.

In the third period, which lasts from four to eight months, we meet with the larvæ of little diptera of the genera *Phora* and *Antonia*, and coleoptera such as *Silpha*, *Hister*, *Saprinus*. The soft parts are transformed into a black *deliquium*.

The fourth period is that of the *Acari:* these colonies exist as parasites, and eat whatever the others have left; they are represented by *Tyroglyphus*, *Uropoda*, *Anthrenus*, etc. The bodies undergo at this period, which varies from six to twelve months, a mummification which may last a very long time.

The seasons have a definite influence on the production of these insects. When a body is put into the coffin at a time when there are no flies about, *i.e.*, from November to February, you will not find any of them in the coffin; but when there are flies at the time of placing in the coffin, they are certain to enter.

The study of the animal life of the tomb is extremely interesting and instructive.

Gentlemen, corpses exposed to the air or improperly buried are sometimes devoured by dogs, wolves, or other carnivorous animals; you easily recognize this by the marks of their bites.

But it sometimes happens that bodies, especially those of newly-born infants, are eaten by rats. The bites of rats are sometimes difficult to recognize. They always attack the parts that are fat, *i.e.*, the cheeks and heels; they divide the skin in a straight line, which often has the appearance of having been cut with a knife; so close is the resemblance that it is often difficult to avoid a mistake. Rats will make a body disappear with extraordinary rapidity. At the Morgue, before refrigerating apparatus was introduced, the rats used to devour the bodies in spite of every precaution.

In submersion in the sea, crabs attack the bodies, choosing the lobes of the ears, the lips, and the nostrils; and, according to the climate, other animals, such as carnivorous fish, cause mutilations, the nature of which it is generally easy to determine.

Do not forget that you may have, in cases of this sort, to form a differential diagnosis in certain circumstances.

To sum up, whatever may be the mode of destruction of a body, there is always a fermentation of the tissues, a production of gas, an oxidation that is more or less rapid, according to the method of destruction chosen, which lead to the return of the organism to the mineral kingdom; furthermore, except in cremation, the intervention of successive colonies of insects is absolutely necessary in order that the destruction shall be complete.

LECTURE VII.

LEGISLATION.—MEDICO-LEGAL APPLICATIONS.

GENTLEMEN,—In order to complete the subject of death from the medico-legal standpoint, it remains for me to enter with you upon the legislation which governs the matter. The enactments are not very lengthy. All that has any concern with it is contained in certain articles of the Civil Code (Art. 77 *et seq.*), and of the Penal Code (Art. 358 *et seq.*).

Article 77 of the Civil Code is thus expressed:

'No interment shall be made without the authorization, on unstamped paper and free of cost, of the registrar of deaths (*officier de l'état civil*), who shall only be entitled to give it after visiting the deceased person to assure himself of the death, and only twenty-four hours after death, except in the cases provided for in the police regulations.'

Article 358 of the Penal Code is thus expressed:

'Those who have caused a deceased person to be buried without the previous authorization of the registrar of deaths in the cases wherein it is prescribed, shall be punished by imprisonment of six days to one month and a fine of sixteen to fifty francs, without prejudice to the prosecution for those crimes to which the authors may have made themselves liable at the same time. The same penalty shall be inflicted on those who have contravened, in any manner whatever, the law and the regulations dealing with precipitate interments.'

The legislator has imposed on the registrar of deaths the

duty of verifying the death; the office is held by the mayor or his deputy. In the 36,000 communes of France, the mayor and his deputy are not necessarily doctors of medicine; they are therefore incompetent, and, as they are fully conscious of their incompetence, they do not take much trouble about it; they do not go to the deceased's house to obtain actual proof of death, and the person who comes to give information of the death is allowed to take away the permission to bury. The law, such as it is, makes this procedure legal. If the defunct had been seen during life by a medical man, the danger would not be so very great. But in the country many people die without any professional man being called in at all. In such a case there is neither any guarantee nor security. What is the period fixed by law that must elapse before burial? In France it is twenty-four hours, and in Paris it is reckoned from the moment when the declaration of decease is made to the registrar of deaths, by virtue of an order made by Frochot in 1805. Frochot remembered the well-known verses of Molière:

'He who buries too soon often commits a murder,
And a man is believed to be dead who has only the appearance of it.'

At any rate, the delay imposes a check on innkeepers and hotel proprietors, who do not care to keep a corpse in their houses for long; it is contrary also to the customs of the South of France, where, by reason of the high temperature, it is desirable to bury the dead as quickly as possible.

In Germany the obligatory time to wait is forty-eight hours, in Spain and Portugal five or six hours, which has made a witty writer say that a man must not sleep too long in those countries, for fear of being put under the earth. In England it is the custom to wait till putrefaction sets in, thus remaining faithful to the traditions of Greece and Rome, where six to eleven days were allowed to elapse between death and the funeral.

The mean adopted in France is good; it is long enough, especially when death occurs in small, overcrowded lodgings. It is impossible to keep the corpse there long, partly because of the smell it gives off, also because promiscuity with death rapidly removes the respect for it.

Nevertheless, we have been obliged in France to make some exceptions to this rule of twenty-four hours; not in order to lengthen it, but, on the contrary, to shorten it. When an epidemic is prevailing, and when putrefaction sets in very early, the mayor may shorten the obligatory period of waiting. Thus, in 1884, when cholera was epidemic in Paris, the prefect of police, after having consulted with the Council of Health, issued a public notice recommending every physician attending a case to give notice himself or to get the family to give notice to the mayor of the district of every death from cholera that took place in his practice; a man was then sent immediately with a coffin; the public medical verifier of deaths, who had also been notified, confirmed the fact of death, and the compulsory delay might thus be safely reduced, since two medical men, the one in attendance, and the public verifier, had both ascertained the reality of death. The public verifier could always obtain a prolongation of the normal period of delay.* M. Tourdes is of opinion that the period of waiting should be extended from twenty-four to thirty-six hours; this does not remove all uncertainty; the danger does not lie in the period of time fixed by law, but in the incompetence of the persons appointed to legally confirm the fact of death.

We ask in France, and our neighbours in Germany have been demanding the same thing since 1846, that all deaths should be verified by medical men; we have in France 36,000 communes, 29,000 of which possess neither a physician nor a medical officer of health (*officier de santé*). Can the duties therefore be placed in the hands of the medical officers of the cantons? One-sixth of the cantons of France have neither a physician nor a medical officer of health! It therefore seems impossible to carry out the law; though this could easily be rectified by taking advantage of the

* The decree of April 27, 1889, made these regulations. It stipulates: 'ART. 1.—The registrar of deaths may in an urgent case, notably in a case of death from a contagious or epidemic disease, or in case of rapid decomposition, and after obtaining the opinion of a medical man, order that the body shall be placed in the coffin immediately after death has been officially ascertained, without affecting the right to order the burial without the delay appointed by Art. 77 of the Civil Code.'

organization which is about to be created in order to carry into effect the law referring to medical assistance in the country. When the question of the verification of death was discussed at the Tribunate, and at the Council of State under the Empire, Fourcroy declared that the registrar of deaths appeared to him to be absolutely incompetent to fulfil the duties of verifier. He was told in reply that, as he had the responsibility, he would take care to be accompanied by a medical man, if he thought proper. It is not desirable for medical men to be assigned duties in this way which belong to them by right.

The difficulty has been overcome in large towns by a simple procedure. In Paris, for example, there is in each quarter a medical verifier, entrusted with ascertaining the reality of every death in his division. A certain number of medical inspectors, placed hierarchically over the verifiers, are retained to ascertain the reality of death in one case out of every three. This organization exists in many French towns. It abolishes almost entirely the risk of premature burial; but in the country, in isolated communes, in hamlets and farms when there has been neither a medical man in attendance nor another to verify death, accidents may happen like that related by Dr. Roger of Morlaix, and which I have already related to you when we were engaged in the study of the signs of death (*v.* p. 37).

I only know one way of avoiding the recurrence of such accidents, viz., to enforce by law that the verification of death should always be performed by a medical man, who would make a diagnosis of death just as he would make one in the case of pneumonia or typhoid fever. If anyone offers as an objection the paucity of medical men in the country, I will say: 'Add the duty of verification of death to the other functions of medical assistance in country places in the law that is now under discussion. If in Lozère, for example, one-third of the cantons have neither a physician, medical officer of health, nor apothecary, it is because persons belonging to these professions cannot gain a livelihood there. If you are really desirous of helping the indigent population, organize the medical service in such a way that the medical

officers may make a living. Nothing is more easy under those conditions than to entrust to them the duty of verifying deaths also. Do you complain that there are not enough medical men to do the work? You would have plenty the very day that you would assure them of a livelihood and remunerate them for their services.'

In order that burial may take place, it is necessary to show the written permission at the church and at the cemetery. This permission is given on an unstamped sheet of paper by the registrar of deaths, after the reality of death has been ascertained; burial cannot be proceeded with in the absence of such permission without committing a breach of the law.

In the case of the death of an adult, the registrar ought to put at the head of the permit 'Declaration of Death'; in the case of a new-born child, on the contrary, he says that a 'child without life' has been reported to him; it is for the heirs of that child to prove that it has lived, if there is any question of the inheritance of property.

Until 1881, fœtuses expelled prematurely by abortion were thrown into privies, dustbins, drains, or on to dunghills.

In 1864, Tardieu showed, in an excellent report,* how immoral it was for such a state of things to exist.

In 1881, M. Floquet, then Prefect of the Seine, issued an order prescribing that the death of a fœtus should be declared, and that it should be buried; several events, both in Paris and the provinces, had called for this administrative measure.

At Provins, in 1880, a fœtus was found on a dungheap; public opinion accused a girl of having induced abortion. At the very moment that girl was being married. As she was actually leaving the church, the deputy to the public prosecutor, acting too hastily, caused her to be arrested; the scandal was prodigious.

An investigation took place, and the medico-legal examination proved that she was a virgin. The deputy was dismissed.

* Tardieu, *Ann. d'Hyg.*, 1864, et 'Étude médico-légale sur l'Avortement, suivie d'une Note sur l'Obligation de déclarer à l'État civil les Fœtus mort-nés,' 4e édition. Paris, 1881.

In Paris a series of analogous events happened : tales told by neighbours, and charges made by hall-porters, led to inquests being held, whereby the falsity of such stories was proved.

In consideration of these facts, M. Floquet issued the order referred to. The district medical officers protested against the order as leading to violation of professional secrecy.

Medical secrecy is in no way affected by M. Floquet's order, for an excellent reason, viz., because the matter is not a secret in any case. The order obliges the fœtus to be taken to the mayor's office, in the same manner as the body of a new-born child would be taken there; but just as a physician may say when he is begged not to divulge the fact of a birth, 'A child has been born in this district at a certain hour of a certain day, of father and mother both unknown, residence unknown,' so he is permitted to declare with the same reservations that a fœtus has been born on a certain day in his district, of father and mother unknown.

A box has been placed in each of the twenty mayors' houses in Paris, wherein the fœtus thus declared is deposited, and whence it is removed by the men whose duty it is to bury it.

Since 1881, the number of premature confinements declared, and of fœtuses thus deposited, has steadily increased; from 80 in 1881, it reached 250 in 1893; at the same time the number deposited in privies and dungheaps has diminished in the same ratio.

The opposition to the decree of M. Floquet was very strong. The opponents, at the head of whom was M. Durand-Fardel, senior, medical inspector at Vichy, who published an extremely spirited memoir on the subject, relied especially on a decision of the Court of Appeal of August 7, 1874. It declared that 'Art. 345 of the Penal Code should be read in connexion with Art. 312 of the Civil Code, by the terms of which the child is only reputed viable after a *minimum* of 180 days or six months of gestation; that the being which comes into the world before this period, destitute not only of life, but of the organic con-

ditions indispensable to existence, constitutes merely a nameless object, and not a child in the sense which a legislator attaches to the expression; that it was not with the idea of such a case that the decree of July 3, 1806, ordered that the body of every new-born child should be taken to the registrar of deaths, inasmuch as the nearer the time of its coming into the world is to the time of its conception, the less does it present the distinctive appearance of a human being; that such an exhibition would be without any public interest or utility, and might, in certain cases, wound the public's sense of decency.' This solution, which has been admitted by several courts of appeal (Amiens, June 27, 1876; Dijon, May 11, 1879), may admit of criticism in more than one respect. Without inquiring deeply whether the exhibition of the product of an abortion might or might not 'wound the public's sense of decency,' and also without examining whether the exhibition would be 'without any public interest or utility,' the principal argument on which this jurisprudence is founded is highly contestable from a judicial point of view.

For my part, the obligation of declaring the fœtuses is less hurtful to the public's sense of decency than the practice of leaving them fully exposed on a dungheap or in privies.*

Innovations, of whatever kind they may be, are always butts for criticism and sources of recrimination. It is the same to-day with respect to the law which renders obligatory the notification of contagious diseases. Meanwhile no one has any longer any idea of protesting against M. Floquet's decree, and there has not been a single prosecution.

* Jurisprudence on this point has varied to a singular degree. Judgments have decided that Art. 358 applies to unauthorized burial, whatever period gestation may have reached, provided that the child presents the form of a human being (Paris, June 15, 1865; Amiens, December 20, 1873; Agen, August 6, 1874. See also Dijon, December 16, 1868; Chambéry, February 29, 1868).

According to the Court of Metz, 'If it is true that the authorization of the registrar of deaths is not essential for the burial of a simple fœtus or embryo—*i.e.*, of an unorganized being—it is not permitted that private persons shall determine the limits within which the obligation of obtaining authorization previous to burial begins and ends. This duty has been imposed by law on a public man, who alone has the right of deciding the state of the deceased individual' (Judgment of August 24, 1854).

All the medical verifiers have noted as a danger at the time of death hasty preparation for burial when the deceased person dies at his own home in the midst of his family. It is the practice under such circumstances, due to the fear of not being able to enshroud the body later, when *rigor mortis* has commenced. You know that the attendants shut the dead man's eyes and mouth, the latter by means of a bandage, that the face is covered by a sheet, and that the body is often placed too soon in the coffin, etc. This custom constitutes a real danger. M. Josat, who has paid much attention to questions of apparent death and premature burial, has given in connexion with this matter a very happy formula which ought to be remembered. He says that the dead person ought to be presumed to be alive until death has been verified, and that he ought to be attended to carefully until this is done, just as if he were alive. Casts of the body can only be taken and autopsies made twenty-four hours after the fact of death has been established; the mayor ought to receive notice of an autopsy; he is bound to be present or to be represented by a deputy. In Paris this duty devolves upon the superintendent of police.

What I have just said applies also to embalming. I have only to say a few words now on the question of the *removal of the body*. Your advice will often be sought on this subject. When a body has to be conveyed a long distance, it is necessary to have a metallic coffin, but a chest composed of sheets of zinc, like those we see used by packers, and covered with oak, will answer in the majority of cases. Lead coffins are very expensive. This expense of transport is still controlled in France by a series of old legal decisions, which are not enforced, however, in every department. They belong to that group of laws, having hygiene in view, which are only observed in a department where the prefect makes them compulsory. The authorization of such a practice in one department does not imply that it is equally so in the next. However strong may be our love of unity in France, we still have to deal with many anomalies.

If the body has to be removed only two or three leagues, and the deceased has not died of any contagious disease, do

not be too harsh; on the contrary, when the journey is long, whether death is from a contagious disease or not, you must insist on the employment of a metallic coffin, covered with an oak shell. Remember that the first effect of putrefaction is the production of gases, which by their excessive tension may even burst a metallic coffin.

What conclusions are we to draw from this long study? A physician need not often hesitate over the diagnosis of death; but he must know how to make this diagnosis, just as he knows how to make that of typhoid fever or meningitis. Some cases present the condition of apparent death, which may be more or less prolonged. The physician alone is capable of making the diagnosis in these; everyone else is incompetent. Also we are convinced that if the verification of death were everywhere entrusted to medical men, the danger of premature burial would be almost absolutely removed.

PART II.

SUDDEN DEATH.

LECTURE I.

SUDDEN DEATH.

GENTLEMEN,—The question of sudden death is one of the most important in forensic medicine. I beg that you will allow me to speak of it in more detail, for medical men are not, generally speaking, in favourable conditions to become acquainted with all the numerous causes which bring it about.

It is easy, as a matter of fact, to study the diseases of the people who are brought to the hospital, and to explain satisfactorily the morbid conditions to which they succumb; but when an individual dies suddenly in the street or in a house, he is not taken to the hospital. Generally the superintendent of police is informed of the sudden death, and appoints the surgeon attached to the police-station to examine and report on the facts. The latter ascertains that there is no mark of violence on the body; he puts this in his report quite properly, but he does wrong if he adds that death is due to the rupture of an aneurysm or to congestion of the brain. He cannot actually know the cause of death of the individual whom he is examining; an autopsy, which he has not made, can alone tell him that, and even then an autopsy will not enable him to be certain sometimes. Why, then, should he pronounce the words 'aneurysm' or 'cerebral congestion'? Sudden deaths due to the rupture of an aneurysm are so rare that out of 1,000 cases observed at the Morgue by

MM. Descoust, Vibert, Socquet and myself, we have only met with fatal rupture of an aneurysm four times; as to cerebral congestion, such a thing does not exist—at least, we have never met with it.

What is the proportion of sudden deaths among medico-legal cases? In the total number of medico-legal investigations, cases of infanticide and of sudden death are almost equal; these two groups together constitute two-thirds of the medico-legal autopsies made in France annually.

The law steps in when death takes place suddenly, by virtue of Article 81 of the Civil Code and of Article 44 of the Code of Criminal Proceedings.*

This is, as a general rule, what happens in these affairs: An individual dies suddenly (it is often persons of advanced age, from 50 to 70, who are thus struck down); death has been preceded by a loss of consciousness more or less prolonged, by coma or by vomiting, which suggests the idea of poisoning by opium in the one case, or by arsenic in the other. The dead man is buried. The friends of the deceased, as they are following the funeral, are disturbed by the thought that they themselves may also be carried off in a few hours, and begin to discuss the circumstances in which the deceased met with his death. Comments are made very freely. If by the fact of the death someone is to succeed to property, and if the heir should be a man in embarrassed circumstances, to whom such a windfall would seem an unhoped-for stroke of good fortune, suppositions become more defi-

* COD. CIV., 81.—'When there are signs or indications of violent death, or of other circumstances which may give rise to suspicion, burial shall only take place after a police officer, assisted by a Doctor of Medicine or of Surgery, has drawn up a written report of the state of the body, and of the circumstances bearing upon it, and shall have added any information that he may be able to collect, with the Christian names, surname, age, profession, and birthplace, of the deceased.'

COD. CRIM. PROC., 44.—'If a violent death occurs, or a death whose cause is unknown or unexpected, the public prosecutor shall obtain the assistance of two medical officers of health, who shall make a report on the causes of death and the condition of the body. The persons referred to in the present article and the preceding article shall be put upon their oath, before the public prosecutor, to make their report and to give their opinion on their honour and conscience.'

nite, suspicions are expressed openly, and the law is set in motion; an inquiry is held, and in three or four weeks after the decease exhumation is ordered, so that a *post-mortem* examination may be made.

I repeat that this is the usual course of events when death has been unforeseen and sudden, without there being any reason to ascribe it to an injury.

We now enter upon the subject of sudden death apart from injury.

Why does sudden death occur? No one dies suddenly apart from the effects of violence, as long as all the organs are sound; but there are some diseases which develop slowly and secretly, without the attention of the patients having been called to them by any pain or by any feeling of illness, and without a physician having ever been called in, and which terminate naturally by a rapid death. Among these diseases I will mention diabetes and arteriosclerosis, accompanied by atrophy of the kidneys. The person affected with arteriosclerosis apparently enjoys good health; he may sometimes present digestive troubles, and fancies that he is dyspeptic; he attributes any slight temporary indispositions to his stomach: moreover, the course of the disease is long, yet an emotion or a chill may kill the patient. A diabetic patient may also look well; he is cheerful, he eats well and sleeps well. The day arrives at last when he becomes comatose, vomits, and dies, while those around him speak of poisoning.

These, Gentlemen, are not sudden deaths in the strict sense of the term. Literally speaking, death is always sudden; that is to say, life ceases in an instant, if we hold the opinion, as do the sick man's relatives and friends, that the moment of death is determined by the last breath or the last beat of the heart. But that which has received the name of sudden death, both among ordinary people and in the law-courts, is a death which is not preceded at all, or only for a short time, by alarming morbid phenomena. The word 'unforeseen' ought to be added to the word 'sudden.' It is this condition which, in the eyes of everybody, as well as of the law, takes precedence of all other considerations. And in order to avoid giving cause for any future misunder-

standing, we will define sudden death as 'the rapid and unforeseen termination of an acute or chronic disease, which has in most cases developed in a latent manner.'

When the state of apparent health has continued up to the last moment, the cause of death may be guessed, notwithstanding. Here is an example of rapid, unforeseen death which is easily suspected: the primary and secondary symptoms of apoplexy are well known to everyone, and there is no need to give information to the authorities, or for the officers of the court to intervene in such cases. Of all sudden and unexpected deaths, apoplexy furnishes the fewest autopsies and inquests.

The officers of the court include in the category of sudden deaths those cases where individuals who appeared to be in good health at the time have lived for four or five days after the fatal seizure.

Sudden death is seen towards the close of certain protracted diseases, such as phthisis and cancer. You are all acquainted with the occurrence of fatal syncope in phthisis, and are aware that embolism may happen in phthisis or cancer. In certain acute diseases, such as typhoid fever, sudden death is equally liable to happen, and M. Dieulafoy devoted his inaugural thesis to the subject. But these are all accidents in familiar diseases. In the strict sense in which we are speaking, sudden death is an unexpected accident in a disease of whose existence we were quite ignorant, and which has run its course without attracting any attention at all.

Fifty years ago the doctrine of Bichat prevailed, according to which it was said that death took place by the heart, the lungs, or the brain.

To-day we can assert, at any rate as far as sudden death is concerned, that death is especially apt to be brought about by the kidneys, and we ought to restore the humoral theory to a place of honour.

M. Lesser, a German medical jurist, whose name is of great weight, takes too narrow a view of the question of sudden death. He is faithful to the ideas of Galen, and is convinced of the truth of the old phrase, *Cor ultimum moriens.*

Out of 100 deaths, he attributes 66 to cardiac lesions, the remainder to unknown causes. But we know that in those cardiac affections capable of inducing sudden death there are very often renal lesions, and an analysis of Lesser's cases proves that he himself met with them.

We ought, Gentlemen, to classify the changes in the organs which may bring about sudden death. We shall pass under review successively the alterations in the circulatory system, those in the nervous system, those in the respiratory system, those in the digestive system, those in the genito-urinary system, specially the female organs, and the kidneys, and also the alterations in the humours, *i.e.*, diabetes, albuminuria, hæmophilia, etc. I am well aware that this classification is not free from the charge of being forced and artificial; but no natural classification can be constructed, and I shall try to leave nothing to be desired in the way of precision and clearness.

I shall then speak of sudden death in new-born infants and in children under two years of age. Sudden death is as common in the earliest years as in old age, and it often gives rise to medico-legal blunders, against which I shall have to put you on your guard.

Besides organic lesions and alteration of the humours, it is necessary to allude to circumstances which may be called 'occasional causes,' and it is of importance to be acquainted with them. They include acts of violence, anger, conflicts, strong emotions, and sometimes special unfortunate susceptibilities of the individual. The effects of cold and heat will likewise engage our attention, for popular opinion ascribes most cases of sudden death to some exceptional external circumstance or other.

Gentlemen, however carefully we may perform every autopsy, however minute our exploration of the body may be, however thorough may be our knowledge of the causes of sudden death, we sometimes meet with cases which it is impossible to explain. The proportion is about 8 or 10 per cent. Often the body submitted to us for examination is in a more or less advanced state of putrefaction; with the best will in the world, our inquiry must remain incomplete, and

present *lacunæ* due to the impossibility of prosecuting our researches further, and particularly to our inability to examine with the microscope tissues that are undergoing decomposition. Sometimes, even although we cannot plead the existence of putrefactive changes, we cannot ascertain the real cause of death.

I will enumerate some of the circumstances which render us thus impotent. Remember, then, that there is a certain number of cases wherein it is impossible to assert that sudden death is the consequence of any specified lesion. That is an important fact. Moreover, the officers of the court do not ask you what the disease was which caused the sudden death of the deceased; they require you to give evidence as to whether or not death was due to violence or to the effects of poisoning. If you find no marks of violence and no traces of poison in the body, say so simply. Justice will be satisfied, for it is all that it desires to know.

LECTURE II.

SUDDEN DEATH DUE TO LESIONS OF THE CIRCULATORY SYSTEM.

GENTLEMEN,—Sudden death often occurs as a result of changes which take place in the circulatory system, but it is not essential that there should be any lesion of importance. A lesion may remain latent during the greater part of life, and be only revealed by accident. This fact is a predominant feature all through the history of sudden death. A lesion of this kind may have its seat in the heart or the vessels (arteries, veins, or capillaries), but especially in the vessels of the brain or kidneys.

I. LESIONS OF THE HEART.

A. Cardiac Muscle.—In the circulatory apparatus the principal organ is the muscle of the heart. The action of the cardiac muscle may cease although there is no valvular lesion; this may happen in the course of certain diseases in which it is impossible to make a diagnosis during life. What are those diseases?

1. *Fatty Overgrowth of the Heart.*—A certain amount of fat is normally deposited on the surface of the heart. This deposit begins as early as the third week and increases as age advances. You have all noticed, when examining hearts in the *post-mortem* theatre, those yellowish streaks along the course of the vessels, and those spots of yellow fat sprinkled over the surface of the muscle, which indicate this condition.

If the fatty overgrowth is considerable, the muscular fibres

can no longer be seen; the heart seems entirely enveloped in a yellow covering of fat.

When the overgrowth is less pronounced, the heart presents on its surface yellow discs, slightly raised, which may be likened to the lenses of spectacles or of an opera-glass, and which conceal, in the form of islets, portions of the muscle lying beneath. Muscular tissue may sometimes be found underneath these fatty patches, but the fat may also infiltrate the muscular tissue itself, forming gaps in it where the presence of muscular fibres can only be detected by the aid of the microscope.

The living person who has fatty overgrowth of the heart does not believe himself to be ill. He looks well; he is perhaps a little short of breath, but he has never had an attack of severe dyspnœa or any symptoms of angina pectoris, which would have given warning of his condition; auscultation, if practised, reveals nothing. The physician will ascertain that the heart is somewhat enlarged, that the valvular sounds are a trifle weak, and that the impulse of the heart is somewhat feebler than normal, but he will not be able to make a precise diagnosis; and yet that individual is suffering from an affection of the heart which renders him liable to sudden death.

This fatty overgrowth does not always make its first appearance in the second period of life, *i.e.* after the 40th year: it sometimes exists in children 15 or 16 years of age.

I remember two accidents which happened under the same circumstances at the Sainte-Barbe institution while I was physician there. Two children died suddenly in a cold bath. In one case the relatives asked for a *post-mortem* examination; in the other they wished to have the body embalmed: in both these children the heart was so loaded with fat that it was impossible to see the muscular fibre. What was the matter with these children? You have doubtless heard the word 'infantilism' pronounced. It denotes a condition which has not received all the consideration it deserves. The children of large cities, such as Paris, Lyons, Marseilles, Lille, etc., exist under certain peculiar conditions. Take the little Parisian for example: he is

confined to very narrow surroundings; his intellect developes rapidly, and is precocious. That child will become towards his tenth or eleventh year the street-Arab (*gavroche*) of Victor Hugo, if he belongs to the lower classes, or a "little prodigy" if he is born in the middle class. At this age his energies seem to be arrested; he can no longer maintain the position he held in his class; the children from the provinces, whom he left far behind at the commencement of his studies, now pass him by. At the same time the development of his testicles is arrested, and he grows fat; the breasts enlarge, and sometimes an abscess forms in them. I have had to open sixty or seventy while I was physician to Sainte-Barbe. The children grow no taller, and sometimes they are like bags of fat. These children, Gentlemen, ought not to undergo the douche or to enter a cold bath. A violent shock to the circulation is sufficient to stop the movements of their hearts, and thus bring about sudden death.

2. *Fatty Degeneration of the Muscular Tissue of the Heart.*—Here we no longer find yellow patches scattered over the surface of the heart; the alteration is more profound; the muscle itself is changed, and is converted into fat. This transformation of the muscular fibres takes place in patches. If you make a section of a heart that has undergone this modification, and wash it, you will see that its substance is studded with islets of a special colour—a brownish or buff red—reminding you, as Laennec described it, of the tint of dead leaves, and its nature is revealed by microscopical examination. A German author, comparing it to the colour of a horse's coat, has appropriately called it "dappled." Fatty degeneration developes slowly and secretly; it often attacks hearts that are hypertrophied, and it gives rise to the same dangers as fatty overgrowth.

3. *Fibroid Degeneration of the Heart.*—Fibroid degeneration of the heart, which likewise developes in patches, is due to chronic myocarditis. It has been well described by M. Letulle. The patches may invade both the muscular tissue of the wall and that of the musculi papillares; it is this condition which leads to rupture of the heart. The

tendons thus degenerated may snap as a result of a fit of anger or other violent emotion, or of coitus, and their rupture entails sudden death, the exact cause of which cannot be determined without a *post-mortem* examination.

Acute myocarditis accompanies infective diseases, such as typhoid fever, small-pox, pneumonia, etc.

4. *Lesions of the Coronary Arteries.*—These arteries are sometimes affected by arterio-sclerosis; they become thickened and nodulated, their calibre is diminished, and the blood-supply to the heart is lessened, often to a remarkable degree. Degeneration of the cardiac muscle is the consequence of all this, and leads to sudden death.

5. *Rupture of the Heart.*—Rupture of the heart was formerly known as 'aneurysm of the heart.' Aneurysm of the heart, analogous to that of the arteries, has no existence.

These lacerations of the wall of the heart are rare, it is true, but they happen occasionally. Thirty years ago Aran collected 33 cases, of which 25 were ruptures of the left ventricle, 3 of the right auricle, 1 of both ventricles, and 1 of the right auricle and right ventricle.

These ruptures are not instantaneous; on the contrary, there is a preliminary alteration by fibroid degeneration. The tearing proceeds from within outwards, widening in its progress, and becoming so extensive that the aperture on the outer surface of the heart is much larger than that on the inner surface. While this process is going on, the contraction of the heart drives a few drops of blood into the rent; the blood thus forced by each impulse into the rent travels farther forwards, at the same time making it broader. Those authors were mistaken who believed that ruptures of the heart could be effected from without inwards.*

In cases where the heart is incompletely torn through, the laceration always starts from the internal surface of the heart.

Ruptures of the apex of the heart are tolerably frequent. It was from a rupture of this kind that Talma died.

* Wilks and Moxon, 'Lectures on Pathological Anatomy,' 2nd edition, p. 116, mention a specimen in which there were two or three merely superficial rents in the heart from structural disease. Death took place from hæmorrhage into the pericardium.—TRANSLATOR.

The heart may give way in the course of certain infective diseases, such as typhoid fever, small-pox, infective pneumonia, etc. The rupture is then due to an acute myocarditis, which lessens the resistance of the muscle. When a physician finds the heart becoming weak in a patient suffering from one of these diseases, he should anticipate the possibility of an accident of this kind.

In rupture of the heart, death seems to depend upon the insufficient quantity of the blood propelled by the heart into the general circulation, and also upon the resistance offered to the movements of the heart by the pressure of the clot poured out into the pericardium. This clot may weigh 7 to 14 oz.

B. Pericardium.—We will now consider lesions of the pericardium. The symptoms of acute pericarditis are so well known that I will not dilate upon them. But it is necessary to remind you of those numerous forms of pericarditis which may exist alone, or may precede by some days the other manifestations of rheumatism, or which sometimes appear suddenly in alcoholic subjects, for example, as well as hæmorrhagic pericarditis, to which Dr. de Lacrouzille devoted his thesis. Abundance of effusion into the pericardium constitutes a grave danger.

For the last forty years paracentesis pericardii has been performed when the fluid is effused in large quantity. Sometimes during the process of tapping the heart suddenly stops, and fatal syncope results. The responsibility of the physician may be called in question under such circumstances; therefore I would advise you never to undertake paracentesis of the pericardium without the help of a colleague, and without having forewarned the patient's relatives of the possibility of a fatal termination.

As a consequence of pericarditis, false membranes may have formed, which may cover both folds of the pericardium, or may form adhesions between them, and then one of two conditions is met with: either the adhesions are loose and long enough to allow of the normal free play of the heart, and of the movements of the two pericardial surfaces on each other, or they are so short as to approximate, or even

to closely unite, the two surfaces, and so produce adherent pericardium. The diagnosis of adherent pericardium is difficult in the living subject; it is not an uncommon thing for it to be found absent *post-mortem*, though its existence had been suspected during life; or, on the other hand, for it to be found present when nothing had pointed to its presence during life. It is a very grave condition, notwithstanding, for in the notes of cases of sudden death due to alterations in the heart that I have collected at the Morgue, sudden death has in several instances been due to adherent pericardium. The heart is somewhat enlarged; the muscle presents patches of fibroid tissue wherever the adhesions are attached, exemplifying the fibroid myocarditis of M. Letulle. The individual whose heart has undergone this change may live, and may even feel no appreciable inconvenience, but after it has lasted some time he may die suddenly under the influence of some emotion or violent outburst of anger; his heart, contracting imperfectly, can no longer perform what is required of it.

The most typical example that I can cite to you is the following: A peasant was riding along a road in his cart, when he saw three women gathering corn-flowers in a field that belonged to him. He wanted to stop them, and cracked his whip in order to scare them away; then, seeing that the women kept moving about in the field, he descended from the cart and ran towards them. The women hurried away, and in doing so one of them fell to the ground. The peasant went to her and picked her up. Her two companions, furious at having been interfered with and chased, maintained that he had unmercifully beaten the woman who had fallen down, which the peasant indignantly denied. The passers-by collected together, and conducted the two women, together with the peasant and his alleged victim, to the police-station. The woman died, succumbing to a paroxysm of dyspnœa. A *post-mortem* examination was ordered to be made, and on the body only insignificant injuries were found; but she had adherent pericardium, which had been unknown to everybody.

This is not a solitary instance, Gentlemen, but it is

typical, because the condition of which we are now speaking was the only lesion that could account for death. Such a termination is usual, but it would be going too far to say that it is invariable. M. Lesser thinks that sudden death can only happen when other morbid conditions co-exist.

C. Aortic Incompetence.—I come now to *valvular lesions*. Aortic incompetence, which is one of the consequences of articular rheumatism contracted in youth, is rightly considered by many authors as a predisposing cause of sudden death. A person with undoubted aortic incompetence may live, it is true, for many years. It is recognized by the pallor of the face, the cardiac murmur, the visible pulse so well described by Corrigan, and which has been called after him 'Corrigan's pulse': the carotid arteries throb in a very violent manner. How is the mechanism of sudden death from this cause to be explained? M. Mauriac has observed in his inaugural thesis that in aortic incompetence the blood propelled by each contraction of the ventricle into the aorta does not remain there; a certain amount flows back into the heart; the coronary arteries no longer receive a sufficient supply of blood; their orifices are closed by the sigmoid valves during the ventricular systole, and in diastole their orifices become patent; but, as a part of the blood driven forwards falls back into the heart, the tension at the mouths of the arteries is much lower than it should be. When the sigmoid valves are sound, they entirely prevent the reflux of the blood-stream. In aortic incompetence this barrier is wanting, and there ensues an emptiness of the coronary arteries which may lead to arrest of the heart's action.

This theory of M. Mauriac is partially true; but when there is aortic incompetence, the left ventricle becomes hypertrophied, sometimes so much so as to earn the name of *cor bovinum*. For a time the cardiac muscle struggles successfully with the obstacle which impedes its functions, but soon, as in all muscular hypertrophies—hypertrophy of the bladder in cases of stricture of the urethra, for example—its fibres undergo fatty or fibroid degeneration; they are larger than normal, but less powerful. The anæmia of the heart

diminishes the vitality of its fibres, it is true, but there is also degeneration of those fibres. When the volume of blood propelled into the aorta falls back in part into the ventricle, Corrigan's pulse may be felt. It is sometimes very forcible, and proves that the blood is driven into arteries which are almost empty. When the blood flows thus intermittently, some parts of the body are of necessity insufficiently supplied; the face is pale, because part of its share of blood does not reach it—it falls back into the heart, instead of being projected along the aorta; we find, therefore, a general anæmia, particularly an anæmia of the brain. Sudden death in aortic incompetence is therefore a product of three factors—anæmia of the heart, degeneration of the heart, and anæmia of the brain; and if an individual suffering from aortic incompetence is obliged to make a great effort or undergoes a severe shock, he may die from cardiac syncope or from cerebral syncope.

D. Mitral and Tricuspid Incompetence.—In mitral incompetence, as a rule, sudden death is less to be feared; it necessitates an inquest less frequently. The patients suffer from dyspnœa and œdema of the lower limbs, and they present all the well-known symptoms of cardiac affections; they are known to have heart disease. A medico-legal inquiry may be ordered, however, under two particular conditions: either when the mitral incompetence is in a very early stage, or else when it is very advanced.

In the first case, the symptoms are but slightly pronounced; the patient is not aware that he has anything wrong with his heart. If he does know it, he may not have suffered from dyspnœa, and he has probably had no dropsy; nevertheless, the cardiac muscle may already have undergone very decided alteration. An attack of pulmonary congestion is quite enough, even in a young man, to bring about sudden death.

A medical student, unaware that he was affected with mitral incompetence, went to a public ball one evening; he danced, but had to stop all of a sudden, as a violent paroxysm of dyspnœa seized him. He became cyanosed, and died shortly after. The autopsy revealed the presence

of mitral incompetence ; the lungs were extremely congested and gorged with blood, so that they looked like two bags of blood, and were almost firm enough to stand upright. It was ascertained also that this young man had partaken of a hearty meal before going to the ball, and no doubt had washed it down with copious libations. That is one of the circumstances most favourable to produce congestion. I cannot too strongly urge upon you to prohibit those of your patients in whom you have discovered the existence of mitral incompetence from dancing, running and taking violent exercise, especially after a bountiful repast.

In England diseases of the heart ending in sudden death are very frequent. English authors attribute a great many sudden deaths to mitral incompetence; they mention the railway-station as one of the commonest places where these sudden deaths occur. You know how many Englishmen live out of town ; they are sometimes pressed for time, always keeping in mind the hour of the train, and have to run to catch it, and they sometimes die at the very moment of entering the carriage.

In the second case, which corresponds with an advanced period of mitral incompetence, the symptoms are very evident ; there is a feeble pulse, œdema of the lower extremities, and anasarca. You know the classical picture of these affections. In contrast with these patients are others who have had no œdema and no dyspnœa, or, at any rate, only in a slight degree, and yet their condition may rapidly change—on the supervention of bronchitis, for example—from one that is attended by but little danger to one that is extremely critical.

When there is mitral incompetence, there is usually some pulmonary congestion ; and when, in addition, there is mitral obstruction, the pulmonary circulation is carried on very imperfectly. Some of the blood which should reach the heart remains in the pulmonary tissue ; the capacity of the lungs for air is diminished, stasis of blood becomes persistent throughout, and consequently the tissues become condensed ; when bronchitis supervenes, attacks threatening suffocation develop at once, and are very severe.

This condition is aggravated when there co-exists a deformity of the spine. In lateral curvature the heart nearly always suffers; and nearly all those who are afflicted with angular curvature succumb to a superadded attack of bronchitis, which complicates the pre-existing cardiac affection. The same thing occurs when renal mischief exists along with mitral incompetence. In cardiac affections this association is by no means uncommon; you know how often the kidneys may be impaired. There may not be much albuminuria, and yet œdema of the lungs sets in very speedily. Also, when an individual who has mitral incompetence is attacked by bronchitis, complicated with œdema of the lungs, he sometimes dies of asphyxia in the course of a few hours.

What has the law to do with cases of sudden death due to mitral incompetence? I have the notes of a dozen cases which furnish an answer to the question.

For the last ten years, partly in consequence of the recommendations of M. Huchard, it has been customary to inject morphine to calm the attacks of dyspnœa of certain cardiac patients. It is not always the family physician who is attending the patient who employs the remedy.

The attacks often come on during the night, and the nearest medical man, or the one who is on public duty for the night and is prepared to come, is called in. This physician knows nothing of the patient's history, and he has no time to make inquiry; he is under the most unfavourable conditions for auscultating the patient whose circulation and respiration are so embarrassed. He gives an injection of morphine to subdue the dyspnœa; the patient is somewhat relieved, and his friends think that he is going to sleep; he does not sleep, however; therefore in half an hour the physician repeats the injection, and takes his leave. This time the sick man does go to sleep. Next morning a message is sent to the physician's house to let him know that he need not trouble to call, as the patient died in the night.

The question that arises here in the forensic aspect is this: Is the physician culpable? In nearly all cases which I have had to examine there was albuminuria. Uræmic

coma is mistaken for sleep due to morphine; it is impossible to blame the injection of morphine, and say it is that which has killed the patient. All that it is possible to say is that the patient had bronchitis or cardiac disturbance from uræmia, and that the morphine injection would not hasten the final coma by half an hour, even if it had such an effect at all.

It is not only morphine that has been blamed for such accidents; these have also been ascribed to wet-cupping, emetics, inhalations of ether, and to every other mode of treatment.

You see, then, Gentlemen, that you must exercise caution. When you are summoned to a patient under such conditions, before taking any steps to give relief, warn the relatives of all the accidents which may follow your treatment —not because of it, but in spite of it.

In *tricuspid incompetence* the same phenomena are observed. When there is emphysema at the same time, attacks of bronchitis are frequent and severe; when there is what Trousseau called an 'overstrained heart' (*cœur forcé*), it denotes dilatation of the right ventricle, and the pulmonary circulation is obstructed as much as in the preceding case.

E. Endocarditis.—Endocarditis gives rise to medico-legal inquiries of a special kind. I do not refer to the endocarditis with hyperpyrexia, which comes on unexpectedly in the course of acute rheumatism, and sends the temperature up to 104° or 106° F., and which has a rapidly fatal termination; such a case is not followed by an inquest. But there is infective endocarditis, which has been well described by M. Haust, who recognizes two forms of it. In the first the infection is limited to the heart; in the second it starts in the heart, and thence becomes general.

Let me give you an example of infective ulcerative endocarditis, limited exclusively to the heart: A young mason, sixteen years of age, came down the ladder, at the top of which he had been working one day, because he felt unwell and out of sorts. He met his father in the street, who reproached him with being lazy, and ended by boxing his ears. The boy fell down, but was picked up, and was found

to be hemiplegic and aphasic. He was taken to the hospital and put under the care of Dr. Lorain, whose house-physician I was at the time. Dr. Lorain detected a cardiac murmur, indicating mitral incompetence; the intensity of the murmur varied from day to day, and in a month was no longer to be heard; the patient improved, but he did not altogether regain the power of speech.

Now, that lad had a wound on his foot which he had neglected, and which originated the infective endocarditis limited to the endocardium, and a deposit of fibrin had formed on the valves.

Under the influence of the emotion caused by the blowing-up his father had given him, an embolus was detached, which was carried along in the blood-stream till it blocked the middle cerebral artery and produced hemiplegia.

When the infective phenomena are general, and there is multiple embolism, we have to do with M. Haust's second form.

How are we brought in contact with endocarditis in medical jurisprudence? A little child had received a blow on his scalp from the ruler of an under-master at school. Neither he nor his parents paid any attention to it at the time; but the child fell ill, became delirious, and the doctor pronounced it to be a case of meningitis, brought on by the blow inflicted by the under-master.

The child died, and the body was transferred to the Morgue. The autopsy revealed the existence of infective ulcerative endocarditis. Gentlemen, the violence of the blow had been grossly exaggerated. It was clearly very wrong of the under-master to strike the child; but there was a marked disproportion between the slightness of the blow and the supposed consequences.

Infective ulcerative endocarditis is frequent as a result of slight wounds, such as a graze of the calf, foot or heel. It does not seem to follow lesions of the alimentary canal or of the bronchi, nor does it appear as a result of surgical operations or amputations; it seems rather to proceed from superficial sores that are attended to imperfectly or not at all.

Endocarditis often leads to *aneurysm of the valves.* In consequence of the ulceration to which inflammation of the endocardium gives rise, lacerations are produced. Small excavated foci, caused by ulceration, form in the neighbourhood of or upon the sigmoid valves: this may bring about sudden death by embolism. But, as a general rule, when there is ulceration on one surface only, fibrin is deposited on it and remains there. When ulceration goes on to perforation of the septum, numerous emboli form, and are carried to all parts of the system.

One last word as to endocarditis, namely, on the treatment by salicylic acid and salicylate of soda. The number of persons treated for endocarditis in rheumatic fever by salicylate of soda, and who have benefited by this treatment, is enormous. It is only when the kidneys are diseased, and do not perform their functions duly, that the salicylate, which has a cumulative action, becomes a dangerous remedy.

F. Angina Pectoris.—Angina pectoris comes well within our scope, for an Englishman, Dr. Forbes, states that out of sixty-four persons thus affected that he has met with, forty-nine died suddenly; still, a certain number of persons affected with this disease live thirty or forty years, and die of something quite different.

We, as medical jurists, may have to interfere, because people may die in what seems to be a first attack; I say 'seems,' for we are never certain that the mishap which has been witnessed by no medical man, and which has carried off the patient, was an attack of angina pectoris; and it is this uncertainty which looks suspicious to the eyes of the law. Moreover, a person may die not only during an attack of angina pectoris, but also in the interval between the attacks.

What is the danger which threatens a person in angina pectoris?

You know that angina pectoris is present when the great vessels are diseased, and when the coronary arteries are degenerated, thickened and tortuous. The muscular fibre of the heart, which receives less blood, and is badly nourished,

undergoes fibroid degeneration; the altered muscle stops either in or apart from an attack, and the patient dies of syncope.

If the medico-legal expert does not find any lesion of the coronary arteries, or, at most, a slight thickening, should he say that death is due to angina pectoris? I think not, for we find similar lesions without there having been any angina. The presence of more or less extensive fibroid patches will suggest the idea of myocarditis. In most cases it is very hard to decide. Changes in the ganglia and inflammation of the pneumogastric and phrenic nerves have been spoken of as causes of angina pectoris; it has been said that it is possible to recognize induration and redness of these nerves even thirty-six hours after death. I am very sceptical, Gentlemen, as to the value of that redness and induration of the nervous tissue. Even admitting that such an investigation might be successful twenty-four hours after death, it would be quite useless to look for it four or five days after death, and I have told you more than once already that medico-legal autopsies are seldom ordered immediately after the individual has met with a suspicious death.

Therefore, as regards the diagnosis of sudden death from angina pectoris, we have no positive basis in morbid anatomy; cases of this sort must be placed in the category of sudden deaths, of which it is sometimes impossible for us to give an exact explanation in our medico-legal reports, and such cases are far from being rare.

G. Neoplasms of the Heart.—Before concluding the subject of lesions of the heart, I ought to say a few words about *new growths* of the wall of the heart, which have in exceptional cases caused sudden death.

I will content myself with mentioning tuberculosis of the septum and of the walls of the ventricles, a case of which has been observed by Dr. Southwood Smith; cancer of the cardiac wall, of which one case has been observed by Ségalas, in a child of 11 years old, and another by M. Laudouzy and myself in a woman 26 years of age; and hydatids.

It has been said that hydatids have a preference for the right ventricle; Richard Smith and Depaul each found one in the interventricular septum; cases have been reported in which the cysts have ruptured and discharged secondary cysts.

Gentlemen, allow me to tell you of a *post-mortem* in which, on opening the heart, we thought we had to deal with a hydatid cyst that had burst into the right ventricle. Microscopical examination did not confirm the diagnosis made by the naked eye. We found instead, little cubes full of fibrin, in the midst of which were red corpuscles more or less degenerated.

I cannot tell you what these little cubes were or how they were produced, although I know of two similar cases; but I can state confidently that you will not be able, in a case that ends in sudden death, to make a diagnosis of cancer of the ventricles during life, any more than that of hydatid cysts.

II. LESIONS OF THE ARTERIES.

'A man is as old as his arteries' is an aphorism which has, I think, been attributed to Cazalis, but which I now know to be much more ancient; from the point of view of sudden death, it is absolutely exact. A man actually is as old as his arteries. Of all diseases of the arteries, fibroid degeneration (arterio-sclerosis) concerns us most; it may manifest itself even in young people. Before entering upon the study, it will be convenient to turn our attention first to the congenital arterial lesions which may lead to sudden death.

A. Congenital Lesions.—One of these lesions, *contraction of the aortic orifice and narrowing of the aorta*, has been demonstrated by Virchow. M. Lesser, of Breslau, has studied it afresh, and has found that the aorta had, in subjects of this malformation, who were 20 or 22 years of age, the size of that of a child of 8 or 10; like Virchow, he has founded a theory of chlorosis upon it. I have not ventured to discuss chlorosis here; it is evident that the arterial circulation, and conse-

quently nutrition, must be defective when the calibre of the aorta is so much reduced, and it may produce a peculiar form of anæmia.

Virchow only goes so far as to say that narrowing of the aorta might at a given moment cause sudden death. M. Lesser, deducing his results from the events observed in certain diseases, goes further, and asserts it as a fact. It is necessary, therefore, when one has to do with sudden death in young adults, to measure the size of the aorta.

It is to a congenital malformation of another sort that the following case of sudden death must be ascribed;* it made a great impression on me. I believe it is a unique case, and the one that most closely resembles it is a case recorded by Laennec:

A medical student, 20 years of age, who had spent the whole of the afternoon in the dissecting-room, went home by rail to Perreux, where his family resided. He dined, and afterwards played at cards with his parents and sisters. The family retired at 10 o'clock; he himself went to his room, wrote a letter of six pages to a friend, and then went to bed. In the middle of the night his mother heard her son walking about, and, thinking that he was ill, rose and found him complaining of excruciating pain in the right side of his chest. A physician was fetched, who thought he had to deal with a case of biliary colic, and gave an injection of morphine. Mind, I am not finding any fault with this physician's diagnosis. The pain lasted throughout the next day, and at 7 *p.m.* the young man died. The father asked for an autopsy, and I was appointed to make it. In the right pleura I found about 7 oz. of non-coagulated blood, the parietal pleura was separated from the ribs, from the third rib to the diaphragm, and there was thus formed a sac containing more than 63 oz. of liquid; the mediastinum was full of blood, the aorta was surrounded by an effusion of blood which reached up to the retropharyngeal cellular tissue and descended to the commencement of the femoral artery; the posterior third of the mediastinum was full of blood;

* Brouardel et Vibert, 'Rupture de l'Aorte thoracique chez un jeune Homme de Vingt Ans' (*Ann. d'Hyg.*, 1892, tome xxvii., p. 450).

the aorta was ruptured in two places; there was one transverse laceration, nearly half an inch long, a little way beyond the origin of the carotid, and a second tear, almost identical with the first, about an inch above the diaphragm.

The aorta was not atheromatous, but its walls were like paper, owing to the atrophy of the middle coat; the muscular and elastic fibres had disappeared; the vessel was narrow, and small also. The young man had had typhoid fever when 15 years of age. Was the arterial lesion a result of the fever, or was it congenital? He had never suffered from any pain that might retrospectively be attributed to this lesion; he had practised gymnastics, had ridden a bicycle, and had not deprived himself of any of the pleasures of his age; in this particular case the rupture of the aorta had not been preceded by any fall, struggle, or any sort of violence.

There is here something very interesting, but which is very little known, perhaps because in the majority of these cases death does not seem to present any characters by which it might have been suspected, and because an autopsy is neither demanded by the friends nor insisted on by law.

B. Arterio-sclerosis.* — *Arterio-sclerosis* causes sudden death more often than any other arterial lesion. The name denotes a particular degeneration of the walls of the arteries, which begins generally at the arch of the aorta, and may then spread so far as to involve the whole arterial system; it has, however, two seats of election, viz., the arteries of the brain and of the kidneys. This generalization and predilection concern us equally. When an artery has undergone this change, its walls become fragile and friable, and its calibre is diminished, and may even be obliterated.

Fragility of the walls tends to produce rupture of the artery. Any artery may rupture. Rupture of the aorta is nearly always determined by an accident, such as a struggle, a rather heavy fall, or a dispute—circumstances which all call for the intervention of the law, which attributes the death to violence. At the autopsy there is found a lacera-

* The term *artério-sclérose*, used in the original, is translated literally to denote a morbid condition of the arteries for which there is at present no well-recognized name in English, though such a term is wanted.—TR.

tion of the aorta, sometimes completely through the wall, sometimes incomplete, with separation of the cellular coat, and a second tear a little lower ('dissecting aneurysm' of Laennec). The coronary arteries may rupture likewise and give rise to hæmorrhage into the pericardium. Along with fragility of the walls, we must take notice of their hypertrophy, which lessens the calibre of the artery and no longer permits the normal amount of blood to reach the neighbouring tissues. This point is chiefly of importance with regard to the brain, where there are but few anastomoses, and where the diminished supply of blood immediately induces anæmia, which manifests itself as hemiplegia, such as was called 'temporary hemiplegia' by Cruveilhier. This is what happened to a coachman, who all at once let his whip fall, and who was carried to the hospital with one side of his body paralysed, though he recovered his senses and the use of his limbs after a few days' rest.

These accidents may be met with even in individuals who are not the subjects of generalized arterio-sclerosis; aphasia and hemiplegia are sometimes due to cerebral arterio-sclerosis, which may remain localized for a long time. When the blood-supply is not merely irregular, but completely shut off, it forms a focus of softening in the part which is no longer nourished, and this leads to death, sooner or later, according to the region implicated. From the point of view of sudden death, the vessel that concerns us most is the basilar artery, which is formed by the union of the two vertebral arteries, and which supplies by its branches the medulla and pons.

I know of about 35 reported cases of thrombosis of the basilar artery. The symptoms occur very much as in the following case, which may serve as a typical example: A man, aged 50, felt unwell; as he was walking along the boulevard, he entered a café to rest; he sat down and could no longer speak; he had not aphasia, however, but paralysis of the hypoglossal nerve. He was taken to the hospital, whence he was discharged temporarily cured.

When the obliteration is immediate and complete, death may supervene suddenly in a few minutes; there is an

abrupt stoppage of all the vital phenomena, just as if the 'vital knot' of Flourens had been divided.

C. Aneurysms.—Arterio-sclerosis may lead to the formation of aneurysms of the great arterial trunks.

Aneurysms of the aorta often take us by surprise in making an autopsy. They may escape notice altogether during life, especially if the pneumogastric nerve is not involved in the aneurysmal sac, and if the bronchi are not too much compressed. A professor of this faculty was one of the most fervent believers in the doctrine of 'the arthritic diathesis.' He said that he himself was the subject of this diathesis, and attributed thereto the violent pains that he felt in the back and in the chest. He was suddenly seized during the night with a violent fatal hæmorrhage from the air-passages. He had an aortic aneurysm, though its existence was totally unknown to himself and to his friends who had examined him, and it had burst.

Aneurysms of the aorta which eat their way through the ribs, and reach the surface of the chest, rarely give occasion for medico-legal investigations; but when they burst into neighbouring organs it is otherwise. These aneurysms may actually open into the spinal canal after having eroded the vertebræ, into the bronchi, or the pleuræ. I know of two cases of aneurysm of the aorta which led to an inquest being held. They were aneurysms of the abdominal aorta, and death, attended by vomiting and coldness of the extremities, was attributed to poison.

Those little aneurysms which arise from the commencement of the aorta, where it is still within the pericardium, may burst into the pericardial sac, and lead to death as rapidly as does rupture of the heart.

I shall not speak to you of aneurysms of all the arteries. I must, however, mention those of the large arteries of the brain, and especially those of the basilar artery. I will add that the arteries of the brain may be affected with arterio-sclerosis though all other arteries in the body may be sound.

It is usually the suddenness of these affairs which leads to a medico-legal inquiry. But the opposite case happens

sometimes. I was directed one day to make an autopsy on an old cachectic woman, who had a large bedsore over the sacrum, and who died in the last stage of exhaustion. The medical verifier of death, seeing that the trunk and limbs were covered with ecchymoses, refused permission for burial. At the autopsy I found general arterio-sclerosis, with an aneurysm of the aorta, which had burst into the left pleura.

A certain number of individuals exist in whom ecchymoses are produced with almost incredible facility; these are the subjects of general arterio-sclerosis. The slightest violence, the least effort, even the effort of pressing strongly on the handle of a door that they are trying to open, is sufficient in such persons as these to produce ecchymoses. I should not like to terminate this rapid review of arterial lesions capable of inducing sudden death; without speaking of rupture of the pulmonary artery. The fact has been observed once by Devergie; he has given us a very abbreviated description of the case; and for my part I do not know to what to attribute the rupture.

III. LESIONS OF THE VEINS.

Lesions of the veins are not generally considered to be a frequent cause of sudden death. Nevertheless such instances are not rare.

A. Rupture of Veins.—Veins may burst. Portal has described rupture of the pulmonary vein where it opens into the left auricle. Morgagni has related, with abundant details, a case of rupture of the vena azygos into the right pleura, which contained 4 lbs. of blood; the anatomical specimen prepared by him is still to be seen in the museum at Padua. This rupture of the azygos vein happened in a tuberculous girl as a result of a violent fit of coughing. Andral has mentioned a case of rupture of the vena cava inferior in a young man who had been wrestling with one of his comrades, without the wrestling having at all amounted to a violent struggle.

B. Thrombosis and Embolism.—The lesions of the veins which, beyond any doubt, provoke the largest number of sudden deaths are *thrombosis* and *embolism of the pulmonary*

artery. Chief among the varieties of thrombosis which lead to sudden death, I should place inflamed varicose veins.

Individuals who die under these conditions do so because the clot coming from an inflamed varicose vein has been discharged into the stream of the circulation, and has blocked one of the branches of the pulmonary artery. Such an accident does not usually call for an inquest, though exceptions are not very rare.

Some years ago a professor of this Faculty died suddenly. His brother-in-law wished to undertake all the necessary duties, and you know how numerous they are. He followed the body on foot in the procession to the cemetery. He was very tired when he returned, and almost immediately was seized with great difficulty of breathing; he would not take any rest, however, and although he was no better the next day, he received many visits. Another attack of dyspnœa came on, and he died in it. He had varicose veins, which became inflamed in consequence of the fatigue which he had incurred during the last few days, and clots detached from the inflamed vein had been carried to the lung, where they had caused a blocking of the artery, which ended fatally.

The same phenomena occur also in phlegmasia alba dolens. The clots found in the femoral and iliac veins, as well as in the uterine veins, extend into the vena cava inferior. If the clot gets dislodged, it enters the pulmonary circulation as an embolus, and if this is large the patient dies.

It is not only in lying-in women that such accidents may happen. It is essential that you should know that even before confinement the peri-uterine veins may be the seat of thrombosis, which only attracts attention when the inflammation spreads to the superficial veins. Women suffering from phlebitis are often allowed to walk about too soon. Out of 150 cases of sudden death due to displacement of blood-clots, death happened 112 times in the first two or three weeks after the thrombosis began. After this time, if it is dislodged, it is in the form of a number of small clots, instead of a single large one, which enter the pulmonary

circulation and produce embolism of less gravity. The results of these are infarcts and hæmoptysis, and the woman only dies if too little of the pulmonary area remains.

When there is a fibroid tumour of the uterus, the veins and uterine sinuses may be attacked in like manner; and in other ways uterine fibroids are often accompanied by phenomena resembling those of confinement.* It is necessary, therefore, to adopt similar treatment in cases of fibroid tumours to that of lying-in women, and to take similar precautions. I will say the same of ovarian cysts.

Thrombosis and embolism may take place in cachexia, such as that of phthisis or cancer, as you know. The patient may be sitting up in bed, eating, or obeying the calls of nature, when all at once he feels suffocated and drops down dead. These accidents are particularly prone to happen in the case of cancerous growths affecting certain organs, where they may remain latent for some time; these are, cancer of the breast, which induces thrombosis of the axillary vein, cancer of the womb, before hæmorrhage has called attention to it, and cancer of the prostate.

Among these forms of venous thrombosis I shall place caries of the petrous portion of the temporal bone, which follows inflammation of the middle ear. Toynbee has shown that the circulation in the brain or meninges is connected by numerous anastomoses with that of the middle ear. Thrombosis of the sinuses, especially of the lateral sinus, may be the consequence of otitis. When otitis exists, and the physician or surgeon fears that caries of the petrous portion may supervene, it is necessary to remember that sudden death may occur. The clots may be in existence a long while without attracting attention.

Here is an instance: A man, 36 years of age, who had inflammation of the middle ear in December and January, but which had been neglected, went to dine with his sister one day in the following June, without having sought the advice of a physician. There was music after dinner, and he played the violoncello. He was seized all at once with a

* Bastard, 'Des Thromboses veineuses dans les Corps fibreux de l'Utérus.' Thèse inaugurale, 1882.

terrible feeling of suffocation, and died. At the autopsy a large clot was found in the pulmonary artery, which corresponded exactly with the main portion, which was situated in the lateral sinus, and whence it had become detached, without the deceased having made any effort or violent movement.

Similar occurrences have been met with in the later stages of typhoid fever.

The same thing may follow boils on the face, especially those on the lips. A Danish physician, Dr. Ch. Trude, has particularly called attention to this complication. In these cases there is often produced an inflammation of the veins of the face, which may spread to the cerebral sinuses and give rise to thrombosis. I ought to mention that all examples of this were observed before the introduction of the antiseptic method into surgery. They are therefore probably due to infection, for they have not been witnessed since. I remember that when I was physician to the St. Antoine Hospital, I saw in consultation with M. Duplay, one of the surgeons to the hospital, a foreigner who had been admitted; he had a well-marked dermatitis of the face, which might have been mistaken for erysipelas, nasal catarrh, and giddiness; and he had become blind. Our diagnosis was 'inflammation of the sinuses of the dura mater,' and the autopsy proved that we were correct.

In Germany four or five cases of sudden death have been observed in the course of gonorrhœa in the male; I only know of one case in France; at the inquest it was shown that there had been phlebitis of the sinuses of the prostate, and that a clot was carried thence into the pulmonary circulation. Death was due to embolism.

I made an autopsy on a young girl, sixteen years of age, whose mother had a lover. To attach this man to her still more, the mother gave him her daughter. The latter contracted gonorrhœa, which led to inflammation of the veins of the broad ligaments; there was thrombosis of the left iliac vein. While sitting on her bed, taking some soup, embolism occurred, which carried her off; the remainder of the clot was found in the iliac vein.

Sudden death after a fracture or dislocation may be caused

by thrombosis of the veins which are in direct relation with the seat of fracture or dislocation. This complication has been described by Azam of Bordeaux.*

It is more frequent in injuries of the lower than of the upper limbs. It is interesting for several reasons: when the surgeon is reducing the fracture or dislocation, he cannot at first recognize the existence of thrombosis, and ascribes the swelling directly to the injury, and not to the thrombosis which is the consequence of it; then he may be blamed if he has given chloroform to set the fracture or reduce the dislocation; in such cases death due simply to embolism has sometimes been ascribed to the chloroform. I could tell you of the case of a provincial surgeon who was actually found guilty of homicide through want of care. And yet, when we think of the number of patients who died before, during and after an operation, before chloroform was introduced into practice, we are not a little astonished at the small number of accidents which have to be put to the account of the anæsthetics, ether and chloroform.

I shall conclude this medico-legal study of sudden death from embolism by relating to you the following case, which shows in what manner you may be called upon to give evidence:

Some years ago, at Nanterre, a house inhabited by an old couple was found shut up one morning. The neighbours were uneasy, and informed the son, who lived in Paris. He arrived, and went into the house. There he found his father dead, in his shirt, lying on his back in bed, with his feet on the floor. He looked for his mother, and found her dead also, at the bottom of a flight of steps leading down to the cellar; a candlestick was by her side. The law was properly set in motion to investigate these two deaths, and an inquest was ordered. The autopsy revealed the fact that the old man had cancer of the prostate, thrombosis of the sinuses, and a large embolus in the pulmonary artery.

* Azam, 'De la Mort subite par Embolie pulmonaire dans les Contusions et les Fractures' (*Bull. de l'Acad. de Méd.*, 1864, tome xxix., p. 816).

The woman had a fracture of the sixth cervical vertebra, and hæmorrhage into the spinal cord. From these *data* it was easy to reconstruct the scene.

On entering the old man's room, there was evidence that a meal had been going on, and that the bottle placed on the table was empty. The woman had lighted a candle in order to go and fetch some wine from the cellar; she had slipped on the stairs and broken her spine; the noise of her fall and the cry she must have uttered roused her husband to jump off his bed and hasten to help her. The effort was too sudden or the excitement too much for him. Directly his feet touched the ground an embolus was detached from the prostatic sinuses, and he died.

Gentlemen, when you have to search for the cause of sudden death, and you have reason to believe that it may be due to embolism, do not conduct the autopsy according to the usual manner in which it is performed in the hospital.

At the hospital you are especially desirous of verifying the accuracy of your diagnosis, therefore you open the thorax and remove the organs contained in it, so as to examine them with greater ease. If you proceed in that way, you will fail to find the embolus you are looking for; the clot which has been carried into the pulmonary artery obliterates one of its branches; there is formed behind it a more or less long coagulum; and if, in order to remove the thoracic organs, you pull on the larynx and trachea, you change the relations of the parts, displace the clot, and will not find it *in situ*.

Instead of this, open the chest freely, open the pericardium and dissect the heart *in situ*, feel with your finger for the clots formed during the last hours of life, which you will be able to remove easily; follow the ramifications of the pulmonary artery; if there is an embolus, you will find it without difficulty, and you will be able to compare the broken surface of the clot thrown into the blood-stream with the remainder of it left in the vein where the thrombus was formed.

C. Air in the Veins.—Allied to this subject of sudden death by embolism is another, which has occupied the

attention of former generations for a long time, and about which I must say a few words. The two Bérards (especially the surgeon), Dupuytren, and others also had noticed that in cases of wounds of the neck, when the wounded man made any effort, air might enter the veins implicated in the wound, producing a peculiar hissing sound as it did so, and that the individual died almost immediately. This was certainly a sudden death.

You know that the aponeuroses of the neck form a sort of framework, the meshes of which keep the jugular veins patent. If one of these veins is opened, the air may enter it; this air mixes with the blood in the form of bubbles and blocks the capillaries; it is like a plug of gas, which plays the same part as a clot, and which brings about sudden death. This is an exact statement.

But the theory of sudden death due to the entrance of air into the veins has been peculiarly extended in its application. The uterine sinuses have been considered to be included within its scope. It has been thought that entrance of air into the uterine sinuses might give rise to sudden death, and that in some cases of abortion death might be due thereto.

Gentlemen, examine the documents published on this question; you will be astonished at the readiness with which facts are adapted to any theory which is fashionable at the moment. And this theory, in as far as it deals with the uterine sinuses, cannot be accepted. As a matter of fact, during confinement, if the sinuses are gaping, there must be hæmorrhage, and consequently the entrance of air into the circulation is difficult; if the uterus is contracted, the sinuses are closed up, and their canal is obliterated. In abortion these sinuses can scarcely be patent.

Well, this theory reigned for more than fifteen years, and has been supported by the most eminent and scientific men. It was founded mainly on two cases. The first was observed by Depaul in the Lying-in Hospital. A pregnant woman who had a deformed pelvis was admitted into the hospital. It was necessary to induce premature labour, and several instruments were passed into the uterus for

that purpose. The woman died without having been delivered. Depaul resolved to perform Cæsarean section *post-mortem*. He opened the woman's abdomen, and found, as soon as he incised the uterus, that air escaped from the uterine vessels.

The record of this very interesting case ought to be preserved. I do not know what explanation to give of it; but it does not prove that air enters the vessels, for the placenta was not separated and the veins were not open.

The second case is as follows: A little operation had been performed on a body which was going to be submitted to a *post-mortem* examination, although leave to do so had not yet been obtained. The operation consisted in tying one or more veins at two points of their course. At the autopsy, on cutting these veins between the ligatures, gas was noticed to escape.

This is a simple example of putrefaction, which is explained by the succession of aerobic, amphibious, and anaerobic colonies, and the gases they produce.

Observe that from the day on which the discussion on the theory of entrance of air into the veins took place, no one else has published any cases of the kind. Now, that happened in 1859 or 1860. When, during the course of twenty or thirty consecutive years, there has not been a single instance of a condition which seemed to be very common before, there is good reason to believe that the facts have been wrongly interpreted, and that the conclusions which had been drawn from them were false.

I do not say that there never can be any gas in the blood; it may be there in cases like those of Dr. Parise, of Lille, who has twice seen gas escape from the wound at the same time as the blood, while performing venesection; but his patients were suffering from gangrene, and the gangrene was of that intense kind which is apt to follow bites, especially rat-bites; he therefore met with phenomena of putrefaction during life.

It may happen also in the case of navvies who have to work in compressed air. You know that, in order to construct certain works—fixing the piles of a bridge, for example

—the labourers are obliged to work in diving-bells filled with compressed air. Nowadays the pressure seldom exceeds two atmospheres; formerly it was not so; this degree was far exceeded, and no precaution was taken at the moment when the workmen came out of the bell, and under those conditions accidents were numerous. They were particularly common during the construction of the Bridge of Kehl, where several workmen died suddenly.

The mechanism of this form of sudden death has been demonstrated in the case of those who have been recalled to life. One of these men was completely blind in one eye. Ophthalmoscopic examination showed that the ophthalmic artery was obliterated, and that a bubble of air had obstructed the artery of the optic nerve. The case is not an isolated one.

When compressed air is absorbed as a consequence of respiration, and the compression is abruptly removed, the air tends to escape, and may produce plugs of gas in the bloodvessels, which, by arresting the circulation at certain points, may cause fatal results.

Workmen are less exposed to these dangers nowadays than formerly, because they are made to pass, on leaving the diving-bell, through a series of chambers in which the atmospheric pressure is reduced by degrees.

IV. LESIONS OF THE CAPILLARIES.

A. Miliary Aneurysms. — You all know what miliary aneurysms are, so I will not describe them. Their favourite seats are the brain and spinal cord. Charcot and Bouchard have pointed out that miliary aneurysms are the most common cause of cerebral hæmorrhage.

In what way may our opinion be called for, from a medico-legal standpoint, in a case of sudden death from cerebral hæmorrhage?

I have told you that we very rarely have to make medico-legal reports after attacks of apoplexy. Death is only suspicious in certain special circumstances; for example, if the deceased had not reached the age at which cerebral

hæmorrhage usually occurs, or if it is attended by more or less unaccustomed phenomena, then the law requires an inquest to be held.

Miliary aneurysms are most common in aged people, yet children of 2, 5, 6, 7, or 11 years of age sometimes die of cerebral hæmorrhage. An inquest is rendered obligatory in such cases as these, either because the child has fallen down, or because its body presents ecchymoses, or especially because the public—which has not much knowledge of these matters—attributes the accident to some extraneous cause.

If we were to rely only on the statistics obtained from the cases collected in works of forensic medicine, we should arrive at the paradoxical conclusion that cerebral hæmorrhage is more common in the bulb than in the rest of the brain. As far as that goes, I can quote to you thirty or more cases of bulbar hæmorrhage, which have been reported because they are hæmorrhages of an unusual kind. I myself have only met with two such cases—one at the Morgue, the other in my private practice—and yet I have made a considerable number of autopsies in my life.

Death is sudden when the hæmorrhage into the brain is of considerable magnitude, and especially when the blood has found its way into the lateral ventricles. The amount of blood effused varies; it may amount to 10½ oz. in fulminating apoplexy, but it may be safely said that recovery is impossible when the effusion exceeds 7 to 9 oz.

Allow me to mention to you three cases in which an inquest was held; they will enable you to grasp, in a somewhat general way, the reasons for your interposition as experts in cases of sudden death from cerebral hæmorrhage:

A man fell down in the street in a seizure due to cerebral hæmorrhage; he cut his head on the kerb; no one witnessed the scene. The body was found, and, as there was a wound, the law required that an inquest should be held. At the autopsy it was demonstrated that this individual died naturally of hæmorrhage in the brain.

Again, a woman was found dead at the foot of her bed, with a wound on her forehead; her chamber utensil was broken. As she was living on bad terms with her husband,

he was accused of having killed her, and was arrested. The autopsy showed that she had succumbed to a hæmorrhage into one of the crura cerebri. Whether she had been overcome by the stroke at the very moment that she was about to obey a natural call to make water, or whether, on the contrary, she had been first struck by apoplexy, and under the influence of the stroke had executed the movement of rotation, which is commonly seen in cases of hæmorrhage into the crus, and consequently had fallen off the bed, I do not know; in any case, the wound was only the result of an accident, and her husband was acquitted.

The third case gave rise, in the last century, to a judicial error. Two individuals were arrested at Calais, and accused of having killed their mother. The first medical experts who had examined the body had indeed remarked that there existed in this woman a sub-epicranial and a cerebral hæmorrhage. As the two sons had had a dispute with their mother, they were immediately accused of matricide. Louis was consulted. Louis had for a long time been physician to the Salpêtrière, and was aware that sub-epicranial ecchymosis is a very frequent occurrence in those who are struck down by cerebral hæmorrhage; he declared that the woman had died a natural death.

There is nothing that ought to astonish us in the production of sub-epicranial ecchymosis, which was thoroughly studied by Charcot and M. Lepine some years ago.

In cerebral hæmorrhage, ecchymosis may appear under the scalp, or in the pleuræ, stomach or liver. There is only one important point about this fact which it is necessary for us to remember: we ought not to conclude, when we meet with ecchymosis outside the skull in a case of cerebral hæmorrhage, that there has been any violence at all; that ecchymosis may be produced naturally and spontaneously, as a consequence of the stroke.

When a lying-in woman dies suddenly from cerebral hæmorrhage, her death may give rise to a medico-legal investigation; not that in her case the hæmorrhage presents any symptoms different from the ordinary, but because sudden death in a lying-in woman, who has had to undergo

certain manipulations, or has had to swallow certain medicaments, astonishes the relatives or the attendants, who ask whether the physician is not responsible for the catastrophe. If, on the other hand, the woman has had no medical attendance, suspicion of an induced abortion arises at once and gives cause for an inquest.

B. Meningeal Hæmorrhages.—Meningeal hæmorrhages frequently occasion medico-legal investigations. You know that they take place in individuals who are predisposed thereto by alcoholic excess, who have syphilitic caries, or who are insane. As an effect of one or other of these conditions, pachymeningitis is set up, which leads to effusion of blood into the arachnoid space. Baillarger, Longet, Virchow, Lancereaux, and Cornil have studied the pathological anatomy of these pachymeningites. I only remember at this moment one point of importance, viz.: that the vessels of this newly-formed product are extremely fragile, and possess no middle coat. The readiness with which they give way is thus easily explained.

The medical jurist's services may be called for in these cases for different reasons. The individuals who are affected with pachymeningitis are either alcoholic subjects or are in an early stage of insanity; in either case the disease (alcoholism or insanity) may have hitherto run a certain part of its course unnoticed, and pachymeningitis may have developed unperceived even by the patient himself. Suppose that one of these individuals gives way to a violent outburst of anger, or that he gets involved in some common-place fight or scuffle; he may return home without manifesting any extraordinary appearance; but the next day he may be found dead, and the superintendent of police will remove his body to the Morgue.

Meningeal hæmorrhage does not take place suddenly; the little vessels which give way do not permit the escape of very much blood at a time. Life is compatible with the existence of hæmorrhage, as long as the compression of the brain is not excessive; according to the calibre of the ruptured vessel, life may be prolonged for five, six, seven, or eight hours; and even recovery is possible.

MM. Motet and Vibert met with the following case, which is somewhat perplexing: An old woman was the victim of a burglar, who, receiving unexpected resistance from her, struck her over the head with his jemmy. The woman became unconscious, and suffered in various ways from the injury, but recovered after a time. Meanwhile the burglar had been arrested; the trial was nearly at an end, when the woman died suddenly. An inquest was held, and the autopsy revealed the presence of pachymeningitis and considerable hæmorrhage into the arachnoid. This woman was neither addicted to alcohol nor insane; she had not exhibited any of the conditions which predispose to pachymeningitis. What was the right conclusion to come to? Could the pachymeningitis and consecutive hæmorrhage be attributed to the blow inflicted on the head? MM. Motet and Vibert did not venture to affirm this; it is probable that this was the actual course of events, but the medical experts, quite properly, did not feel justified in interpreting the facts so rigorously.

C. Capillary Embolisms.—Capillary embolisms will not detain us long; besides, they are rarely met with; *septic* emboli are the commonest. When there is a wound on any part of the body, especially when that wound is gangrenous, as in bedsores of the sacrum, fatal septic emboli may be deposited in the lungs. Here is an example:

A lunatic died in the St. Evrard Asylum. He complained before death of pain and sense of suffocation. The patients around him accused an attendant of having ill-treated the deceased. An inquiry was held, and I was directed to make an autopsy. There were no marks of blows on the body, but there was a bedsore over the sacrum, and there were some infarcts in the lungs. The patient had died of septic embolism.

I ought to say, Gentlemen, that since the introduction of antiseptic dressing these cases have become much more rare.

I cannot pass silently over a certain form of embolism which has been called 'embolism of fat,' the emboli having been formed in the little vessels.

It was about the year 1880 that Fournoy and von Recklinghausen believed that they could trace sudden death following fractures to these fat embolisms. I have had the opportunity of examining cases similar to those in which Recklinghausen had attributed death to embolisms of fat. According to his view, these emboli were formed out of the medulla of the fractured bones, which penetrated the veins and then blocked the vessels. For my part, I think that these fat emboli are often produced by the putrefactive colonies of micro-organisms, which were but little known fifteen years ago. Since microbiology has made the progress with which you are familiar, and since the colonies of putrefaction have become better understood, cases of death attributed to embolism of fat have become extremely rare.

D. Local Disturbances of the Circulation.—I come now to the last chapter of the disorders of the Circulatory System which may lead to sudden death.

An individual may die from anæmia or congestion resulting from a considerable disturbance of the general or local circulation. You know that these two circulations are to a large extent independent of one another. I will name to you as an instance a blush, the erythema of modesty, which follows even a very trifling emotion. Here is a phenomenon of congestion, which, if it shows itself in a very marked degree, may entail anæmia of some other part of the system.

In cases of fatal syncope from anæmia, it is of post-hæmorrhagic anæmia that we should think first of all.

I must mention to you the following case observed by myself:

A pregnant woman, having very large vulvo-vaginal varices, was returning from a visit to a midwife; a formidable hæmorrhage came on, and she died of syncope. The midwife was quite innocent of causing this accident. I have many times had to make an autopsy on women who have died of *post-partum* hæmorrhage. I will add that these women were often those who had just committed infanticide.

A man covered with blood and giving no signs of life was

found one evening on a seat in the outer boulevard. The superintendent of police thought that a crime had been committed. I made an autopsy, and found a clot reaching from the mouth to the trachea; in the trachea was found a fibrinous clot, like those which form in the heart. I was able to follow up this clot, and proceeding farther and farther, I at last came to an open aneurysm in a cavity in the lung.*

When paracentesis abdominis is performed, at the moment that the blood flows again into the little abdominal vessels which the pressure of the contained fluid had kept closed, a congestion is produced here which may entail death from cerebral anæmia; even a moderate degree of congestion may suffice to bring about this catastrophe.

It used to be the practice when an individual was attacked with copious hæmoptysis to apply cupping-glasses or Junod's boot—you know that apparatus which fits closely on to the leg and is then exhausted of air; the blood is drawn with force towards the lower extremity. In America, where Junod's boot is still frequently employed, though almost exclusively by quacks, fatal syncope is frequent. The quantity of blood displaced by this attraction to the leg can scarcely be more than $1\frac{3}{4}$ pints, yet it is enough to cause syncope.

When individuals get up for the first time after a long illness, fatal syncope may take place; it is therefore necessary not to allow convalescents to rise hurriedly. In fact, a sudden congestion takes place in the lower limbs when we move from the horizontal to the upright position.

There is no need to have been kept to bed a long while to experience these sensations. We have all sometimes felt giddy or dizzy on jumping out of bed in the morning, due to anæmia of the brain produced by sudden congestion of the lower limbs. It is obvious that these phenomena will be much more pronounced in convalescents and lying-in women, and may even be sufficient to cause fatal syncope.

Owing to the doctrine of embolism being now in favour, this syncope will nearly always be attributed thereto, while in reality it is simply due to cerebral anæmia.

* It is perhaps open to question whether death in this case was not due to asphyxia rather than to syncope from anæmia.—TRANSLATOR.

You will not find anything remaining at the autopsy which will enable you to conclude that syncope has occurred. We possess no characteristic sign of this accident.

In connexion with the subject of death due to cerebral anæmia, the result of disturbance of the general circulation, it is appropriate to say a word or two about certain forms of congestion which may likewise entail death. I refer to those attacks of congestion to which the subjects of alcoholic excess are liable. Generally these persons have taken food, and eaten heartily while intoxicated; they go to bed, then in the middle of the night they turn sick and vomit, but cannot effectually expel the contents of their stomach. The food that they have eaten enters the nasal fossæ, the trachea, and bronchi, and they die, literally drowned in their own vomit.*

* Is vomiting in these cases due to cerebral congestion, or merely to irritation of the stomach by undigested food?—TRANSLATOR.

LECTURE III.

SUDDEN DEATH IN LESIONS OF THE CEREBRO-SPINAL SYSTEM AND THE MAJOR NEUROSES.

GENTLEMEN,—Certain lesions of the cerebro-spinal system may in an unexpected way give rise to sudden death which appears to the eye of the law to be of a suspicious nature.

I. MENINGITIS.

I will place *latent meningitis*, acute or chronic, first. I shall appear to you to be guilty of an enormous medical and scientific barbarism. You have been brought up clinically in the idea that meningitis reveals itself by fever, pain in the head, vomiting, muscular spasm, etc. How, then, you will say, can meningitis, going on to suppuration of the meninges, develop secretly, without attracting any attention, without displaying any of the classical symptoms of inflammation of the coverings of the brain? Well, gentlemen, latent meningitis does exist . . . and its existence is only discovered *post-mortem*.

Let me give you some examples. An individual felt out of sorts all at once, having been in good health hitherto. He went to a druggist, who gave him two pills; the patient swallowed the pills and died. The druggist was accused of having poisoned him. Tardieu made the autopsy, and found suppurative meningitis, with a layer of pus of appreciable thickness spread out over the pia mater.

Ollivier, of Angers, has related the case of a workman attacked with a sudden illness while he was at his work; he

went to bed and died in four hours. Suppurative meningitis was found at the autopsy.

Lastly, M. Vibert made an autopsy on the body of a prostitute who was found one morning in a bedroom of a hotel with the death-rattle in her throat. She was brought to the hospital and died there. As the girl had come to the hotel the evening before in the company of a man who had left again an hour afterwards, the idea of a crime naturally arose. M. Vibert ascertained at the autopsy that there was a sheet of pus two-fifths of an inch thick spread over the whole extent of the meshes of the pia mater.

Each of these patients performed all the normal and physiological acts of life until within a few moments of their death; none of them had any mental disturbance, pain, vomiting, or paralysis; their meningitis was therefore quite latent. I should add that they were addicted to alcohol.

Tubercular meningitis runs its course under the same conditions as suppurative meningitis. The results of inquests on such cases are nearly always the same; they are generally held on children of 12 to 15 years of age. These children all at once become dull and sullen; they have fits of ill-humour, become quarrelsome and sometimes are beaten, then they rapidly die in the course of 12, 15, or 24 hours. The autopsy reveals the presence of tubercular meningitis that must have lasted 8, 10, or sometimes 20 days, and that has developed without any of the earlier symptoms or signs.

Chronic meningitis, so well described by MM. Hanot and Joffroy, evidently has fewer surprises for us. The two individuals on whom they made autopsies had been for a longer or shorter time inmates of a lunatic asylum. The suddenness of death might have caused an attendant to be suspected, and it is such suspicions that might give occasion for an inquest. They found dropsy of the fourth ventricle, which was flattened and increased in breadth to double its size.

Cerebro-spinal meningitis is happily not very common in France; it prevailed there all through the second third of this century. It assumed an epidemic character. The

epidemic which raged three or four years ago in Cyprus was very severe. Cerebro-spinal meningitis is attended by vomiting and paralysis, and death takes place in some cases in three or four hours. Often the disease does not manifest itself by any symptom; it runs its course rapidly and secretly. When there is an epidemic of this complaint anywhere, it serves to explain any sudden death that may happen, and there is hardly ever any need for an inquest; but when such cases occur either at a time when no such epidemic is prevalent, or at a place at some distance from the seat of the epidemic, they cause astonishment and baffle explanation, and the officers of the court order an inquest.

II. ABSCESS OF THE BRAIN.

Abscesses of the brain may run their course without attracting the attention of the patient, or of his medical attendant, or of those about him. This seems all the more extraordinary, because I am not speaking here of those miliary abscesses the size of which does not exceed that of a pin's head, but of those abscesses which are as big as a pigeon's egg, or even a hen's egg. These abscesses may cause death after symptoms which only last a few hours.

When I was a young doctor and physician to the Sainte-Barbe College, I had one day to examine a young servant of the institution who was attacked with otitis. I sent him into the hospital, where he came under the care of Bernutz. He returned in a fortnight, apparently completely cured. On the evening of his return, to celebrate the occasion, he went to the Vieux-Chêne ball, where he drank freely and danced all night. Next morning, after his return to Sainte-Barbe, he set to work to polish the floor of the dormitory as it was his duty to do. All at once he fell down, and I was summoned to see him; as he had become unconscious, I sent him back to the hospital, where he was re-admitted, this time under the care of Gallard. The latter noticed that the running from his ear had nearly ceased; the patient gradually recovered his senses, but died suddenly on the following day. At the autopsy an abscess the size of a hen's egg was discovered in the temporo-sphenoidal lobe.

This abscess, which had caused death in a very sudden manner, evidently did not originate merely on the night of the ball, but must have developed at the time when he was under Bernutz. Thus, this man had for a fortnight an abscess in process of formation in his brain, and yet he was able to accomplish all the normal acts of existence.

I had been much struck by this case. In 1866, I read before the Anatomical Society a memoir on 'Caries of the Petrous Portion of the Temporal Bone,'* and I found in the writings of Itard, as well as in those of other authors, fifteen almost identical cases of abscess of the brain recorded. These abscesses are usually consecutive to caries of the cranial bones, but very rarely to syphilitic lesions; these abscesses are very frequent as a result of caries of the petrous portion. Only once was an abscess of the brain, due to a lesion of the bones, provoked by a blow. This case was reported by Closmadeuc. There was a peripheral hæmorrhage. Toynbee has made a study of this question: the plate of bone which separates the tympanum from the meninges is very thin; it is sometimes congenitally absent. On the other hand, the capillary circulation of the middle ear communicates with that of the meninges. It is intelligible, therefore, how easily inflammation may be propagated from the middle ear to the meninges. It is less easy to understand how an abscess of the brain comes to be produced under such conditions, because abscesses of the brain are never in contact with the carious surface. The grey matter is intact; the white matter alone contains the abscess cavity. It would seem as if the grey matter served as a barrier to the abscess. I will not attempt to explain to you why things happen thus; I only beg you to remember this: an individual who has lost a large portion of one cerebral hemisphere may live for a certain time without the lesion being made manifest by any disturbance of health whatever.

Is this contrary to physiology? No.

As a matter of fact, long before the occurrence of the case which I have just related to you, M. Chauveau injected different substances into the brains of living sheep. This

* Brouardel, 'Carie du Rocher' (*Bull. de la Soc. Anat.*, 1866).

was during the epoch when great endeavours were being made to determine the question of cerebral localization, and M. Chauveau hoped to throw some light upon the question by his experiments. He began by injecting water; the sheep was somewhat stunned at first, but soon recovered and went on grazing in the field; then suddenly, on the following day, it sank and died. After water, M. Chauveau injected other substances, including chloride of zinc, which transformed that part of the brain with which it came into contact into a firm magma. The results were always the same, but the experiments have not been published. But I remember this fact, that the animals could live with a portion of their brain destroyed, and that the lesion would not be revealed by any external sign. Well, Gentlemen, it is the same in the case of man.

Some time ago Itard, a celebrated aurist at the commencement of this century, paid great attention to this subject. He collected a great number of cases, and wrote that Nature was very provident, inasmuch as the cerebral abscess, which was trying to work its way towards the exterior, attacked with caries the very thin bony lamella near which it was almost always situated, in order to give vent to the pus. This condition is true if we take it the reverse way, for it is not the abscess, but the caries of the petrous portion, which is the initial phenomenon.

III. CEREBRAL TUMOURS.

Cerebral and *cerebellar tumours* behave almost exactly like abscesses of the brain.

We are less surprised to find them at the autopsy, for we know that these tumours often develop without giving rise to any indications of their presence. Individuals thus affected may have attacks of vomiting, which are put down to dyspepsia; if they are young or adolescent, they may have hemichorea, which sometimes suggests the idea of a cerebral lesion. Others have vertigo, diabetes insipidus, or diabetes mellitus. None of these symptoms attract much attention; but when the patient suddenly falls down either

in the street or in his own house, the more or less singular circumstances in which he has been struck down, or else a wound or abrasion occasioned by the fall, causes the law to intervene.

Here is an example: A dozen years ago I was directed to make a medico-legal autopsy in a case with the following history: It was the commencement of a strike. Some paviors who had a disagreement with their master wished to enter his office, and lay their complaints before him before they left their work. Sharp words passed between them, a dispute followed, and the master, who had been driven to the further end of the office, tried to extricate himself by pushing aside two or three of the workmen who were standing nearest to him. One of these men suddenly fell dead. The master was arrested and locked up, as much to preserve him from the fury of his workmen as to keep him within the grasp of justice. At the autopsy I found in the brain of the deceased workman three little pediculated fibrous tumours on the anterior wall of the fourth ventricle, the largest of which was the size of a small haricot bean. This man had been for some time in imminent danger of sudden death. The excitement of the circulation provoked by the quarrel had sufficed to bring it about. His body bore no trace of violence, and the other witnesses of the scene declared that he had not been struck.

These examples are not the only ones. In Germany, Maschka looks upon alcoholic excesses, fatigue of all kinds, and dancing, as the immediate cause of death during the development of these tumours.

These tumours are most often tubercle, cancer, or fibroma; sometimes hydatid cysts have been observed. Lancisi reported* a case a long time ago in which death was due to the presence of a large hydatid on the surface of the brain, fatal either by rupture or by compression of the brain.

The indifference that the brain sometimes shows to the presence of tumours is confirmed experimentally by its tolerance of foreign bodies, *e.g.*, the projectiles of fire-

* Lancisi, 'De subitaneis Mortibus,' libri duo. Romæ, 1707.

arms. In one autopsy we found a revolver bullet, $\frac{1}{3}$ inch in diameter, lodged in the left occipital lobe, where it had been encysted for a long time, and a second similar bullet, the base of which was embedded in the squamous portion of the right temporal bone. Both were the results of attempted suicide which happened several years previously. The individual at last put an end to his life by hanging.

Those tumours which most commonly give occasion for medico-legal investigations are located in the bulb, pons, or crura cerebri. They may compress the veins of Galen, and sometimes reveal their existence by clouding the intellect, or by causing vertigo or visual trouble, but very often nothing occurs to make their presence suspected. I shall only mention sudden death as a result of *glosso-labio-laryngeal paralysis*, to refresh your memory. You know that this affection is due to destruction of the cells of the nuclei where the motor nerves of the tongue, lips, and larynx have their origin in the bulb. The hypoglossal is the first to suffer, then the facial, then the pneumogastric.

Sudden death is also one of the anticipated terminations of *acromegaly*.

IV. LESIONS OF THE SPINAL CORD.

I come now to lesions of the spinal cord. I shall not say much about medullary hæmorrhages, which are ill understood. As far as my experience goes, they have only given rise to medico-legal investigations in the case of women either during pregnancy or after confinement. *Pott's disease*, when it affects the spine just below the occiput, may at an early stage lead to sudden death. By the name 'Pott's disease' is understood tubercle of the vertebræ. This often only manifests itself by localized pain or by torticollis. An abrupt movement or violent effort may cause the odontoid process to break and compress the spinal cord. There is loss of consciousness, and more or less rapid death. Heurteaux, of Nantes, has narrated a case of sudden death resulting from the opening of an abscess due to Pott's disease of the spine just below the occiput into the spinal canal.

V. EPILEPSY.

The question of sudden death in the course of an attack of epilepsy is of great interest. When even an experienced medical jurist publishes a treatise on *post-mortem* examination in relation to forensic medicine, he finds it very difficult to assign definite and pathognomonic characters to death in an epileptic fit. In the treatises which you have in your hands, it is stated that death is due either to rupture of the heart, or to the passage of food from the stomach into the trachea and bronchi, or else to asphyxia resulting from the position occupied by the patient during the fit, such as may cause the mouth and nose to be pressed into the pillow. In the first case it is clear that death must be attributed to a lesion of the heart; in the other two, to a merely mechanical asphyxia. There is nothing therein peculiar to epilepsy.

In all the works of Charcot or of M. Grasset at the Salpêtrière, we could not find twenty cases of death from epilepsy. And yet M. Lesser reports 17 cases of individuals dying in an attack of *epilepsia gravior*. Looking at these cases closely, it is evident that he includes under the name 'epilepsy' all sorts of convulsive seizures—uræmia, etc.

What are the signs of death that are to be found in the true epileptic neurosis? After an attack we find that the neck and shoulders are covered with spots like flea-bites, that the conjunctivæ are injected, that the tongue is bitten in one or several places, and that the bronchi are filled with froth. These are the signs that we shall meet with in the body of an epileptic who has died in a fit. We have no others whereon to base our conclusions, and these signs are almost the same as in death by strangulation by means of a somewhat pliable ligature, such as a handkerchief or scarf, which does not leave a mark on the skin and subcutaneous cellular tissue.

A dozen years ago, the body of a child was found under a heap of sacks on one of the quays of Paris. The marks found on the body had those characters which I have just described to you. There was no very distinct mark of

strangulation round the neck, and there were but few ecchymoses forming punctate lines. The case was about to be dismissed. I expressed my conviction to the public prosecutor that that child had been strangled. The inquiry was resumed, and the truth was discovered. The child wore a scarf round its neck, with the ends waving behind. His companions had pulled the ends hard, so that the child was strangled; and then, being frightened at what they had done, they had hidden the body under the pile of sacks, in the midst of which it had been found.

Many diseases also may produce similar lesions.

The law interferes in the case of death in the course of an attack of epilepsy on account of attendant circumstances which may make the death look suspicious. I know of two such cases, one of which has remained deeply graven on my memory by reason of the tragic consequences it had. A tradesman, 33 years of age, whose business was beginning to prosper, accompanied his wife to the station, as she was going on a journey. On returning from the station he met a girl, whom he accosted and took home with him. After having performed a certain number of acts, the nature of which you may guess, the girl went to the water-closet, but did not return. The man became uneasy, rose up, and knocked at the door, but obtained no answer; and from sheer weariness he went to fetch the porter, who broke open the door. The girl had died in the water-closet, and as she had fallen from the seat she had injured herself in several places; among other injuries she had a scalp wound. The police superintendent took the matter up, and an inquest was ordered. This girl had a hard chancre, gonorrhœa, and pus in the bladder. She presented also punctate ecchymosis of the conjunctivæ and shoulders; the tongue was bitten, and there was froth in the bronchi. My conclusion was that this young woman *might have* died from an epileptic fit. The superintendent was informed from other sources that she was subject to epileptic convulsions.

The unfortunate tradesman acquired syphilis and gonorrhœa. The scandal induced his wife to petition for a divorce; he had to give her back her fortune. Deprived

of this capital, he could not pay his debts; he became bankrupt, and I am told that he blew his brains out some years afterwards.

In the country the question may present itself under a different aspect. Individuals may fall into the fire during epileptic fits, and burn themselves more or less severely. This fact, known to criminals, has sometimes led them to throw the body of their victim into the fire, or to set the house on fire. In every case there are difficult problems to solve in medico-legal inquiries concerning sudden death in the course of an epileptic fit.

I can relate to you another still more recent case:

A careless young fellow, 16 or 17 years of age, was found dead in the prison van which was carrying him from the police-station to Mazas prison. The municipal guard who was in the van said that the individual must have had an epileptic fit. At the autopsy I only found a little froth in the bronchi; there was no punctate ecchymosis under the conjunctivæ or on the shoulders, or any biting of the tongue. The inquiry threw no light on the epileptic antecedents of the lad. He was morally abandoned, and had no relatives; he had run away from the situation which had been found for him. No one could supply any definite information. I think that the opinion of the municipal guard was correct, but you will understand that I could not base my conclusions on the diagnosis of a Parisian municipal guard.

I do not know any more difficult question for the medical jurist to solve, if he is not already aware that the individual, whose body he is examining, had a history of epilepsy.

VI. HYSTERIA.

Sudden death in the course of a hysterical fit is much rarer still than in an epileptic attack. The cases published by M. Grasset of Montpellier* do not seem to me to be very conclusive; they refer to individuals who suffer from albuminuria, cerebral tumours, sclerosis, etc., in addition. It seems to me that in this complicated condition it is not

* Grasset, 'Maladies du Système nerveux.'

the hysteria, but the organic lesion, to which sudden death must be ascribed.

Mollière of Lyons is the only author who has published a case where it was impossible to discover any cause of death whatever, beyond hysteria.

VII. INHIBITION.—SLIGHT INJURIES.

Insignificant injuries, even the slightest blows, may bring about sudden, even instantaneous, death. In such cases as these the medical expert may be extremely perplexed. Before proceeding any further, allow me to relate to you an absolutely typical case:

Two boys, aged 12 and 14, apprenticed to a typographer, were playing in the workshop after luncheon; they rolled on the ground, wrestling together and throwing one another over, but were laughing all the time and had no quarrel or dispute. The bell rang for them to resume work; the little apprentice, who was at that moment lying uppermost, rose up laughing, and gave the other a slight kick in the epigastric region, saying: 'You are conquered; your shoulders have touched the ground.' The other attempted to rise, but fell back dead. There was much excitement about it in the workshop. A medico-legal examination was made, but no trace of ecchymosis could be found. We did not even find anything which would explain the fact of death, unless it was due to a small hæmorrhagic point in the bulb no bigger than a pin's point.

This case is the type of absolutely sudden death provoked by a blow in certain regions of the body, although the blow may not have been violent.

There are certain regions which present this susceptibility; the epigastrium is the chief. Lancisi, Astley Cooper, and Maschka have reported cases of sudden death following slight violence inflicted here.

[Sir Astley Cooper's case is as follows*: A man belonging to the India House was attempting to lift a weight, when another came up and jocosely said: 'Here, stand on one

[* Cooper, 'Lectures on the Principles and Practice of Surgery,' Eighth Edition, p. 9.]

side, and let an abler man attempt it;' and at the same instant gave him a slight blow on the stomach, when the poor fellow dropped down and expired. His body, upon being opened, showed no marks of violence.]

What happens in such a case? It used to be said that death took place from syncope, by reflex action upon the heart; nowadays, since the works of Brown-Séquard have been published, we call it death by 'inhibition.' Instead of a reflex movement, there is produced, on the contrary, an arrest of one of the functions which was in action at the time the violence was suffered. What are the functions which are always in operation in the human body? They are those of circulation and respiration; and these are the ones which are arrested.

It has been observed that every time that the action of the heart has been stopped after a blow on the epigastric region, the process of digestion was going on. I have already spoken to you of M. Mirenowitch's experiments on frogs; I shall not recapitulate them; but remember that there exists an intimate relation between the stomach and the heart, by means, no doubt, of filaments of the pneumogastric.

Next to the epigastrium must be placed the *hypogastric region;* a kick in the lower part of the abdomen may induce sudden death.

Records of sudden death after violence, even though this be slight, applied to the *laryngeal region,* are rare. Nevertheless, such cases exist.

You remember a case which I narrated to you, while we were studying the 'moment of death,' of what befell a certain priest (p. 22), who was dismissed for his misconduct, and accused of having killed his mistress, just as she was packing up her trunk. The priest maintained that he had only clasped his *quondam* mistress's neck, without using any force, and only in fun, and that she dropped dead immediately.

The medical jurists of the time did not venture to assert or deny the possibility of such a fact.

I mentioned to you also that, in consequence of the feeling

excited by that case, an officer of dragoons said that one of his comrades had been nearly killed in the same manner.

Since then, examples have multiplied. Tardieu has recorded the case of an old woman who sold some snuff to a little urchin. While he was waiting for his screw of snuff, the boy, tickled by the sight of the old woman's *pomum Adami* moving up and down in her neck, struck her a blow on the larynx as if he were trying a catch a butterfly; the woman died instantaneously.

It has been stated, as an objection to the medical jurists who believe in the explanation of these cases by inhibition, that there have been many others in which individuals have not died after sustaining injuries of considerable violence over the region of the larynx, *e.g.*, after having survived attempts at strangulation. We do not as yet know the mechanism of such processes, but we know that they occur; so when you are asked in a court of law if it is possible for a person to die when placed in those conditions which we have just been examining, you should reply: 'It is possible.'

Gentlemen, there are also other parts of the body which possess this special sensitiveness: such are the mouth and nose.

Volkmann relates that he had to operate one day on a hare-lip in a child a year old. He inserted the pins; the child became blue and ceased to breathe; he removed the pins, and the child returned to life. Four hours afterwards Volkmann wished to proceed with the operation; this time no accident occurred. Volkmann even remained for some time by the side of the child to see that all was going on well. He then went home, but was sent for again in great haste; the child had again presented the same grave symptoms as at the first operation. Volkmann hastened back, but the child was dead.

The experiments of Brown-Séquard have shown that the regions over which the branches of the trigeminal nerve are distributed have the same susceptibility as the epigastrium and the larynx. It has also been thought that the nape of the neck might be included among these 'privileged' regions: there is only one case on record, and that is not conclusive.

Some students at Aberdeen thought that they had reason to complain, rightly or wrongly, of the conduct of the University porter, and resolved to play him a trick in return. They carried him off, led him into a dark room in which there was a block of wood, blindfolded him, and told him that he was going to die. The porter was naturally very much agitated. He was made to lay his head on the block, then, by means of a wet cloth twisted into a lash, one of the students gave him a blow on the nape of the neck. The man died immediately, to the stupefaction of the students.

What was the cause of death? I do not know at all. Was it the blow on the nape of the neck? It is possible. But do not forget that the larynx rested on the block, and that it might have been the seat of a shock by *contrecoup*, or of such a violent injury as would occasion death.

Certain minor operations and insignificant wounds sometimes bring about rapid or sudden death.

In Schmidt's *Jahrbücher* I find, under the author's name, the following case:

A peasant was stung by a bee; the sting was followed by syncope, but the man came to himself. Two years afterwards he was again stung by a bee, and died. This man had evidently an exceptional susceptibility.*

I quote this case to you because there was no question here of chloroform, or of any accident complicating surgical procedures. The same applies to the following two cases.

Martineau quotes the case of an individual in whom a hydatid cyst was to be punctured; the trocar did not enter the cyst, and was withdrawn. Only two or three drops of blood escaped; the patient suddenly expired. Were any small branches of the pneumogastric nerve injured?

Desnos relates a different case, also concerning an individual suffering from a hydatid cyst. Desnos applied Vienna paste in order to procure the formation of adhesions. Everything went on well at first, but in four or five hours after the application of the caustic, the person died sud-

* Inquests are reported occasionally on cases of death resulting from the sting of a wasp, often, though not always, about the mouth.—TR.

denly, although no lesion of the heart or of any other organ could be detected *post-mortem*.

Therefore, under the influence of certain extremely superficial lesions sudden death may ensue. Suppose, now, that chloroform had been administered, the responsibility of the operator would be called in question.

Sudden death may even take place before an operation is commenced. A patient on whom lithotomy was about to be performed died at the very moment at which the surgeon was introducing the sound into the urethra. There was no autopsy, and I will do no more than mention the case.

I can, however, relate a more recent one of the same sort:

M. Legroux sought the aid of M. Routier in applying a splint to one of his patients who had broken the neck of her femur. While these gentlemen were making their preparations in an adjoining room the woman died. Suppose this death had happened in the course of an operation after the administration of chloroform or cocaine, I need not tell you what the consequences would be. You ought always to keep these cases in your mind, especially if you happen to be called upon as experts to sit in judgment upon your fellow-practitioners.

The presence of foreign bodies in the pharynx, larynx, and œsophagus produces a more or less rapid death; but these cases do not belong to the special chapter of forensic medicine upon which I am now discoursing to you.

Gentlemen, you can see that in a large number of cases medico-legal investigation will only lead to very inconclusive results if you do not know the manner in which the fatal accident has happened, and if you have not been made acquainted with all the details. Suppose the case is one of a child's death from convulsions, your scalpel will give you no scientific proof of the pathogeny of death in this case, or in a great many others.

I advise you also to reply very clearly and without hesitation to the questions which the judge asks you, and to say, 'I can find no lesion which can explain death.' You will, of course, state all the morbid phenomena that you have found in the heart, the brain, the liver, the kidneys, and

every other organ; but you should add that other persons may have lesions quite as serious without death taking place; you should say that you are obliged to confess that it is impossible for you to say what is the actual cause of death.

It is no humiliation for a medical jurist to acknowledge, after making the most conscientious research, that he does not know; but it would be humiliating for him to recognize that he has made a mistake.

LECTURE IV.

SUDDEN DEATH DUE TO LESIONS OF THE RESPIRATORY SYSTEM.

GENTLEMEN,—We shall devote our attention successively to lesions of the larynx, trachea, bronchi, lungs, and pleuræ.

I. LESIONS OF THE LARYNX, TRACHEA, AND BRONCHI.

A. Lesions of the Larynx.—I described to you those lesions of the larynx which may cause sudden death when I spoke to you of the inhibitory phenomena which follow blows inflicted on the laryngeal region ; but I am anxious to tell you first of all, and I entreat you to keep it in mind, that sudden death is caused much more often by superficial than by deep lesions of the larynx. Tubercular or syphilitic ulceration of the mucous membrane of the larynx may certainly give rise to œdema of the glottis and asphyxia ; but this œdema is foreseen : the quality of the patient's voice has been altered for a long while, he coughs, expectorates abundantly, and has become aphonic. There is no ground for surprise.

We are, however, baffled by such a case as this : A man, 42 years of age, wished to catch an omnibus. He ran about ten paces, jumped on to the platform, and, at the very moment he was entering the vehicle, fell down dead. At the autopsy, two very small polypi, as large as peas, were found close to the ventricle of the larynx, and it was then ascertained that this man had come up from the provinces some days before to undergo an operation for the removal

of these growths. He had had no attack of spasm or of laryngitis before his death.

In adults, sudden death may be due to the presence of a polypus in the larynx. In children it may occur in the course of laryngismus stridulus, or at the moment of removing the cannula after the operation of tracheotomy. Some children do actually die in these last conditions. In others it may be necessary to replace the cannula, in order to obviate the laryngeal spasm which threatens to carry them off, and who will be saved by this means.

What are the causes of these spasms? Authors differ. Some have found little vegetations around the cicatrices, which they say cause the spasms which compel further operative interference. Others state that they have never found anything of the kind, and that death takes place unexpectedly. I will not say which is true. I merely advise you to remember the dangers which a child may incur upon removal of the tracheotomy tube.

B. Lesions of the Trachea.—I must draw your attention particularly to fatal asphyxia resulting from the introduction into the trachea of food, the contents of a pulmonary cavity, or of a lumbricus which has contrived to ascend into the pharynx and enter the glottis.

The most common cases are evidently those in which food coming from the stomach has been introduced into the trachea. The following case is borrowed from Laennec: 'Professor Corvisart, wishing to pay surprise visits to a certain department of the Clinical Hospital, went there one evening at an unusual hour. He entered the porter's lodge, and found this individual digesting his dinner, with which he had taken too much to drink. The man was surprised, and felt sick, but made a violent effort to restrain vomiting. He fell to the ground and expired. When the body was opened, the bronchi, trachea, and larynx were found full of half-digested food.'*

Gentlemen, whether or not an individual has made such a bacchic repast is of little consequence. He feels that he must be sick, though he wishes not to vomit because he is

* Laennec, 'Auscultation médiate,' 3rd edition, tome i., p. 259.

in the presence of his superior, or of some one before whom he would be ashamed to do so. He strives by a violent effort not to expel the food which is thrown up his œsophagus into his throat. The chymous mass enters the trachea, and he dies, asphyxiated.

In order to understand the readiness and the force with which foreign bodies may enter the trachea and bronchi, I will mention to you the case of a sewerman, who fell in the sewer of the Rue Rochechouart with his face in the trench of the sewer, and whose trachea M. Descourt found to be stuffed with sewage sediment, as if rammed in by a ramrod, and in the midst of this mass was a pebble as large as a haricot bean, which had been made to enter there by a strong effort of inspiration. Further evidence is afforded by those new-born infants who are thrown into privies and fall into semi-solid fæcal matter; they make efforts at inspiration, and thus introduce this matter to the finest extremities of the bronchial ramifications. When a section is made of their lungs at the autopsy, and pressure is applied, little threads like pieces of vermicelli are squeezed out, the excrementitious nature of which it is easy to recognize.

C. Lesions of the Thyroid Body. — The trachea and bronchi may be compressed from without by a morbid condition, which sometimes occasions sudden death. This disease is hypertrophy of the thyroid gland. It is true that, in cases of very large suffocating goitres, attention is aroused, and the accidents which may happen are foreseen. But goitres may lead to sudden death although they are quite small, and do not give rise to stridulous breathing or to attacks of dyspnœa; in women, whether pregnant or not, hæmorrhages may take place in cysts of the thyroid body, and prove rapidly fatal.

D. Lesions of the Mediastinum.—Tuberculosis of the bronchial glands may also bring about sudden death.

Cases may present themselves in several forms:

1. The existence of tuberculous glands around the bronchi is not easy to recognize; sudden death happens more frequently in these cases than in others. Remember what you see in a strumous child whose cervical glands, for

example, are swollen: it seems to you at first that these glands are enlarged; they are really small. It is the surrounding tissue which is œdematous and swollen, and its congestion gives the gland its enormous appearance. It is the same with the bronchial glands. The nodular mass compresses the trachea, and if the process takes place in youths or in children, whose trachea and bronchi are very soft, the pressure may be so great that death occurs in an attack of suffocation in the course of two or three hours. It is very difficult in such a case to make a precise diagnosis. Auscultation reveals nothing of importance, and percussion alone can give you a clue.

2. In the second period, when there have been repeated attacks of inflammation of the peri-glandular cellular tissue, it is no longer soft and yielding, but becomes hard and resistant; it continues to contract, and thus constricts the trachea and bronchi. The bronchial glands themselves are hard and degenerated, sometimes containing calcareous deposits. They may be expelled after having perforated the trachea. Fritz, one of my fellow-assistants in the hospital, had to perform tracheotomy one day, on an emergency, upon the daughter of the director of the hospital to which he was attached; this little girl was stifled and very nearly asphyxiated, when Fritz withdrew from the trachea a calcareous body which was nothing but a bronchial gland.

Under the influence of this compression bronchial spasm is produced, followed by fatal syncope. An autopsy will immediately disclose the cause of death in this case.

Rilliet and Barthez have stated in their book that the large bloodvessels may be opened by the ulceration into them of bronchial glands which have become hard and cretaceous. This may possibly occur, but at any rate it is very rare, and I have not seen it mentioned by anyone except these two authors.

Sudden death has been observed in *cancer of the mediastinum*. I have only met with one such case, and it gave rise to medico-legal inquiry.

An attendant at the Necker Hospital was accused of

having strangled a patient who was restless in his bed. The autopsy disclosed the fact that this individual, on whose body no trace whatever of violence could be detected, had an enormous mediastinal cancer three inches in diameter; this cancer compressed the trachea so as to completely flatten it.

With regard to this, allow me, by way of parenthesis, to put you on your guard against accusations against hospital attendants, which are nearly always made at random. I remember a case which occurred in the St. Anne Asylum. A lunatic, who was somewhat less mad than the rest, was employed there in helping to keep the books of the establishment. One day, while turning over the leaves of the register, he came across the name of a deceased patient with this note appended: 'Internal strangulation.'

The madman plied his imagination, and persuaded himself that this patient had been strangled by one of the house-physicians. He made formal accusation to the police, so that the law took the matter up; exhumation was ordered, and at the autopsy intestinal strangulation was found, which had caused death.

Gentlemen, we may smile when we read of such cases: they are very difficult to clear up, and they cause the medical expert the greatest annoyance.

II. LESIONS OF THE LUNGS.

A. Pulmonary Congestion.—Pure, ideal pulmonary congestion, without any primary or concomitant disease, is very exceptional. We shall have to speak of sunstroke and heat-stroke in this connexion.

I think that the cases of idiopathic pulmonary congestion reported by different authors as having caused sudden death should be accepted with caution. Hourmann relates that a young man went to a ball after partaking of a heavy dinner, and suddenly fell down dead. He adds that the heart was very large.

Dr. Fortassin, who had advanced cardiac disease, retired

to bed; in the night rattling was heard in his throat; his friends ran to his side, but he died. At the autopsy his lungs were found to be like two bags of blood; the right lung was extensively lacerated, and the pleural cavity was full of blood.

This case is not one of idiopathic pulmonary congestion, but of an accidental complication of heart disease, which seems to have caused death.

The same remark applies to the following case, related by Ollivier of Angers:

A man was in arrears with his rent; in an interview with his landlord a somewhat violent dispute took place, and the man died suddenly. At the autopsy it was found that he had adherent pericardium.

M. Verneuil has related several cases of death from pulmonary congestion in the course of erysipelas; Devilliers, in the puerperal state. Houdé wrote his inaugural thesis on the frequency of pulmonary congestion in articular rheumatism. These are, in my opinion, examples of secondary pulmonary congestion.

I believe that pulmonary congestion sufficiently intense to induce sudden death, without any concomitant disease, is extremely rare, and that an autopsy will always reveal the disease which has determined the pulmonary congestion. On one occasion, at the Morgue, I came to the conclusion that death was due to pulmonary congestion. Both lungs were really gorged with blood, but the bronchi were the seat of considerable dilatation—being large enough to hold pigeons' eggs placed in a row; between the dilated bronchi the pulmonary tissue was in the condition of chronic pneumonia.

When there is a less extensive disease of the lungs, there may be a violent congestion around this lesion—quite out of proportion to the importance of the lesion itself; still, the primary disease exists.

We have nowadays quite given up using the phrase 'fluxion to the chest'; we use the term 'pneumonia' instead. 'Fluxion' has disappeared from our vocabulary, and, in fact, nothing can be seen of it *post-mortem;* but,

nevertheless, it is an accompaniment of some diseases, and constitutes a source of danger to life.

As a consequence of tuberculosis or of renal or cardiac disease, pulmonary congestion may occur, and may bring about sudden death, but it is not idiopathic.

B. Pneumonia.—I come now to sudden death in *pneumonia*.

Gentlemen, when we hear for the first time of sudden death in a case of pneumonia, we feel as much astonishment as when we are told of sudden death in abscess of the brain; and yet pneumonia may, under certain circumstances, run its course in a latent manner, and only be recognized *post-mortem*. Hourmann and Dechambre were the first to give a systematic account of sudden death in pneumonia, while they were house-physicians at the Salpêtrière. At that time science was dominated by the views of Morgagni on morbid anatomy; everyone endeavoured to classify, define, and catalogue diseases; sudden death in pneumonia was put down to cerebral congestion. Hourmann and Dechambre noticed that female inmates of the Salpêtrière would sometimes die suddenly under singular conditions; for instance, they might have taken their breakfast and be walking in the garden or sitting on a bench talking to their companions, and all at once fall down dead. *Post-mortem*, these gentlemen found extensive pneumonia that must have existed for several days, and yet had given rise to no symptoms. We understand these cases better now. Charcot has described them well, and has proved that not only is there no rise of temperature in such patients, but that the temperature is even subnormal.

I do not wish to discuss the question of the absence of fever and of other symptoms; I am standing on medico-legal ground. You will sometimes meet with cases of pneumonia—even suppurative pneumonia—that have developed in an entirely latent manner, in old people, in alcoholic subjects, or in those persons who are midway between health and disease—pregnant women, for example (Ollivier d'Angers). The circumstances which call for judicial inquiry are always the same: an individual, who did

not seem ill previously, dies suddenly, under suspicious, perhaps tragic, conditions. Here is an example :

A woman, 66 years of age, was found in her room with gurgling in her throat ; and a plug of linen lay between her lips : she died without being able to give any explanation of her condition, and her body was removed to the Morgue for the purpose of an autopsy being performed upon it.

Quite a romance had been constructed on the incidents of this case. The porter remembered that a man had accompanied this woman to her room, and had left the house shortly after ; he was able to describe this man, who was identified and arrested.

This woman had a perforation of the arch of the palate ; upon investigation, it was proved that she was accustomed to plug this aperture with a linen tampon. The autopsy demonstrated that she was suffering from pneumonia, and that the tampon had become displaced and wedged between her teeth, either in her delirium or in the agony of death.

Accidents such as that which complicated this case call forth the interference of the officers of the court.

Some years ago there was brought to the Morgue the body of a hump-back, which had been found in the Seine and had not been identified. The hair was as black as possible, and none of the teeth were wanting, though they were somewhat worn down ; these two facts made us think that the individual was about 60 years of age. At the autopsy we found pneumonia of the apex. This individual, whose hair and teeth were so well preserved, was an alcoholic subject, who had thrown himself into the Seine in an attack of delirium in the course of pneumonia.

It was found on making inquiry that he was 80 years of age. I quote this case incidentally to impress on you that we have no certain criterion of the age of any individual whose case we may have to examine. Say simply that the individual appeared to be of such or such an age.

C. Capillary Bronchitis.—*Capillary bronchitis* may cause death under somewhat different conditions. I shall not speak here of the form which is met with in childhood, but

shall come to that later on; I shall only deal with it now in so far as it attacks youths, adults, and old people.

The term 'suffocating catarrh' is a very appropriate one for this condition; it admirably characterizes the pathological condition to which it is applied. It supervenes in old people from exposure to cold. In most cases it does not give rise to any medico-legal investigation; in others an inquest is called for. Under certain conditions adults may be affected. During the siege of Paris, I lost 150 soldiers or 'Gardes-Mobiles' at the Javel ambulance station, from capillary bronchitis. It was intensely cold in December, and you know that many of these unfortunate men had their feet frozen, with formation of eschars; they were also insufficiently fed. These young soldiers guarded the trenches at night. They were cold and were overcome with dizziness, so that they had the appearance of being drunk. They had to be led to the ambulance; they could not even undress, but fell all of a heap on their beds and went to sleep. At the end of five or six hours they died, with their mouths full of froth, the product of bronchial over-secretion.

M. Ranvier, who held an appointment at the Val-de-Grâce Hospital, at the same time met with precisely similar cases.

According to the information which we managed to collect, these men had been attacked first with aphonia and bronchitis, and they suffered from general exhaustion. On *post-mortem* examination, we always found the bronchial tubes filled with froth and the lungs scattered with black apoplectic foci, varying in size from that of a hazel-nut to that of a walnut. These phenomena, which were met with in soldiers who were merely suffering from a catarrh, were repeated in an identical form in January in some of their comrades, when an epidemic of measles was raging in their ranks.

It is as well that you should know of these cases; in winter we often read in the newspapers, when the weather is very cold in Alsace-Lorraine, the north of France, or elsewhere, that an individual—a carrier, for example—has been found dead on the roadside. You may be asked for your

opinion as a medical expert. Remember that the presence of froth in the bronchi, subpleural ecchymoses, and pulmonary apoplexies may be the effect of intense cold, and so the hypothesis of crime may be dissipated. Children used to be told, and quite rightly, not to drink cold water while in a perspiration. I saw, at Ste. Barbe, two young people die in an identical manner after drinking water drawn from the pump when they had been playing at prisoner's base. In these cases the cold did not act upon the external surface of the body, but by reflex action on the lungs by means of the pneumogastric. In such cases as these you will have to decide as to the responsibility of the principals—head-masters of schools or directors of institutions; there is no fault that they can be reproached with, except that of allowing their pupils to have access to a tap of water.

Capillary bronchitis offers a further point of interest. It may happen as a result of an accident which is called 'night-man's asphyxia.'

I have notes of three cases which happened in two accidents of this kind. You know, Gentlemen, what is meant by 'nightman's asphyxia.' A workman goes down into a cesspool that has previously been opened; he gives a few blows with his pickaxe and suddenly falls down. Remember that the workmen are supposed to wear a belt to which a rope is fastened; but workmen will not comply with regulations, even those which are expressly framed to ensure their safety while engaged in their work.

When a cesspool is emptied, it is generally deemed sufficient to empty it partially, *i.e.*, to remove the liquid and semi-liquid matter. After this process has been repeated several times, the fæcal matters form a thick, stratified, hard and resistant crust at the bottom of the pit, which has to be broken up with a pickaxe and removed with a shovel. This procedure is styled 'putting the finishing touch.'

In the Rue St. Dominique, a nightman was about to undertake the cleaning out of a cesspool; while he was breaking up the solid fæcal crust, he was exposed to the gas which was given off (I do not know the composition of this gas, but it does not seem to me to be simply sulphuretted

hydrogen), then he staggered and fell. His comrades shouted to him to come up, and one of them descended into the cesspool to fetch him, but he fell down also. These two workmen were brought up again, and the one who had fallen first was the first to be restored to life, by means of artificial respiration—a method which I need not describe in detail here.

In the second accident, the same series of events occurred, but this time only one workman suffered.

Well, Gentlemen, in these three cases the workmen took their places in the cart after they had recovered, lit their pipes, and returned home; they ate their dinner, went to bed, and in a few hours they died of capillary bronchitis.

What has the medical jurist to do with such cases as these? He may be consulted because the insurance companies refuse to pay the claims. The company admits having assured the workman against accident, but it declares that it is not responsible here, inasmuch as the workman died in bed, and not while working in the cesspool, and that between the time of the accident and the commencement of the catarrh several hours had elapsed, during which the man appeared to be in good health.

I had some difficulty in getting the responsibility of the insurance company acknowledged in these cases. I succeeded because the two accidents happened within a few weeks of each other, because I was directed to conduct the medico-legal investigation in all three cases, and because I had to deliver my reports to the same magistrates, so that I could more easily persuade them to share my conviction.

D. Pulmonary Phthisis.—Pulmonary phthisis may be a cause of sudden death; I have already spoken to you of cases of this kind when dealing with thrombosis, embolism and profuse hæmoptysis. But besides ordinary phthisis we may have acute tuberculosis.

You will sometimes have to deal with cases in which persons are accused of a crime because some one has died in their presence, in circumstances which the law regards as suspicious. And you will find, at the autopsy, that the lungs of the so-called victim are studded with tubercular granula-

tions. A young tripe-seller, 20 years of age, was busy preparing some tripe for a customer at his stall in the market. The customer was stretching out his hand to take the tripe which the dealer was handing to him, when at the same moment the latter fell backwards, striking his head against the edge of a table, and his blood streamed out. The buyer hastened to procure assistance; but his actions gave rise to the idea that there had been a struggle. The police stepped in, and the customer was arrested, while the body of the tripe-seller—for he was dead—was conveyed to the Morgue. At the autopsy I ascertained that both lungs were stuffed with tubercle; they even stood upright on the slab. At the inquest evidence was given that the tripe-seller, who was addicted to alcohol, had been at work all the preceding night. No one in his vicinity had ever heard him cough; no one, not even he himself, suspected that he was tuberculous. Alcoholism was the principal factor in the latent course pursued by the tuberculosis. Remember, then, that tubercular phthisis may run its course without manifesting any symptom.

Shall I relate another case to you? A child, 12 years old, whom his master had struck on the head with a ruler, died suddenly. The master was accused of having caused the child's death. *Post-mortem*, the lungs and meninges were found full of granulations. It is evident that the master had no right to strike the child with the ruler, but this slight blow had nothing whatever to do with the production of the pulmonary and meningeal lesions.

Is it possible for sudden death to occur in *double pneumothorax?*

Bricheteau has reported two such cases.* M. Duguet has recorded a third. These are the only cases that I know of.

E. Cancer of the Lung.—This is a painful affection of slow progress, and is accompanied by attacks of suffocation, and by sputum of characteristic colour. I only know of one case of sudden death from this disease which has given occasion for an inquest.

The accused person in this case was a chemist, who had

* Bricheteau, 'Clinique médicale.'

given two pills to a gentleman who had consulted him, and who had died suddenly after swallowing the pills. The chemist was prosecuted for illegal practice of medicine, and for making a mistake in the drugs he had sold. The autopsy having revealed the existence of cancer in the lung of the deceased, the prosecution was abandoned.

F. Emphysema of the Lungs. — Piedagnel wrote his inaugural thesis on sudden death in pulmonary emphysema. He collected the reports of thirty cases, which were published not long ago. I should like to make the same remarks with reference to emphysema that I did in the case of pulmonary congestion. I do not believe that emphysema alone, apart from any other lesion, can lead to sudden death, any more than simple pulmonary congestion can do so.

G. Pleurisy.—Of all pulmonary affections, pleurisy causes the greatest number of sudden and unforeseen deaths. They frequently occasion medico-legal investigations. These cases of sudden death may be divided into two categories, according to the process by which death is brought about: one of these has been well described by Aran, physician to the St. Antoine Hospital; the existence of the other has been demonstrated by a large number of observers.

Aran was struck by this case: A young man, aged 25, came to his consulting-room one day quite out of breath. He called himself an 'arthritic,' and ascribed his symptoms of oppressed breathing to that diathesis. Aran made him undress, examined his chest, and ascertained the presence of pleuritic effusion reaching up to the middle of the infraspinous fossa. He told the patient to get home and go to bed, and as the latter consented to have paracentesis performed, he would come and perform it immediately.

At the very moment that Aran reached the house the patient died.

There are cases of latent pleurisy, where the effusion takes place gradually, where there is only slight shortness of breath, without severe attacks of suffocation, which are the most frequent causes of sudden death. I have seen thirty such cases at the Morgue since 1876.

Besides these cases of pleurisy with very abundant sero-fibrinous effusion, there are others with less fluid, sometimes purulent, and involving the diaphragm, which cause sudden death.

The pathogeny of this form of sudden death has given rise to lengthy discussion. It has been ascribed to displacement of the heart, the theory being that, when the apex of the heart is displaced to the right by effusion on the left side, the heart is so twisted thereby that its action is interfered with, and that sudden death may result from this abnormal condition. Now, pleuritic effusion is at least as common on the right side as on the left.

Torsion of the aorta has also been credited with causing the disaster, but without any more reason.

Embolism has also been mentioned. Two cases might appear to corroborate this view. The first is that of Dr. Wood, an American. He relates that an individual became suddenly hemiplegic and aphasic in the course of an attack of pleurisy, from embolism of the middle cerebral artery. The second case is that of M. Vallin,* who reports a case which is identical with Dr. Wood's.

In both cases the embolus came from the pulmonary veins; the clot which had been broken off entered the left side of the heart, passed into the arterial system, and blocked the middle cerebral artery. These cases therefore confirm the theory, which is possibly correct. But can this sole explanation be applied to all cases of sudden death in pleurisy? That is a very different matter.

Gentlemen, when one lung is no longer able to perform its work, the other is obliged to carry on the whole of the lesser circulation. The quantity of blood that is necessary to maintain circulation has, therefore, only one lung at its disposal, and this organ has almost double work to perform; suppose, then, that from any cause the circulation of blood in the healthy lung is obstructed, hyperæmia or congestion must follow, which may cause sudden death: *post-mortem* in such cases, apoplectic nodules are found. I do not maintain that this is the sole cause of sudden death in pleurisy,

* Vallin, *Soc. méd. des Hôp.*, 1871, and *Gaz. hebd. de Méd.*

but I am sure that it is one of the causes, since I have found in many instances, *post-mortem*, that the healthy lung is congested and full of apoplectic foci.

Woillez* has reported some cases of sudden death occurring in the course of pleurisy. Read these reports over again, and you will find in his accounts of the *post-mortem* appearances, which are described with the great care characteristic of Louis's pupils, the exact lesions that I have pointed out to you.

They have not struck Woillez in the same light, however, nor has he attached more importance to the discovery of apoplectic foci in a healthy lung.

Lastly, in some cases there is, along with the effusion, fatty degeneration of the heart, adherent pericardium, etc.; we are entitled to regard these lesions as contributing to bring about sudden death.

From the point of view of forensic medicine, the questions are often embarrassing. Answer them for yourselves in the following instance:

A policeman arrested a man: the latter resisted, and aimed a blow with his fist at the chest of the officer, who fell down dead; witnesses saw the blow struck, and the arrested man admitted having delivered it.

On opening the thorax, a considerable amount of pleuritic effusion was found, compressing the right lung. The officer was therefore in danger of sudden death at the moment when he was making the arrest. Was it, therefore, justifiable to say that the blow had caused death? At any rate, it was only the exciting cause.

Sudden death may happen during the operation of *paracentesis thoracis;* it is less common nowadays than formerly, when fewer precautions were taken about the operation. While I was house-physician I had one day to assist one of my masters in performing paracentesis: the patient was a wealthy banker, and four professors of the Faculty were present at his bedside; a number of basins were in readiness to receive the fluid that was to be drawn off. The needle was entered, but without result; the puncture was repeated

* Woillez, 'Traité des Maladies des Voies respiratoires.'

twice more, but still without any success; and at the end of a quarter of an hour the physicians went away without one of the basins having been wetted. In six hours the patient suddenly began to expectorate a large quantity of albuminous fluid, and died.

Legroux, Marotte and others have expressed the opinion that death during paracentesis is due to syncope. The patient is usually seated on his bed; in proportion as the pleuritic fluid escapes there is a rush of blood towards the lungs, and syncope follows from cerebral anæmia. This is possible.

Since we have had more perfect instruments, and as we can repeat the aspiration from time to time, we do not completely evacuate the cavity, and we no longer exhaust it by removing all the effused fluid. When the proper point is exceeded and an excess of liquid is withdrawn, considerable pulmonary congestion ensues, and as a consequence there is bronchial over-secretion, just as in 'suffocating catarrh'; it is, however, much more albuminous, doubtless owing to exudation of blood serum into the alveoli of the lung.

M. Terrillon has made a study of these cases;* he has collected about thirty of them, all nearly identical. The individual on whom paracentesis is performed is seized with a spasmodic cough; the operation is not proceeded with; the patient is put to bed. On feeling his pulse, there is nothing to give warning of any accident. An hour after the patient coughs up an extraordinary amount of liquid from his bronchial tubes, and dies suffocated.

Such accidents scarcely ever happen now, since the operation is not pushed so far now as it used to be. However, they do occur occasionally, and the responsibility of the physician or surgeon will be called in question. In cases of the sort, I shall always remain faithful to the rule that it is wise to leave some fluid behind in the pleural cavity, but I should not think it a serious error if the physician should go a little farther. It depends on an estimation of the nature of the case. The amount of fluid in the pleura cannot be

* Terrillon, 'De l'Expectoration albumineuse après la Thoracentèse.' Thèse inaug. Paris, 1873.

known exactly ; it is easy to make a mistake. Anyone who declares that there are 5 pints effused may only find $1\frac{1}{2}$ or 2 pints, while another who believes that there is only an insignificant effusion may be astonished at having to withdraw $3\frac{1}{2}$ or 5 pints. It seems to me, therefore, quite unjustifiable to hold a fellow-practitioner responsible for an error of this kind.

Accidents of another kind have been described by Raynaud and myself. They may take place while washing out the pleural cavity, or during the injection of iodine, etc. In such circumstances epileptiform convulsions may occur, but I do not think that they have ever caused sudden death. Moreover, they do not seem to be met with now that the operation of paracentesis is performed with greater skill and precision.

H. Rupture of the Diaphragm.—I ought to say a few words to you about rupture of the diaphragm. It is necessary that you should know that it may exist. How is it produced ? It is very difficult to say exactly, partly because it is an extremely rare condition, partly because it is very difficult to ascertain whether or not there has been a congenital hernia. In cases of sudden death, with or without violence, a portion of the abdominal viscera may be found intruding in the pleural cavity ; it is not always easy to say what was the exact state of the organs that existed before the final accident. M. Duguet* has recorded 17 cases of rupture of the diaphragm, and I would advise you to read his very interesting memoir, discussion of which now would detain us too long.

* Duguet, 'De la Hernie diaphragmatique congénitale.' Thèse de doctorat. Paris, 1866.

LECTURE V.

MODIFICATIONS OF VASCULAR TENSION: THEIR ACTION AS AUXILIARY CAUSES, OR AS EFFICIENT CAUSES (WHEN IN EXCESS).

GENTLEMEN,—Certain influences play an important part in the causation of sudden death. Their mode of action is to produce changes in vascular tension. With your permission, I will distinguish between their modes of operation as follows:

I. AUXILIARY CAUSES: EFFORT, COLD, HEAT.

Many persons think that heat and cold are the two prime factors of sudden death. This is true to a certain extent. Heat and cold frequently determine sudden death in those who are the subjects of some lesion which places them in a position of physical inferiority and prevents them from successfully resisting such influences. But, as a rule, heat and cold only act as contributory causes.

There are other cases where, apart from any concomitant lesion, heat or cold may determine sudden death. *Post-mortem* you will only find healthy organs, and the problem you have to solve will be difficult.

When these influences are exerted in an accessory capacity, we may sum them all up in the same formula: they bring about some modification in vascular tension. They comprise effort, the process of digestion, cold, and heat.

You know what *effort* signifies. The muscles of the chest are contracted; respiration is performed by the diaphragm only; all the viscera within the chest are as motionless as

possible, in order that the individual may have a firm basis from which his muscles may act. See what happens in coughing: the walls of the chest are fixed; the diaphragm alone acts; the body becomes stiff; vascular tension is increased; the veins swell; the face gets red. If there is any *locus minoris resistentiæ* in the circulatory system, *e.g.*, a miliary aneurysm in the brain, it may burst, and its rupture may cause sudden death. Cases of this sort have been noticed during parturition, in the fits of whooping-cough, in defæcation, and even during coitus.

While the process of digestion is going on, there is equally an increase of vascular tension. It has been noticed that cerebral hæmorrhage often takes place after a meal, especially if much has been taken to drink. By drinking two or three pints of liquid, which is not an exaggerated amount, the vascular tension is raised, and a vessel may give way before the kidneys have had time to dispose of the surplus by secretion of urine, thus restoring the tension to its normal degree.

As to variations of temperature, it is certain that sudden death is most frequent during the winter months.

When sudden death is due to the influence of heat or cold, the mechanism by which death is produced is not the same in both cases. Understand, Gentlemen, that I am only speaking now of such temperatures as we meet with in France.

Under the action of somewhat intense heat, the capillaries dilate, the skin gets red and covered with perspiration. The dilatation of the capillaries lowers the vascular tension; the pulse remains regular, but is more frequent. When the vascular dilatation is considerable, and the heart is weakened by any cause whatever—in persons suffering from aortic incompetence, for example—it may produce fatal syncope.

The action of cold shows itself in the contrary way. The capillaries contract instead of dilating; intra-vascular tension is increased; the pulse is less frequent. It causes a reflux of blood to the central organs, and if any vessel is weakened it will burst. This is what happens in those who suffer from aneurysm, particularly miliary aneurysm.

In both cases heat and cold only act as auxiliaries to some pre-existing cause.

II. EFFICIENT CAUSES: COLD, HEAT.

These agents may be, in a certain number of cases, the sole factors of death. They may become efficient causes by their excess. A body is found by the roadside: what is the cause of death? Nothing but a *post-mortem* examination will supply you with facts which will enable you to decide whether death may be due to heat or to cold. You ought to be able to deliver a reasoned opinion, and, in order to do this, you should know first of all that an excessive temperature is not indispensable. Heat and cold may kill without the thermometer registering abnormal temperatures.

A. Heat.—Let us first consider death due to heat alone. It has been said that it may be due to sunstroke or heat-stroke; there is no great difference between them. Of course, I exclude that trifling effect of insolation which is common in our climate, and which shows itself by erythema of the skin, and is devoid of danger.

We know but little of sunstroke in France; but it is very frequent in America. In New York it kills 20 or 30 persons every year. There are more victims of sunstroke in New York than in any other city in the world.

In heatstroke, on the contrary, it is not the solar radiation which kills. People are found dead in the shade of a wood or under a tent, while the thermometer registers 97° F. in the shade. The heat is a moist one.

In sunstroke the symptoms resemble those of meningitis. In persons thus struck we meet with delirium, cerebral disturbance (which were formerly designated 'frenzy,' or 'phrenitis'), and sometimes vomiting. Claude Bernard* and M. Vallin have experimented on this subject, but their results were not very decisive. Cl. Bernard shut animals up in boxes, only the head being outside the apparatus, and exposed to the sun. The animals subjected to these experiments showed symptoms like those of meningitis after a certain time; but an animal placed in these conditions cannot move—its body, confined in a box, cannot liberate the heat which is stored up in it. It is no longer in the same situation as an animal that is free to move about as it likes,

* Claude Bernard, 'Leçons sur la Chaleur animale.' Paris, 1876.

and the results of the experiments to which they were submitted ought to be accepted with great reserve.

Heatstroke is very prevalent in India; it is from that country that the descriptions of it come. In France we had our first opportunity of studying it about 1866, and the earliest cases that were met with were misunderstood. At that time the Suez Canal was nearly finished, and the ships began to bring back to Europe the labourers and soldiers who had served in the East. On board several of these ships some of the passengers suffered from a singular form of illness. These individuals, who were, moreover, in an excessively hot atmosphere (104° F. in the shade), spent the day in their cabins. Some of them, who had been in good health hitherto, were seized, on leaving the table, with attacks of delirium and frenzy; they wished to jump overboard, and they died speedily.

These phenomena were regarded as attacks of pernicious fever supervening in persons who had lived in hot climates, and who had formerly suffered from intermittent fever there. This was the explanation given by M. Texier. It has had to be abandoned. We are now convinced that the attacks were only cases of heatstroke, and it is now found necessary to take negroes as stokers on board ships passing through the Red Sea, for none but they can resist the intensity of the heat which prevails in the stokehole.

Besides these fatal cases which take place in distant regions, we had, even in Paris, in 1877, some sad cases which may help to elucidate the nature of the disorder. When the review of July 14 was over, the troops were disbanded, and returned to their cantonments. Some regiments retired to the woods of St. Cloud or Vaucresson. The men were disposed to rest themselves there, and many were seized with genuine heatstroke. Dr. Pioche, who was then a military surgeon, has contributed a complete account of these cases. He relates that no sooner had the men removed their knapsacks than they fell down panting, with their faces flushed and anxious, and some of them died. It is a curious fact that the non-commissioned officers especially were selected as victims.

The question of clothing has very much to do with the production of heatstroke. During the Chinese War, two battalions took part in the military operations from the beginning of the campaign. The men of one of these battalions still wore the cloth uniform which they had worn in Europe; those of the other battalion had been supplied with the colonial dress. Among the latter no accident was met with; among the former, on the contrary, the heat made numerous victims. In all other respects they were equally exposed.

People may die of heatstroke in a conflagration. This fact was proved to us when the Opéra Comique was burnt. I am well aware that the production of carbonic oxide must be taken into account in such conditions. But the lungs cannot long withstand the introduction of air heated to 104° or 122° F., even if this air contains no carbonic oxide.

Dr. Speck* has reported the following case: A girl complained of rheumatic pains. She was put to bed, and ten loaves of bread fresh from the oven were placed around her. At the end of three hours, the unfortunate girl was dead. She had succumbed to the hot vapours exhaled by the loaves of bread.

In connexion with such examples as these, those fatal accidents should be considered which may suddenly befall individuals in a vapour bath. You may be called upon to make medico-legal investigations in cases of this kind. Without speaking to you of that woman who was found dead in a bath-room, the temperature of which was 187° F., and where the steam-jet remained open, there are less extreme cases, where the temperature is not too high, but where the individuals who suffer have not been able to endure it long. I do not know whether these individuals had any constitutional defect, which is the main factor, or at any rate, a potent predisposing cause, of sudden death; but I know that under any circumstances vapour baths, with a temperature of 158° to 185° F., give rise to accidents so frequently that I do not dare to recommend them.

What is the *modus operandi* of heat when it determines

* 'Cas de Mort par la Chaleur' (*Ann. d'Hyg.*, 1876, tome xlvi., p. 561).

death in these conditions, *i.e.*, in India, or in the stokehole of a ship? When the heat becomes considerable, the capillaries of the skin and of the lungs dilate; intravascular tension is lowered, and the skin is bathed in perspiration. While the skin perspires, the lungs eliminate a still larger amount of water. Observe, Gentlemen, that when an individual suffering from pneumonia or typhoid fever has a dry tongue, it is because he no longer eliminates watery vapour by his lungs.

The organism gives off watery vapour as a defence against the heat. But when the external air is saturated with moisture, the organism can continue the struggle no longer, the lungs can no longer eliminate water, the beats of the heart increase in frequency, its sounds become indistinct, and it stops; while the axillary temperature runs up to 104° F., or even 113° F.; the individual is literally baked, and he dies.

The process is identical with that in a porous earthenware carafe; the water in the interior of the vessel is chilled by the evaporation of that which percolates to the outer surface. When the atmosphere is dry, and the body is kept more or less in motion, much higher temperatures can be borne than in a confined place where the heat is moist.

The lesions found *post-mortem* are those of pulmonary congestion. Hestrez has very fairly compared the lungs to two bags of blood; the bronchi are full of froth. The blood remains black, though in contact with air and oxygen; it no longer becomes arterial, therefore the corpuscles must have undergone a profound alteration. It is very important for the medical jurist to be aware of this fact, because it is always possible at an autopsy, except after certain forms of poisoning, or when putrefaction is already advanced, to restore the red colour to the blood. In this case it is no longer possible to do so.

The nervous system suffers severely. Vallin has insisted that these patients are insensible. They have headache, become delirious, then comatose, and die. The pupils are contracted at first, but dilate widely in the last moments of life.

In 1844, during the conquest of Algeria, General Bugeaud, who led a column of 3,000 soldiers, was exposed to an extreme temperature; he lost 200 men, eleven of whom committed suicide in the space of three hours. Ideas of suicide are, as a matter of fact, common in individuals suffering from heatstroke, especially if they are alcoholic subjects.

Gentlemen, when the temperature of a muscle is raised, certain phenomena are observed which I ought to bring to your notice; they have been shown very clearly by M. Marey's registering apparatus. When this instrument is attached to a frog's thigh, the animal's muscles are tapped several times, and the contraction which follows each tap is marked on the register; in proportion as the muscle is warmed, the curve diminishes in amplitude, and soon becomes a straight line, and although the taps are repeated, the line remains horizontal. Kühne of Heidelberg has explained the phenomenon by the coagulation of myosin. Others have ascertained the presence of lactic acid in the muscles of the frog, just as in over-driven animals. M. Vallin observes that, in animals exposed to the full heat of the sun's rays, the heart stops in systole; if the animal is killed immediately, M. Vallin finds the left side of the heart so hard as to deserve the epithet 'ligneous.'

As regards the secretions, there are only two which offer any point of interest: at the commencement of heatstroke, perspiration is profuse, then it stops; the urine, on the contrary, is scanty at first, but becomes abundant (polyuria) when the skin no longer acts. Morehead has pointed out the frequency and intensity of this desire to urinate. Gubler states that he has found albumen and sugar in cases of this class.

I should find myself in considerable difficulties, Gentlemen, if I were obliged to give an opinion, founded simply on *post-mortem* examination, on the cause of death in a medico-legal investigation of a fatal case of heatstroke. These cases happen more often in the provinces than in Paris. Do not forget to inquire under what circumstances the person died; find out whether he had been eating or drinking; go and examine for yourself the wood in which

the body was found; ascertain the temperature, the force and direction of the wind, the moisture of the air, etc., on the day when death occurred. These details are of importance, for examination of the body will only afford presumptive evidence.

B. Cold.—Death from cold is more common than that from heat. In Russia cold kills about 700 persons annually. M. Lacassagne* estimates that we lose in France on an average 200 men and 50 women annually from cold.

This proportion is easily explained: the occupations of men expose them more than women to external cold.

An experiment of Magendie's explains in a very suggestive way the mechanism of death from cold. He shut up a rabbit in a cage, the temperature of which was maintained at 32° F.; in five minutes the temperature of the rabbit had fallen $5\frac{1}{2}°$; in a quarter of an hour it had fallen 11°; and in 40 minutes it had fallen 36°, and the animal died. It is easy to understand why this happens. Under the influence of cold the capillaries contract and vascular tension is increased. As the resistance augments, the action of the heart becomes slower. As long as the peripheral capillaries are contracted the body does not cool much, for the blood does not reach the surface, and thus part with its heat by radiation; but when the contractile force of the capillaries is exhausted, they dilate, blood rushes to the surface, and gives up a great deal of its heat.

You know that when you make snowballs your hands are cold at first, but afterwards become red and warm, the capillaries being dilated. It is the same with the cold douche. The jet of cold water makes the capillaries contract; they should not dilate until the douche is over, in order that it may prove beneficial. But if the individual becomes warm under the douche, to use the douchers' expression—*i.e.*, if the capillaries, which were at first contracted, dilate while still exposed to the jet of cold water—he turns blue, the blood, chilled by the cold water, returns cold to the internal organs, and the situation becomes perilous.

When the cold is intense, frost-bite may occur; the nose,

* Lacassagne, 'Précis de Médicine judiciaire.' Paris, 1886.

eyelids and ears are usually the first portions of the body to suffer. But these are local lesions, which are quite distinct from our present subject.

Our physiological resources against cold are limited. When the degree of cold is slight, we walk more briskly; we feel exhilarated; we inhale more oxygen and exhale more carbonic acid.

It is no longer so when the cold is intense. In death by cold it seems as if combustion is arrested; the blood remains crimson; it no longer contains carbonic acid, and it has lost its coagulability. The chemical changes in the body are therefore very much disturbed.

What is the action of cold upon the nervous system? If the exposure to cold has been of long duration, the individual has no recollection of what has passed; there is amnesia (which has been well described by M. Motet*).

At the outset there may be delirium, there is often a propensity towards suicide, and always a tendency to sleep; sensibility is deadened (remember that the application of cold was at one time used to procure local anæsthesia in petty operations, such as that of ingrowing toe-nail); sight is dim; according to Gmelin, the retina is pale and the lens sometimes frozen. The vaso-motor system is also affected. Weir Mitchell placed a bladder of ice along the course of the ulnar nerve; the hand became cold, then the capillaries dilated, and it grew red, just as after section of the great sympathetic.

The muscles contract under the influence of slight cold; remember the movements of the cremaster and the desire to pass urine, which you can prove experimentally on yourselves. When the cold is keen, the muscular contractions last longer, and finally stop; Marey's recording instrument has made this clear. The muscular fibres no longer contract voluntarily; the individual cannot walk, and is obliged to stop; he becomes stiff, and the action of his heart ceases. The urine, which is abundant at first, is suppressed at last; the skin remains dry, and there is no perspiration.

* Motet, 'Intoxication par l'Oxyde de Carbone, auto-observation' (*Ann. d'Hyg.*, 1894, tome xxxi., p. 258).

Larrey has given a masterly description of death from cold in his account of the retreat from Russia; I cannot resist the temptation of reading a few lines of it to you:

'We were all in such a state of prostration and torpor that we could scarcely recognize one another; we marched in gloomy silence. The organ of vision and the muscular strength were weakened so that it was difficult to proceed, and even to maintain one's equilibrium. The individual thus affected fell at the feet of his companions, who did not turn their eyes to look at him. Although I was one of the most robust men in the army, it was with the greatest difficulty that I managed to reach Wilna. On my arrival at that town, I had no more strength or courage left; I was ready to fall to rise no more, like so many other poor wretches who had perished before my eyes. . . . The road from Miedzeski to Wilna was covered with corpses. Death in these poor creatures was preceded by pallor of the face, a sort of idiocy, difficulty of speech, and by weakness, or even a total loss, of sight. In this condition some of them marched for a while, guided by their comrades or friends; muscular action grew perceptibly weaker, the individuals staggered as if they were drunk; weakness increased steadily until the man fell—a certain sign of the total extinction of life. . . . They were immediately struck by painful torpor, then passed into a state of lethargic drowsiness, and in a few minutes their burdensome existence was over.'

Similar cases were observed on the ship *Tegethoff*, and have been described by Payer and Weyprecht while wintering in the ice at a temperature of 58° F. When the men left their cabin to go out, they were sometimes exposed to a difference of 126° or 130° F.; but as it was possible to keep the cabin warm, they were able to withstand these violent changes.

I have told you, and I repeat, that sudden death may be produced without the external temperature being extraordinarily low. It has been observed even with the thermometer at 32°, 30°, or 28° F., when the wind is very strong. This is a very important fact to know in forensic medicine.

In 1845, General Levasseur, after receiving a repulse, led

his troops to Sétif. This is the retreat which is known as 'The retreat of Bou Thaleb'; it occupied forty-eight hours, during which the thermometer did not fall below 32° F. But the wind blew with such force that the men could not light a fire, and consequently could not prepare their soup. Out of 2,800 soldiers commanded by General Levasseur, 208 died in forty-eight hours, and when the column arrived at Sétif, 521 entered the hospital. The never-abating wind, together with inanition and the despondency which always attends retreat, had made these soldiers less able to resist cold than they would have been under other circumstances.

The medico-legal questions connected with death from cold are not numerous; it is necessary to take into account the intensity of the cold, the force of the wind, and the length of time that the individual has been exposed to their influence. An adult resists cold tolerably well, because of the size of his body, provided, at any rate, that he is not an alcoholic subject, and that he does not enter a wine-shop or tavern on the way. Alcohol, which dilates the capillaries, promotes the action of cold. Here is an instance, which took place in Russia: The thermometer was about 18° or 19° F., and the fête to celebrate the distribution of spirit licences was being held in a certain town. Potemkin gave a supply of alcohol for gratuitous distribution in the square of the town; 1,500 to 1,800 persons died of cold.

In the country, when an individual is found benumbed with cold or frozen, he is not allowed to pour brandy down his throat, but he is laid on a manure-heap or in an oven used for baking bread; empiricism is thus in agreement with the teachings of science, and has long ago found a means of combating the disastrous effects of cold.

Inanition, of course, aggravates the effects of cold. It is a singular thing that lunatics are unaffected by it; they do not complain of cold, and they resist it better than their attendants.

New-born children are exposed to great dangers from chills; they are not protected by the mass of their body, and they generate only a small amount of heat. They are most exposed on the occasion when they are taken into the

country in what is called the 'nurse's convoy.' When the passengers alight from the railway carriage, after a journey that has lasted some hours, some poor little infant is often found to be dead already, or else dying, and about to finish his days in the vehicle—appropriately called 'purgatory'—which is to take him to the village which was his destination. Sometimes the chill of which these nurslings die is purposely contrived. The plan is very simple, and the medical jurist will have great difficulty in proving it. The door and window are both left open; the infant is suspended from a nail in a current of air, and the result is only such as might be foretold. If the medical jurist intervenes, he finds the signs of pulmonary congestion, with mucus and froth in the bronchi.

What conclusions can safely be drawn from such *data?* Chills are also the most frequent causes of death as a result of baby-shows.

With regard to old people, the law interferes in cases of sequestration. You know that in country places the father and mother often give their property to their children, in order that the latter may provide for themselves, on condition that they shall be comfortably boarded and lodged as long as they live. The children are sometimes ungrateful; the old father is sometimes half starved; he is consigned to a damp, cold room, and dies of pulmonary catarrh. A medico-legal investigation is in most cases fruitless.

LECTURE VI.

SUDDEN DEATH DUE TO LESIONS OF THE DIGESTIVE SYSTEM.

GENTLEMEN,—Lesions of the œsophagus, stomach and intestines may cause sudden and suspicious death. Certain diseases of the pharynx may do the same.

I. LESIONS OF THE PHARYNX.

I shall perhaps astonish you, Gentlemen, by saying that sudden death may supervene in the course of simple pharyngitis, or erythematous sore throat. An autopsy throws no light on these very puzzling cases. I do not know of many cases of the kind, it is true, but those which I am able to relate to you are typical:

It is some years since I met with an event of this kind. I was asked to attend a young medical student who was dresser to M. Cusco; he had just had an attack of syncope. As he was suffering from a slight sore throat in the evening. I went to see him again on the following day with M. Cusco. M. Cusco, who was at the time paying much attention to laryngoscopy, examined his pupil's larynx, and found neither œdema nor even redness there. The young man had another attack of syncope, but revived; he had a third during the night, and recovered again. He asked M. Cusco's permission to spend a little time with his family, and in a fortnight wrote to ask for extension of leave. He caught a fresh chill while he was staying with his relatives, pharyngitis returned, and he died in an attack of syncope. This fact, which I

believed for a long while to be a solitary instance, surprised me much.

In 1874 I was called in a great hurry to see a girl who was suffering from a slight sore throat, and who, I was told, had had an attack of syncope. When I arrived, as speedily as possible, she was dead.

Finally, not very long ago, I received a pitiful letter from a young provincial physician, who believed he was to be blamed for a fatal accident which had befallen one of his patients, and he begged for my opinion.

This physician had been summoned one night to the suburbs of the small town where he practised to attend a girl who complained of a sore throat. The throat was somewhat red; there was some gastric disturbance, but there were no grave symptoms, and considering the hour of the night, and the distance from any druggist, the physician did not insist on the administration of an emetic, which he intended to prescribe on the following day. When he returned the next day, the girl was dead. I reassured my fellow-practitioner, and replied that the administration of an emetic would not have altered the situation.

Simple sore throat may, therefore, provide us with a very disagreeable surprise, and as the redness disappears after death, we are not entitled to conclude that no sore throat has existed because no trace of it is to be found at the autopsy. What is the nature of these accidents? In my opinion it resembles laryngeal spasm, or the inhibition which results from a blow, although a slight one, over the larynx. Remember, in this connexion, that case which I have already narrated to you of the maid-of-honour, Mme. Adelaide, who died suddenly, at the moment when a Danish physician was applying a drop of ammonia to her pharynx.

Closely allied to these pharyngeal phenomena, which we must ascribe to spasm or inhibition until we get a better classification, there are others in which sudden death is the effect of material causes.

When an individual swallows hard and compact substances, or when he eats gluttonously, and the food which he stuffs into his throat blocks the entrance of his larynx,

he dies suddenly, choked. Accidents of this sort are not uncommon among general paralytics, and I ask you to bear this liability in mind.

II. LESIONS OF THE ŒSOPHAGUS.

I come now to lesions of the œsophagus. We meet with cases here, Gentlemen, which are often singular, sometimes inexplicable, and which may give rise to suspicion of poisoning. It was with this in view that M. Letulle reported two cases of sudden death due to dilatation of the œsophagus, with small superficial ulcerations in one case, but which were absent in the other. The autopsy did not reveal the cause of the dilatation in either of them. We know, besides, that in stricture of the œsophagus there may be an accumulation of food in the pouch above the stricture, which may cause sudden death by pressure.

At this very moment a great stir is being made in some of the newspapers about the supposed poisoning of the Comte de Chambord. You know that, when the Comte de Chambord was taken ill, several eminent physicians, including Vulpian, were summoned to Frohsdorf. The physicians who met at the patient's bedside agreed in the diagnosis of cancer of the stomach. After a temporary improvement, the patient's condition grew worse and he died. *Post-mortem*, no cancer was found at all; only superficial ulcerations, with a few deeper ones, were found in the œsophagus. Vulpian, with characteristic honesty, did not hesitate to declare, not only that he had made a mistake in pronouncing that the case was one of cancer, but also that he could not state what was the cause of the ulceration of the œsophagus. By that time rumours of poisoning were going about; then no more was heard about it. For some weeks this rumour has been revived again, and it is openly stated in certain circles that the Comte de Chambord was poisoned. None of the persons who make this assertion could state, any more than I could, what poison is capable of producing these lesions.

Gentlemen, lesions that we did not expect to find are often met with in making autopsies; lesions are also met

with which are not described in any nosological scheme, lesions which we cannot classify at all. These are matters which surprise us, I admit, but they do not justify us in expressing a suspicion of poisoning. It is certain that when this happens in the case of a person of princely rank, or of a political notability, the imagination is prone to exaggerate everything, and to find something extraordinary in what would only have been looked on as natural in a member of the middle class. If you survey the history of France, your attention will often be arrested by similar cases, and a great number of princes and princesses, who were believed to have been poisoned, really died a natural death.

III. LESIONS OF THE STOMACH.

Before entering upon the study of the lesions of the stomach which may cause sudden death, let us first settle two incidental questions—sudden death from indigestion, and death in dyspeptic coma.

Can a person die suddenly from indigestion? (Notice that I am not speaking here of children; I shall deal with them later on). All authors reply in the affirmative. Well, Gentlemen, I have read all the cases which they have recorded, but I have not met with a single case in which pre-existing lesions in other organs than the stomach were not sufficient to account for death; in most cases the patient had some renal affection, or was convalescent from typhoid fever.

Such was the case of the lad which Dr. Martel* has reported: the boy was convalescent from a mild attack of typhoid fever, and was allowed to walk about the ward as he pleased, when one day, after breakfast, he had an attack of syncope, and died so rapidly that he was dead before the arrival of the house-physician, though the latter had been summoned at once. An autopsy was made; all the organs were healthy, but the stomach was distended by a mass of haricot beans not yet acted upon by the gastric juice. This lad, who had been subjected to a strict regimen during his

* Martel, *Gaz. hebdom.*, 1877, p. 605.

fever, acquired an exaggerated appetite, as convalescents commonly do; he had obtained an extra supply of this indigestible food from his comrades, and had swallowed it hastily to avoid being detected.

If this lad had eaten these beans in his ordinary state of health, he might have had an attack of indigestion, but he would not have died. Tardieu only quotes one case, and it is hardly conclusive:

An individual, who was, as the report says, somewhat out of health, went to a druggist, who gave him four purgative pills. He swallowed only two of these before retiring to rest; in the night he was seized with vomiting and died. The druggist was accused of having poisoned his customer. The two remaining pills were found and submitted to analysis, but they contained no suspicious substance. The autopsy revealed no organic disease.

The druggist who sold the pills was accused of having poisoned the patient, but an analysis of two pills that remained disclosed nothing suspicious. For my own part, I believe that indigestion will in the very near future be erased from the list of causes of sudden death.

Dyspeptic coma has been studied in Germany especially; I have only met with two cases, neither of which was fatal. It is analogous to diabetic coma; but there is no sugar in the urine. It has been profoundly studied by Kussmaul, and hence has received the name of 'Kussmaul's group of symptoms.' The name connotes a group of symptoms which I will describe to you briefly. Suppose that an individual in good health, who may or may not have suffered from dyspepsia formerly, is suddenly seized with somnolence, at first slight, but rapidly deepening into coma, and with a peculiar form of dyspnœa characterized by deep and regular, but often accelerated, respiratory movements. The temperature is more often lowered than raised, and the breath has a characteristic odour like that of apples or over-ripe fruit, and the urine is reddened by the addition of perchloride of iron.

It has been thought that these phenomena are due to auto-intoxication by acetone, liberated by intestinal fermentation. Acetone actually has an odour like that of ripe

fruit, and the addition of perchloride of iron produces a red colour when it is present in the urine.

But Senator, Riess, and Litten have detected acetone when there has been no coma; they have, moreover, insisted on the fact that Kussmaul's group of symptoms is met with in the course of various diseases, such as pernicious anæmia, diseases of the liver and kidneys, chronic catarrh of the bladder, certain eruptive diseases, etc.

We ought, therefore, to ask ourselves whether it is not one of these diseases which is the cause of death, rather than dyspeptic coma, which we will regard, if you please, merely as an exceptional occurrence.

We ought to place by the side of Kussmaul's disease the sulphuretted hydrogen dyspepsia of children, which has been described by Senator, Cantani and Stefano. I have no personal experience of it.

Simple ulcer of the stomach is a very common cause of sudden death. The *round ulcer*, which has only been well known since Cruveilhier's time,* is not a disease that has only appeared in modern times.

Madame, sister-in-law to Louis XIV., whose funeral oration was delivered by Bossuet, appears to have died of simple ulcer of the stomach. The symptoms which her disease presented, its sudden gravity and tragical ending, immediately gave rise in the minds of contemporaries to the idea of poisoning.

Nowadays we are familiar with the characters of ulcer of the stomach, and it would seem to be difficult to make a blunder.

However, one of the first medico-legal cases with which I had to do was one of this kind. Mme. Lerondeau, a woman living in a suburb of Versailles, was accused of having poisoned her husband. He had complained to several of his neighbours of not feeling well one morning, and died the same day, after taking some sorrel soup which his wife had prepared for him. I do not know whether the husband and wife had been living on bad terms together, but the fact is that the law intervened;

* Cruveilhier, 'Anatomie pathologique.' Paris, 1830-32.

the woman was arrested, and a *post-mortem* examination was ordered. The analytical chemist found a small quantity of oxalic acid in the stomach; the medical jurist discovered on the mucous membrane of the stomach, and minutely described, six small ulcers near the pylorus. He did not think that these were simple gastric ulcers, but asserted that they were caused by oxalic acid that had been put into the soup, and Mme. Lerondeau was sentenced to imprisonment with hard labour. Owing to a flaw in the proceedings, the sentence was annulled, and the case was transferred from the Court of Versailles to that of Paris. Mme. Lerondeau's counsel applied to Wurtz, Vulpian, and Bergeron. Vulpian examined the specimen, and found that the lesions had all the appearances of simple gastric ulcer. Wurtz has shown, in a remarkable memoir, that when the mucous membrane is in a catarrhal state, the digestion even of a piece of bread gives rise to the formation of oxalic acid, even to a more considerable amount than that found by the chemist at Versailles in M. Lerondeau's stomach. The Attorney-General abandoned the prosecution.

It is not very difficult, Gentlemen, when we discover an ulcer of the stomach, to determine whether it has been caused by some caustic substance or by natural inflammatory processes. In the simple ulcer you will always find the characteristic projecting margin and smooth base, which cannot deceive you. When an individual has swallowed sulphuric or hydrochloric acid, there are erosions, perforations, and lesions of all kinds.

A simple, round gastric ulcer may develop in a latent manner, without producing any marked functional disturbance. It can, therefore, easily be understood how a suspicion of poisoning may arise in the mind of some relative or friend of the deceased. This suspicion is evinced more frequently—I will even say that it is constant—when a person dies of perforation of the stomach with symptoms of peritonitis.

It might be thought that an individual in whom perforation has suddenly occurred ought always to present the characteristic signs of peritonitis, but it is not so; he may

become collapsed, and present symptoms like those of cholera.

Leudet of Rouen* has related the following case: While he was house-physician at the Hôtel-Dieu, a man walked abruptly out of a public-house facing the hospital, holding his hand to his abdomen, suffering acute pain, and exclaiming: 'They have poisoned me!' The man was taken to the Hôtel-Dieu, while the crowd, believing what he said, proceeded to sack the public-house. The man died. Leudet made an autopsy, and discovered perforation of the stomach by a simple ulcer, and commencing peritonitis.

When the simple ulcer is undergoing cicatrization, and the patient is getting better, the intolerable pain after eating having disappeared, and a strict milk diet being no longer persisted in, he is sometimes tempted to eat more than is good for him, and the consequences may be most disastrous.

While I was Aran's house-physician at the St. Antoine Hospital, a man was under his care suffering from simple ulcer of the stomach, which was healing, and he had abandoned a strict milk diet. It was spring-time, and the man was walking about the hospital yard. He went to the porter's lodge, bought an apple-tart, and ate it in the yard. He was immediately seized with vertigo, fell down, was carried indoors, was put to bed, and soon died. At the autopsy the cicatrix was found to be torn, and the organ was distended with gases which had penetrated beneath the mucous membrane of the stomach, so that the walls seemed to be inflated.

Since the time of Hunter and Cruveilhier, *post-mortem* ulceration of the stomach has been recognized as a fact; it is attributed to the action of gastric juice upon a portion of the wall of the stomach which has lost its epithelium or undergone some other lesion. All that I know of these ulcers is obtained from the writings of authors; I have never had any opportunity of seeing them, but I have twice seen a *post-mortem* ulceration under similar conditions, as a result of poisoning by a non-caustic substance. In both cases the

* Leudet, 'Clinique médicale.' Paris, 1874.

poison was strychnine; one was a case of suicide, the other of accidental poisoning.

Let us take this case: A boy went to a druggist to ask for poison wherewith to get rid of his cat, as he was tired of the animal. The druggist, whom it was impossible to identify, handed him a packet of strychnine. The boy went home, altered his mind, and deposited the poison in his desk. Then he thought he would like to see what the powder tasted like, so he moistened his finger, dipped it in the powder, and tasted it, though he spat most of it out again (he was able to state this), and he died in well-marked strychnine convulsions. *Post-mortem*, I found the stomach small, containing about 2 oz. of blackish liquid; in the fundus there was a circular perforation $1\frac{1}{5}$ inches in diameter, and at a distance of $\frac{1}{5}$ inch from this was another perforation about $\frac{1}{5}$ inch in diameter. The mucous membrane seemed to have undergone digestion. The spleen was a soft pulp.

Experiments on animals show that the introduction of a certain quantity of strychnine into the stomach considerably increases the secretion of gastric juice; perhaps that is the way (I only offer the suggestion) that strychnine acts in certain affections of the stomach.

When you are making an autopsy, and find a perforation of the stomach, you will have to make a differential diagnosis between simple gastric ulcer, poisoning, and the ingestion of some caustic substance.

I will quote one other case to you before ending the account of sudden death from diseases of the stomach. A Paris physician, who was well known in the theatrical world, had suffered for a long time from dyspepsia. He married a very pretty and elegant young wife; he was also accustomed to administer morphine injections to himself. The rumour went about among his friends and the public that his wife would be only too pleased to be rid of her husband. He died. His friends insisted on a medico-legal *post-mortem* examination, but they were not satisfied with the result of it. They then examined the numerous volumes in which the deceased had written day by day for more than twenty years his impressions and details of his sufferings. Fortunately

for his young widow, her husband's notes and the opinions of the physicians whom he had consulted agreed with the results of the autopsy, and the proceedings were stayed. The autopsy had brought to light an enormous dilatation of the stomach, the larger curvature measuring 30 inches, the smaller 19 inches; the food could not easily pass out of the stomach, for the pylorus, which was situated in the right iliac fossa, was connected to the rest of the intestine by means of the duodenum, which was curved like a swan's neck. There was a formidable accumulation of liquid containing detritus of food in the stomach; the colon was filled with scybala as large as one's fist.

IV. LESIONS OF THE INTESTINES.

Medico-legal intervention is much more frequent in simple ulcerations of the *duodenum*. M. Aloncle* has collected 39 cases. Since then M. Bucquoy has published a certain number, and the total number of cases on record amounts to a hundred.

A distinguishing feature of simple ulcer of the duodenum is that its existence is quite unknown both to the patient and to those around him. In ulcer of the stomach there are pain, vomiting and hæmorrhage; ulcer of the duodenum gives rise to no symptoms. Moreover, sudden death, in the medico-legal sense, is comparatively more frequent in the latter than in the former.

A well-built youth, about 20 years of age, was brought to the Pitié Hospital. He complained of acute pain, and kept his hands pressed on his abdomen; he had been very well during the day, but at 7 *p.m.* he was seized with atrocious pain in the abdomen, seemingly situated between the stomach and liver. He soon became collapsed, and died at 5 *a.m.* He presented symptoms like those of cholera—aphonia, suppression of urine, etc. The autopsy showed that this young man had a simple ulcer of the duodenum; it was evidently of long standing, being surrounded by a rim like that of a simple round ulcer of the stomach. The

* Aloncle, 'De l'Ulcère perforant du Duodenum.' Thèse de Paris, 1883.

intestine was perforated, and food had entered the peritoneal cavity; the peritoneal cavity contained 2½ pints of yellowish fluid.

Ulcers of the duodenum are situated in the first part of that segment of the bowel, and by preference on its free surface.

I know of only one case of perforating ulcer of the jejunum.

Intestinal ulceration may be caused by dysentery, tuberculosis, cancer, or typhoid fever. Medico-legal intervention is sometimes demanded by the relatives of the deceased in such cases.

I remember the following case: A girl belonging to a very honourable family was attacked with typhoid fever, and stated in her delirium that she had been violated, giving full details and quoting names. She died, and her parents, recollecting the delirious statements made by their daughter, insisted on an autopsy being made. The girl had ulceration of the ileum, and was a virgin. Whether or not an attempt on her chastity had been made, I do not know, but at any rate the act of violation had not been completed.

All these ulcers may give rise to intestinal hæmorrhage, which may produce syncope. Death may result from it, and we ought always to bear the possibility in mind. M. Lancereaux has, within the last few years, thrown light upon a subject that was already known, but which had been imperfectly studied before; I refer to embolism of the mesenteric artery, which may give rise to intestinal ulceration and hæmorrhage. Finally, we sometimes meet with persons who have died of intestinal hæmorrhage, although it is impossible to discover the vessel that has given way. This fact has been established by Gendrin and Trousseau.

Much importance has lately been attached to a special form of ulceration which takes place in the vermiform appendix. This perforation is rapidly followed by grave symptoms, which remind one of those of cholera, and are more like those of poisoning than those of peritonitis; there are abdominal distension and vomiting, and the surface becomes cold. Reginald Fitz was the first to describe this

disease; it is important for the practical physician as well as for the medical jurist to know of it.

Never in your practice pronounce the word 'poisoning,' unless you are sure of your diagnosis; if it has once escaped your lips, and reached the ears of the patient's relatives, they will not be able to think of anything else! Before uttering a word of suspicion, think over all the phenomena of perforation which I have briefly described to you; it is a diagnosis which you will have to make, though it is not always very easy to establish.

Hindrance to the passage of the contents of the intestine may be of long standing or may develop abruptly. In both cases it may give rise to sudden and suspicious death. When it is abrupt, there is internal strangulation. A small hernia, unknown to the subject of it, may be strangulated at the moment of its formation; its existence can only be proved *post-mortem*, because liquids have been able to pass along the intestine during the lifetime of the patient; strangulation has not been complete; the symptoms presented by the patient—diarrhœa, vomiting, and coldness of the surface—have led to the belief that the case is one of poisoning. Such cases happen by the thousand.

In *simple intestinal obstruction* medico-legal intervention is sometimes required. Let me give you an example:

Towards the end of the Empire, an old lady was seized with uncontrollable vomiting. As she had occupied a conspicuous social position and had been intimately connected with one of the Bonaparte family, it was thought that she had been poisoned. The physician who attended her advised a consultation. At the time when the consultation was to take place, the old lady was sitting on her zinc toilet-pail, and suddenly a curious noise was heard, the nature of which was not evident at the moment; she had just passed an enormous gall-stone, which is now exhibited in Dupuytren's museum; this calculus had blocked the intestine. Naturally all suspicion of poisoning was dispelled; the lady recovered and returned to America, where she died recently more than 80 years of age.

Forensic medicine may also have to deal with cases of

simple constipation; in one case nearly 30 oz. of fæces was found in the intestine. M. Socquet has removed from the large intestine 17½ lbs. of fæcal matter.

A great inventor, who had amassed a large fortune, but whose name I shall not mention, habitually suffered from obstinate constipation; he soothed his pain with chloroform.

One day he received a visit from two friends who were not so well off, and after their departure he was found dead on the sofa; his brother, with whom he had not lived on the best of terms, suspected that he had been murdered by these friends; the bottle of chloroform and a folded cloth had been found by the side of the body. The law intervened, and an autopsy was ordered. I found the intestine loaded with very hard fæces. The autopsy could not reveal to us how he came by his death. Whether he had put himself to sleep for ever by means of chloroform, or whether he had been put to sleep by his friends, I cannot say; but it is always a difficult matter to send a person to sleep by means of chloroform if he does not wish to be anæsthetized. Before speaking to you of the curious phenomena and complications which long-continued constipation sometimes produces, allow me to point out to you the singular fact that malformations of the anus may give rise to sudden death. A little girl, 8 years of age, died with symptoms of poisoning. The body was sent to the Morgue for *post-mortem* examination. The child had an imperforate anus; defæcation had been performed by means of a small fistulous communication between the rectum and vagina, a little below the hymen; this fistula had been blocked by hard fæces; an enormous accumulation had formed in the rectum, which measured nearly 5 inches in diameter. There was also arrest of development of the uterus. This little girl had lived up to that age without any of the family suspecting that her bowels were not relieved in the usual manner. She died of intestinal obstruction, the symptoms of which were actually taken for those of poisoning.

These cases of death due to intestinal mischief are very interesting, and they are closely connected with certain pathological problems that are now receiving attention.

M. Vibert has related the following case, which is of great medico-legal interest because of the situation occupied by the victim, and because of the disputes which might arise after his death as to the payment of a claim for life assurance:

A young medical man, aged 23, who practised in the suburbs of Paris, went to lunch one day at his brother's house in Paris; he was in the habit of taking injections of morphine; in the morning he was indisposed owing to an attack of abdominal pain and diarrhœa; he was unable to eat any luncheon, and, as his sufferings increased, he determined to return home; he died in the water-closet used by the station-master, on his arrival at the station where he intended to alight. As Dr. X.'s brother knew that Dr. X. had insured his life, he went to the public prosecutor and stated to him very straightforwardly that he had been asked whether his brother's death might not be due to some unforeseen cause, viz., suicide by an over-dose of morphine. All the inhabitants of the little town where Dr. X. practised were convinced that suicide had taken place.

In case an autopsy confirmed this supposition, M. X. determined to renounce his claim upon the insurance office. A medico-legal autopsy was performed by M. Vibert, and it was ascertained that there was a tubular stricture of the descending colon commencing a little way above the sigmoid flexure, and 7 inches in length; the wall of the stricture was indurated and thickened, and presented a layer of dense fibrous tissue about $\frac{1}{25}$ inch in thickness beneath the mucous membrane; the intestine was somewhat dilated above the stricture, and there was a small quantity of fæces there. M. Vibert concluded that death was due to natural causes, there being no evidence of the presence of any poison.

Since then we have made four autopsies of the same kind at the Morgue. What is the cause of death under such conditions? It is identical with that which I previously described to you under the title of *dyspeptic coma*. M. Bouchard has proved the existence of ptomaines in fæces, and in all such cases special forms of fermentation may lead to auto-intoxication, as in this case. The anomalous feature

of these cases of poisoning is that they occur in some instances, but are absent in others. All these novel facts are of great interest to the medical jurist, and he ought to bear them in mind when he is conducting his investigations.

To what cause should these strictures be assigned? As a general rule, when inquiries are made of the relatives and friends of the deceased, and information is obtained as to the previous history, the disease can be traced to a neglected attack of dysentery; cicatrices result which steadily contract.

V. LESIONS OF THE LIVER.

I come now to the consideration of those lesions of the liver which may occasion sudden and suspicious death. These, Gentlemen, include a certain number of special cases; but you will be of the same opinion as myself when you listen to an enumeration of all the diseases of the liver; and you will agree that any one of them may lead to sudden death under conditions which would suggest to one's mind the possibility of poisoning.

Take malignant jaundice, for example; you know its characters, and are well aware of the yellow colour which rapidly invades the face and the whole body of a person who seemed well previously.

To my knowledge, the law has stepped in in two fatal cases because phosphorus-poisoning was suspected, and those individuals were prosecuted to whose advantage it was for the death to take place. In another instance, where there also was malignant jaundice, the individual who died suddenly had been taking part in a discussion shortly before. His neighbours, who had noticed that his skin had become yellow in a very short time, spread the report that his death was due to a violent paroxysm of anger to which he had been provoked, and that bile had become mixed with his blood. As there had been a dispute, the officers of the court took the matter up, thinking that the deceased had perhaps received blows which would occasion death. The man was found to have acute atrophy of the liver, which was quite sufficient to cause jaundice and account for death.

Finally, Gentlemen, I shall give you the particulars of a very interesting medico-legal autopsy, for the case on which this inquest was held gave rise also to an accusation of attempt to procure abortion. The case was that of a female of 35 to 40 years of age, who was a servant to a medical man. She suffered from atrophic cirrhosis of the liver, and had become debilitated in consequence of the disease. Her abdomen grew large, and this was noticed by her neighbours. She was seized with syncope one evening, and died the same night. As she had had epistaxis at the moment of syncope, blood was found on her sheets, pillow, and chemise. The porter of the house at once accused the medical man of attempting to procure abortion on his servant. The body was carried to the Morgue, and I made an autopsy. The woman was not pregnant, but she had eighteen or twenty pints of fluid in the peritoneal cavity; her liver presented the typical characters of cirrhosis.

Sudden death due to *gall-stones* is a rare event. Portal* quotes two cases. Dr. Durand-Fardel and Curry each record one. Charcot† speaks of syncope sometimes occurring in the course of biliary colic.

I myself can relate to you the following case: A young woman, 25 or 30 years of age, active, and of good constitution, forewoman in a feather manufactory in the Rue du Caire, had an appointment at Lagny. As she was afraid of missing the train, she ran to the Eastern Railway station; but when she reached the Place de Strasbourg she found that she had several minutes to spare, and went into a café, where she drank some currant syrup with seltzer-water, and having paid for it, she took her ticket and entered the carriage. The train had only just started, when she was seized with horribly painful colic, and said to her fellow-travellers in the compartment: 'I have been poisoned in the café; I do not know what it was that I have just been drinking.' At last she reached Lagny,

* Portal, 'Observations sur la Nature et le Traitement des Maladies du Foie,' p. 170. Paris, 1813.

† Durand-Fardel, 'Maladies des Vieillards.' Paris, 1854.

where she was met by her friends; but as her pain kept getting worse, they took her to a hotel near the station. A physician who was called in haste reassured them, and told them that the patient was suffering from biliary colic. The pains increased, however, and the young woman died in the night. The event caused considerable sensation at the hotel; inquiries were made, and some astonishment was expressed when the circumstances were ascertained under which she had left Paris. The superintendent of police intervened, and the body was sent to the Morgue, where a *post-mortem* examination was made.

Post-mortem. — The bile-duct contained a good-sized calculus, and there were many more in the gall-bladder. The most curious feature observed at the autopsy was the fact that the lumen of the duodenum was completely obstructed. There was collateral œdema of the coats of the intestine, the mucous membrane being raised to such a degree as to make an absolutely resistant tube.

[In a case observed by myself, fatal syncope happened during an attack of biliary colic. *Post-mortem.*—A gall-stone of considerable size was found lying in the duodenum, and evidently had recently passed. The liver presented numerous small nodules of cancer.—TRANSLATOR.]

Allow me, in connexion with this subject, to make a short incursion into the domain of clinical medicine. When examining patients suffering from biliary colic, there is often found dulness on percussion over the region of the liver, and the question is raised whether this is caused by a distended gall-bladder or Spigelian lobe. I am inclined to believe, judging from the result of this autopsy, that this dulness is sometimes due to distension of the duodenum. This case is almost unique, and it is very interesting. How could sudden death take place without perforation, or any other grave anatomical lesions? Death is certainly due to stoppage of the heart, determined by a reflex inhibition due to excitation of the pneumogastric filaments distributed over the liver.

Ruptures of the gall-bladder and biliary ducts are possible. I have never met with a case where the passage of a

calculus has caused a rupture or laceration, and thus brought about an escape of bile into the peritoneal cavity. I believe that when these lesions occur they are due to some other cause; thus, ulceration of the gall-bladder may take place in typhoid fever, for example. In other instances, the presence of a gall-stone may set up inflammation of the gall-bladder; but then adhesions form between the peritoneum, the gall-bladder, and the intestine, and ulceration, if it happens at all, does not give rise to a perforation into the peritoneal cavity, but into the intestine, and there is not the same danger.

Hydatid cysts of the liver may burst into the peritoneal cavity. When the cysts are large, their existence is usually well known to the physician and the patient's friends, if not to the patient himself. But if no one knows of their existence, what will happen? The patient may die suddenly in profound collapse. He will not present the symptoms of acute peritonitis, although there is inflammation of the peritoneum. He will die with choleraic symptoms, and if death supervenes under conditions that are at all peculiar, the law will intervene, and an autopsy will be ordered.

Tardieu records the following case: A husband surprised his wife *in flagrante delicto* of committing adultery. A violent scene took place between the three actors in the drama, and the husband ran to find the superintendent of police. On his return he found his wife unconscious and collapsed, and she died in the course of three hours with choleraic symptoms: diarrhœa, vomiting, suppression of urine, etc. How could any one believe, in spite of the denial of the husband and lover, that no violence had been inflicted? A medico-legal autopsy was ordered, and death was found to be due to the rupture of a hydatid cyst into the peritoneal cavity. Was the rupture due to an act of violence? The body showed no trace of it, and probably there had been none.

VI. LESIONS OF THE SPLEEN.

Lesions of the spleen do not often give rise to medico-legal intervention in our own country, but in those lands where malarial fevers prevail it is quite otherwise. The

spleen may burst as a result of very great violence, such as a crush of the body or a fall from a height.

A man took his mother-in-law for a drive in a tilbury. The tilbury was overturned in such an unlucky manner that the man fell on the top of his mother-in-law, and the latter died almost immediately. The man escaped unhurt. There was a medico-legal investigation, because of the circumstances in which the accident took place. At the autopsy, the spleen was found to be ruptured.

The spleen may also be ruptured during the straining of childbirth, especially when labour is difficult.

In warm climates—in countries where intermittent fever prevails—the spleen of those individuals who have undergone frequent attacks of malarial fever becomes hard, and it also becomes extraordinarily fragile. Dr. Pellereau, who practised in the Isle of Bourbon, has published the result of seventeen medico-legal autopsies, in which he shows that the spleen may be ruptured by very slight violence; he relates, for example, the history of an individual who was running across some fields, and was struck lightly in the splenic region by the branch of a cactus that he brushed against in passing. This injury, if it deserves the name, caused a rupture of the spleen and fatal hæmorrhage into the peritoneal cavity.

I myself have been consulted about a similar case:

A gentleman, occupying a very good social position in the department of Charente-Inférieure, was accused of killing one of his friends in the course of a dispute. There had actually been a little scuffling, in the course of which the friend had been pushed against a writing-table, but with so little force that he paid no attention to it, and made no complaint about it at the moment. He returned home, and when he arrived there he became ill. He rapidly became blanched, and died. A medico-legal autopsy was ordered. The medical jurist who made it found the spleen ruptured, and concluded that the dead man's friend was to blame. He stated, however, that the spleen was hard, but not much enlarged.

When the physician drew up his report, he had, however,

only consulted the works of European authors, who do not, or, rather, who did not, mention the special fragility of the spleen in persons who have inhabited warm climates, and have had attacks of intermittent fever there. I remembered this fact when I was called upon to make a further report, and I learnt that the deceased had formerly been a naval officer, who had been invalided in consequence of frequent attacks of malarial fever, which made his continuance in the service quite impossible. The proceedings were stayed.

VII. LESIONS OF THE PANCREAS.

We shall pass rapidly, Gentlemen, over lesions of the pancreas. Even if we understood something of its functions, we do not know much about its pathology. In the autopsies that I have made, I have sometimes found hæmorrhages in the pancreas. As death was due in these cases either to pulmonary congestion or, as in the case of the young woman that I related to you a little while ago, to biliary colic, I am forced to believe that pancreatic hæmorrhage is a concomitant, and not an essential lesion.

VIII. LESIONS OF THE SUPRARENAL CAPSULES.

I shall not speak at any greater length on this subject. M. Letulle has related two cases of sudden death in cachectic individuals, and in the autopsy on each he found advanced tuberculization of the suprarenal capsules. [Addison's disease?—TRANSLATOR.]

I shall not add any more to what I have already said in the course of these lectures about lesions of the peritoneum. Remember only that, from the medico-legal point of view, there are fatal—even rapidly fatal—forms of peritonitis, which do not present the usual symptoms of peritonitis. These cases of peritonitis, on the contrary, give rise to phenomena which we can only call choleraic, such as suppression of urine, aphonia, vomiting, diarrhœa, and collapse.

The same may happen in tuberculosis and cancer of the peritoneum.

LECTURE VII.

SUDDEN DEATH CAUSED BY LESIONS OF THE FEMALE GENITAL ORGANS.

GENTLEMEN,—It might appear reasonable to divide this chapter into two sections, one relating to lesions of the genital organs in pregnant women, the other relating to lesions of the same organs in women who are not pregnant. This plan would lead to numberless repetitions.

A. VAGINAL EXAMINATION.

Allow me to draw your earnest attention to a very important point. You may be exposed in certain cases to suspicions which may cast discredit upon you and compromise your reputation.

In a woman, whether pregnant or not, who has lesions of the uterus or its appendages—fibroid tumours, for example—simple vaginal examination, such as a physician makes daily in his consulting-room, may cause sudden death.

I remember that, when I was house-physician, I was one evening with my colleague, Chas. Martin, in Gosselin's wards, by the side of a bed in which was lying a woman, on whom he had to make a vaginal examination. He made the examination, and then went to wash his hands. The woman died suddenly, without M. Martin, who was washing his hands at the end of the ward, or even myself, who was by the bedside, being able to render any aid, however quick we might have been. *Post-mortem* we only found a fibroid tumour. All the organs were healthy. When I exhibited the specimens at a meeting of the Anatomical Society,

Dr. Barth related to the society three or four similar cases that had occurred in his own practice.

Some years later Lorain published the following case:

A girl, 16 years of age, who had contracted gonorrhœa, although she had the signs of virginity, was admitted under his care. Lorain himself administered an injection through the orifice of the hymen, by means of a syringe with wings. The operation was very simple, and the introduction of the tube of the syringe could not cause any injury. At the fourth injection the girl died suddenly.

Twice within my own knowledge it has happened that women have died in the consulting-room of a physician who had simply made a vaginal examination. You see what would be the consequences of an accident of this sort: the physician is obliged to give notice to the superintendent of police that there is a corpse in his house; a romance, a legend, is quickly invented; if the deceased woman was pregnant, and if she had said to her neighbours that she regretted her condition, the physician will be accused of having attempted to procure abortion. Tardieu* has very justly compared these sudden deaths with those which take place in abortion.

In country places the physician will be in a very awkward situation in the presence of such rumours and of the public hostility, which will not always be allayed even when the result of the autopsy is made known, and he will often have great difficulty in recovering his reputation after such attacks have been made upon it.

Simple vaginal examination may also have another consequence.

M. Tarnier stated in the Court of Assizes that women have twice come to him in order to submit to such an examination, and have aborted the same evening, and yet neither of them wished for abortion to take place.

This is an extremely interesting chapter from the point of view of medical responsibility. If we ask ourselves to what cause these sudden deaths are to be attributed, what I have

* Tardieu, 'Étude médico-légale sur l'Avortement,' 4e édition. Paris, 1881.

already said to you concerning inhibition and the following remark will enable you to explain the process.

Superficial lesions sometimes suffice to bring on palpitation or intermission of the pulse even in robust, though very nervous, women, without any lesion of the heart; cauterization of a small ulcer on the cervix of the uterus will make this palpitation and intermission cease. Is not that a proof of the intimate relation that exists between the innervation of the genital organs and that of the heart?

B. EXTRA-UTERINE GESTATION.

Sudden death may supervene in the course of extra-uterine gestation. This gestation may be interstitial or tubal. It seldom reaches the normal term. Sometimes the fœtus does not die until pregnancy is far advanced; it may remain for a time in the true pelvis, and be then discharged in fragments.

Whatever may be the course of events in extra-uterine gestation, suppose a woman is the subject of it, in what circumstances will the intervention of the law be called for?

Allow me, Gentlemen, to recall to you a case that I referred to when I was speaking to you of the tension of gases produced by putrefaction (*vide* p. 101).

A celebrated actress came to Paris with her maid and two American travelling companions, who did not know a word of French. They went for a walk in the Bois de Boulogne. During the walk the actress felt unwell; she was taken to the Pré-Catelan, where she drank a glass of milk; as she became worse, she was obliged to stop at the Armenonville Pavilion, where she died. I told you that an Englishman of high social position had time to reach Paris before the autopsy; he found me at the Morgue, and the first words that he said to me were, 'It is not possible for this woman to be pregnant; I have very good reason to be certain.' I assented. The actress had a three-months tubal pregnancy, and the fœtal cyst had ruptured into the peritoneal cavity; the young woman had therefore died of intra-peritoneal hæmorrhage. I told the English lord that she had died of

rupture of the veins of the ovarian plexus into the peritoneal cavity; the precise cause of death I only stated in my official report.

The public, which was much excited about the death of this distinguished actress, learnt from the journals of the day, which pride themselves on being well informed, that I attributed the mishap to the fact that the young woman had drunk a glass of cold milk at the Pré-Catelan.

I will quote a second case to you:

A young physician, who took his degree in 1884, set up in practice in Paris, and took into his service a maid, 24 years of age. One evening he went out after dinner, and when he returned from his walk he found a mob in front of his door, and the hall-porter was in a great rage. The maid was dying of loss of blood, and expired soon after. The young physician was immediately accused of having treated his maid as if she were his mistress, and of having attempted to procure abortion. The body was removed to the Morgue, and the autopsy revealed the existence of a tubal pregnancy of three months' duration, with rupture of the fœtal cyst into the peritoneal cavity.

The unfortunate doctor, in spite of the conclusions of my report, was obliged to leave that quarter and set up in another part of Paris, a long way from his former residence.

Gentlemen, you are young; allow me to give you a piece of advice: when a physician is young and unmarried, he ought only to take into his service females who are plain and who have passed the canonical age.

C. RETRO-UTERINE HÆMATOCELE.

Besides these tubal or abnormal pregnancies, apart even from pregnancy at all, death may take place from hæmorrhage into the peritoneal cavity. Bernutz has applied the term 'hæmatocele' to such conditions.

Here is an example which is all the more interesting because the patient recovered, and I was able to follow up the case for a long time afterwards: A lady was taking up her quarters in a new lodging, and was standing on a pair of

steps; though she was not making any violent effort, she was taken ill and I was sent for; I found her completely bloodless, though not losing blood by any external orifice. My assistant and I took it in turn to stay near the patient, spending four whole days thus, and giving her an injection of caffeine or of ether every ten minutes. The woman was unconscious, scarcely alive. Thanks to the teaching of my master, Bernutz, I recognized the existence of a pelvic hæmatocele, although the most careful exploration did not yield any evidence of it. It was only on the third day, when it had become encysted, owing to the formation of false membranes due to peritoneal irritation, that it became possible to confirm the truth of the diagnosis.

Cases of this kind do not always pursue such a fortunate course. They may sometimes give rise to sudden death. Gallard asserted that hæmatoceles were always due to rupture of a fœtal cyst in an extra-uterine gestation, and that careful search would always detect a *corpus luteum*, which would reveal the nature of the disease.

Virchow attributes the formation of hæmatoceles to the rupture of extremely fragile and highly vascular false membranes, similar to those of pachymeningitis, consecutive to an attack of inflammation of the peritoneal pouches. The origin of such conditions really matters very little, so long as we recognize their existence.

D. RUPTURE OF THE UTERUS.

In *natural pregnancy* the uterus may sometimes rupture in the second month, under the influence of a strain or slight violence. I have never met with an accident of the kind, but Moynier has reported a case.

E. VULVO-VAGINAL VARICES.

In certain women, most often during the second or third pregnancy, vulvo-vaginal varices, sometimes of considerable size, may be met with. They are even found in primiparæ. These varicose clusters may be almost imperceptible; in some cases they may attain the size of the fœtal head. These

varices may burst as a result of an effort during delivery, or even apart from delivery. The blood escapes externally, and the woman may die of hæmorrhage.

I once had to perform a medico-legal autopsy at the Morgue, together with MM. Tarnier and Champetier (of Ribes), on the body of a woman who was suspected of having procured abortion; we did not, however, find any evidence of abortion, but a considerable bundle of vaginal varices; nevertheless, it was impossible to discover the opening from which the blood had flowed.

This is not an isolated instance. When a woman dies under these conditions, the laceration of the varicose vein is no longer discoverable, because the varices are no longer distended by liquid; it would be necessary to inject the varicose cluster in a way that might be possible in the *post-mortem* theatre, but this would not be an easy matter in a medico-legal autopsy, where, when there is a suspicion of abortion, we examine the uterus, its appendages, and the placenta (if it exists), before thinking of varicose veins in the vulva and vagina. At any rate, I do not know of a single medico-legal autopsy in which the orifice by which blood has escaped has been found in a cluster of varicose veins.

When rupture of these varicose veins takes place during delivery, at the moment when the fœtal head passes, it is impossible to be in any doubt as to the nature and cause of the hæmorrhage. But it is otherwise when the rupture takes place before labour begins.

There may be sudden and suspicious deaths during delivery. Moynier has reported cases of rupture of the utero-ovarian plexus, but this is very rare.

F. SYNCOPE.

Here is another accident, which is more frequent. When a woman is confined, she may have an attack of syncope. The fact is certain. When the birth is secret, and especially in cases of infanticide, the accused woman always says that she became unconscious and did not know what

was happening, and that when she recovered her senses she found the child dead between her thighs.

At the assizes, the judge will ask you if such attacks of syncope are common; they are possible, but they are not frequent under normal conditions. I was much surprised to read in a lengthy memoir by Freyer, a distinguished obstetrician of Berlin, that out of 165 confinements he had met with 34 cases of syncope. Dr. Freyer expresses no astonishment at this proportion; he appears to consider it natural, and he does not relate the circumstances in which these syncopal attacks took place. There is an enormous difference, in this matter, between our experience in France and that which Freyer describes.

Moreover, statistics are not of much importance; the interest to us lies in the conditions under which syncope may present itself.

Is syncope more common among women who are confined in secret? Perhaps. These women, of course, do not wish anybody to know of their delivery; they have determination enough to suppress all cries and groans; it may be that the very excess of pain may bring on syncope in them.

This is probably the most frequent mode by which syncope is produced in those women who are confined secretly; yet this syncope may also be determined by an attack of hæmorrhage or some other obstetrical accident, since there is no competent person present to prevent or check it.

G. CHLOROFORM.

You know that of late years it has been customary to administer chloroform during labour. Obstetrical anæsthesia is not so deep as surgical anæsthesia, I admit. Yet there have been deaths to deplore. Ought these deaths to be attributed to chloroform? Is it not possible for syncope to come on in women who are under the influence of chloroform just as in those who are not? I point out to you the possibility of these accidents, for they may give rise to very embarrassing problems; the responsibility of the physician or midwife may be questioned, and you may be called upon to decide the question.

A certain number of sudden deaths after confinement, and sometimes in pregnancy (for the pathogeny is the same), are attributable to venous thrombosis and embolism. I shall not repeat what I have already said on this subject, while studying with you the lesions of the circulatory system. In pregnant women, thrombosis of the veins of the lower extremities and of the vena cava may take place before confinement; the straining of the woman during the act of parturition may dislodge the clot, which is then precipitated into the circulatory stream.

Finally, sudden deaths have been observed due to abscess of the ovary, 53 hours after delivery; but I do not lay much stress upon this.

LECTURE VIII.

SUDDEN DEATH IN FEVERS.

GENTLEMEN,—There are certain fevers in which death may occur in a sudden and somewhat unexpected manner, and therefore give rise to medico-legal intervention.

You know what intermittent fever is, Gentlemen, with its pernicious forms—algid, comatose, and choleraic.

You are aware that an attack may be pernicious from the very beginning, without the patient having had any attacks of fever previously; that algidity may show itself along with the initial *rigor—i.e.*, in the first stage; that the comatose form usually appears at the end of the second stage; and that the choleraic phenomena present themselves in the sweating stage.

These different forms of attack may, however, be mixed up, and become 'subintrant,' and there are all sorts of ways in which it is possible for death to take place under suspicious circumstances at any period of the disease. Death may occur in the first attack; it may occur in the first stage with as much likelihood as in the second or third.

In those countries where pernicious fever is rare, attacks of this class are nearly always misinterpreted. From the medico-legal point of view, the medical jurist intervenes all the more frequently in fatal cases of pernicious fever, in proportion to their rarity, because public opinion does not know to what cause to assign them; *i.e.*, in countries where cases of intermittent fever are fewest, medico-legal intervention is at its *maximum*, and in countries where such fever is prevalent, medico-legal intervention is at its *minimum*.

In the hæmorrhagic forms of certain *exanthemata*, such as small-pox and scarlet fever, death may happen suddenly, especially in pregnant women. When the hæmorrhagic form of the disease has not been recognized, the medical jurist may be directed to make an autopsy.

I shall not enumerate here the causes which may lead to sudden death in fevers or infective diseases, either during their course or during convalescence. We have drawn attention to them already when studying myocarditis, endocarditis, thrombosis, embolism, syncope, etc.

You will find them set forth at length in systematic treatises.

LECTURE IX.

SUDDEN DEATH DUE TO HÆMOPHILIA.

GENTLEMEN,—I come now to sudden and suspicious death due to *humoral changes;* I use this term in a somewhat elastic sense, so as to include hæmophilia, diabetes, uræmia, and alcoholism.

Hæmophilia is a rare affection, and on that account does not often give occasion for medico-legal intervention. But when this is required, the medical jurist will find himself beset with very great difficulties.

Hæmophilia may occur in isolated cases, or it may run through families.

When a bloodvessel is opened in one of these subjects, it is almost impossible to arrest the hæmorrhage. When a man who is the subject of hæmophilia dies of hæmorrhage, would it have been possible to stop that hæmorrhage?

You see that the question of responsibility crops up at once; there is the responsibility of the druggist to whom the man, who has just become unconscious, is carried, and the responsibility of the physician who has been called in to render first aid. The examples that I am going to cite to you, Gentlemen, will enable you, I think, to form an opinion.

Thirty years ago, a youth, 14 or 15 years of age, neither of whose parents was the subject of hæmophilia, fell down in the Rue de l'Odéon and cut his lip, causing hæmorrhage. The lad was taken to his parents' house, which was in the same street, and they sent for me. In spite of my long-continued efforts, I found it impossible to stop the hæmor-

rhage; I sent for my master, Dr. P. Lorain, who was no more successful. We summoned Nélaton and Gosselin to a consultation, but the hæmorrhage could not be arrested, and the lad died in the night.

Eighteen months afterwards, Gentlemen, this lad's sister was married. On her bridal night hæmorrhage ensued in consequence of the rupture of the hymen; she died twelve hours after, without any of the physicians or surgeons who were collected round her bed being able to check the hæmorrhage. How does forensic medicine come to intervene in these cases of sudden death in hæmophilia? I have had personally to deal with two such cases, and in almost identical circumstances.

A young man went to his barber, who combined the profession of dentist with that of hairdresser. After having cut the hair or the beard of his customer, the barber, noticing that he had a decayed tooth, persuaded him to have it extracted. He extracted the tooth, and hæmorrhage took place. Remember that at that time the practice of dentistry was free, and that the law which regulates it at the present time did not then exist. The barber, not knowing how to stop the hæmorrhage, took his customer to a chemist, who applied plugs of perchloride of iron, but in vain. The patient was then carried to St. Antoine Hospital, where he died. Was the barber-dentist responsible for the young man's death? The widow brought an action against him for damages, and at that point I was commissioned as an expert. Was the young man the subject of hæmophilia? Perhaps he was, but he was not aware of it; no more was the barber. The father, mother, and brother of the deceased were still living, and we could not discover any trace of the disease in them.

In the second case, on the contrary, a very celebrated dentist, who possessed many qualifications and diplomas, was involved. A young woman who was about to be married was taken to him. He examined her teeth and recommended the extraction of a stump; the stump was removed, and hæmorrhage immediately followed, which it was quite impossible to stop, and the young woman died. The dentist,

it seems, had lost his head somewhat when this accident took place. He went away repeating :

'Oh, my God! it is I who have killed her! it is I who have killed her!'

The family, whose suspicions were aroused by these imprudent words, on the advice of a physician who did not think of its being a case of hæmophilia, and who expressed the opinion that 'powerful' hæmostatics should have been used, brought an action against the dentist.

I had to be very reserved in my conclusions, for, in spite of the absence of any hereditary taint, it was not demonstrated that the girl was not the subject of hæmophilia.

The great danger of hæmophilia is that neither the subjects of it nor those in habitual intercourse with them are aware of the fact. The slightest injury may induce a catastrophe in them.

LECTURE X.

SUDDEN DEATH IN DIABETES.

GENTLEMEN,—Diabetes is the disease of all others which runs the longest course without its subject being aware of it, whatever may be the quantity of sugar voided in twenty-four hours. The ordinary diabetic is a man who has a good stomach and digestion, who appears to be in good health up to the moment at which he enters upon what may be called the 'pathological period,' which is revealed by a succession of boils, loss of teeth, ocular troubles, etc. The common belief is that the diabetic passes much urine, but sometimes this is not the case at all, and at other times the patient scarcely notices it. He drinks more, perhaps, than other people, therefore it seems only natural to him to make water more freely and more frequently; moreover, if the quantity of urine passed increases little by little every day, there is not sufficient difference between one day and another to attract his attention. Diabetes may develop in an entirely latent manner. I am persuaded that a few years hence clinical observers will be able to break up the group, which is at present regarded as homogeneous. For my own part, I have never met with two cases of diabetes that are absolutely alike. In one class of cases, the patients are fat, in another class thin; there is diabetes with excess of urea, and diabetes without such; but classification according to these varieties does not afford a solid basis for forming a prognosis. The only form of diabetes which I would actually separate from the main group is that which results from an injury—a railway accident, for example—and which

has been specially studied by M. Richardière and myself.* This form is more curable than the rest, and in none of these cases did we meet with accidents such as those that I am going to point out to you.

Certain individuals, whom no one suspected of being the subjects of glycosuria (this is important, for it alone explains the intervention of the medical jurist), may be carried off very rapidly by a great variety of accidents. They may die of *pulmonary complications*, such as the 'fulminating pneumonia' of Bouchardat. This form of pneumonia is only detected 24 or 36 hours before death takes place. It may develop with extreme rapidity, something like the pneumonia of the aged, but it is accompanied, however, by symptoms of reaction which make it evident that the patient is ill 24 or 36 hours before he dies.

They may die from some *complication of a wound or surgical operation*. You know that before the introduction of antiseptic dressings surgeons hesitated before operating on a diabetic. Gosselin did not care even to open a boil in such subjects. Since the claims of antisepsis have become established, it has been shown that rapid death in such cases is only due to an intensive culture of streptococci and staphylococci; but it is true, nevertheless, that diabetes renders the healing of a wound much more difficult.

A wholesale mercer of the Rue de Rivoli slightly abraded the skin over the crest of the tibia in falling over a footstool. He was carefully treated by his usual medical attendant, who called in Trélat to a consultation, as the wound did not heal. The medical attendant being taken ill, I was asked to take his place. I was then house-physician to Aran, and the urine was systematically examined in all the patients under his care. I therefore examined my patient's urine, and found that it contained sugar. The next day but one, the brother (a notary) and sister of my patient begged me to examine their urine also. I found that they were passing from 900 to 1,200 grains of sugar *per diem*. All these three persons lived for more than 20 years without ever experienc-

* Brouardel et Richardière, 'Du Diabète traumatique au Point de Vue des Expertises médico-légales' (*Ann. d'Hyg.*, 1888, tome xx., p. 204).

ing any disorder that might be attributed to diabetes. My patient in particular died only two years ago: he survived 32 years after the occurrence of the above-mentioned trifling accident, and he would never have known that he had diabetes but for that wound being so slow in healing.

And notwithstanding the great advantages which antiseptic treatment bestows on our patients, it should always be ascertained, before undertaking an operation, whether or not they suffer from diabetes. Death may take place in an unforeseen manner in diabetes. The form which most often gives rise to suspicion, medico-legally speaking, is that which is called 'diabetic coma.'

All observers agree in saying that coma sets in after a phase characterized by loss of appetite, dyspepsia, constipation, vomiting, pinched face, and feeble pulse, indicating gastro-intestinal disturbance. These symptoms might suggest peritonitis, but for the absence of pain and fever. There is also a peculiar form of dyspnœa, marked by ample, regular and slow respiratory movements. This dyspeptic period lasts from 36 to 48 hours; then the patient becomes comatose; the temperature in the axilla falls to 95°, and there is loss of consciousness. The comatose phase lasts from 24 to 36 hours. You see that the entire process lasts 4 or 5 days altogether.

The above is a picture of diabetic coma as it was first described. Then exceptions were discovered; cases of diabetic coma were met with which were comatose from the first, the abdominal stage being quite absent. These cases are often difficult to interpret, and they may easily give rise to suspicion. This does not apply to those persons who know that they are diabetic, and whose history is well known in towns like Vichy or Carlsbad, where they spend season after season. These patients pursue a course of treatment; but as they are, or think they are, in good health, they make excursions, go to the Casino, do not husband their strength, or sometimes they overdo their treatment because they have not consulted their physician, or have ceased to see him. They suddenly fall into a state of coma. Such cases as

these have been well studied by Cyr,* a physician at Vichy, who died a few years ago.

Cyr has described another variety, of which I myself have seen three examples. A diabetic, as a result of over-work, of preoccupation, or of cerebral excitement, becomes mentally disturbed. His character is changed: he becomes morose and difficult to live with, and at length talks in an incoherent manner, which I can only compare to the babbling of individuals in the first stage of anæsthesia from chloroform; then headache and giddiness supervene, and the individual suddenly becomes comatose. Cyr has never observed convulsions.

If any member of the patient's family or any of his acquaintances know that he is diabetic, there will be no medico-legal difficulty. But if no one was aware of it, suspicions of poisoning may arise, whether or not there may have been dyspeptic troubles before the comatose period is established.

A medico-legal autopsy will be ordered, but it will be without result; the medical jurist will not find any lesions on which conclusions can be based. His only chance is to find urine in the bladder, and sugar in that urine; unfortunately, the bladder is most often empty. In case of poisoning, as a general rule, the autopsy is not performed immediately after death; in most cases exhumation has to be performed. The difficulties of research will then be all the greater, and even if liquid is found in the bladder, its composition will have undergone alteration, and may contain sugar no longer, although it might have done so during life.

The medico-legal difficulties, Gentlemen, are therefore very great, and the problem is very difficult to solve.

If we are to believe Colin and Parrot, the quantity of urine passed during coma is diminished to such a degree that Parrot has been tempted to speak of 'anuria'; thus, the diabetic seems to die at the moment when excretion of urine ceases.

* Cyr, 'Traité pratique des Maladies du Foie.' Paris, 1887.

Another form of sudden death in diabetes has been described, due to *syncope* or *atrophy of the heart.* Two English physicians, Dickinson and Scott, are the principal writers who have laid stress on this form. In the autopsies on diabetics that I have made, I have found the heart fatty, but never atrophied.

LECTURE XI.

SUDDEN DEATH DUE TO THE KIDNEYS.

A. URÆMIA—AUTO-INTOXICATION.

GENTLEMEN,—Death due to the kidneys is the most frequent form of sudden death. Let me say at once that the renal lesion is not always the only factor; there is often a combination of causes, and for this reason the mechanism of this kind of sudden death is difficult to determine. But from the point of view with which we are concerned at present, it is necessary to remind you that the kidney is the great emunctory of toxines and of all foreign products which pass through the system, entering the blood and being discharged from it without assimilation. Death supervenes when poisons manufactured in the system, or unwholesome food that has been ingested, can no longer be adequately removed by the diseased kidneys. The individual is therefore poisoned either by his food or by poisons which are generated within his own body, *i.e.*, auto-intoxication.

When we study the kidney in childhood, in the adult, and in old age, we see that the size of the gland in proportion to the rest of the body is not constant. In the child the kidney is of enormous size, in the adult it is less, and it is atrophied in old age.

Take the kidney of an adult. You know its shape; you know that it consists of cortex and medulla, and that it is provided with a hilum, in which are the pelvis and calyces surrounded with a padding of fat. In old age the hilum enlarges and becomes loaded with fat, while the cortex

shrinks, so that the senile kidney is contracted in two directions.

It may therefore be said, from an anatomical point of view, that the essential part of the kidney diminishes with age.

From the physiological point of view, we know that a dose of iodide of potassium given at the same time to a child, to an adult, and to an old man, appears more quickly in the urine of the child than in that of the adult, and more quickly in that of the adult than in that of the old man.

Ten years ago I made the following experiment in my own house. I took a young man, aged 20 (he had not yet drawn lots for the conscription), who was my servant, an adult, myself (I was 45 years of age, and I consider that my kidneys were then those of an adult), and my mother, aged 70.

We each took 15 grains of salicylic acid, dissolved in half a bottle of wine and water, in the course of the day. In my servant, the salicylic acid appeared in the urine an hour after breakfast; in myself, only in the evening, after I had drunk all the half-bottle; in my mother, not until the third day. On the following day the servant no longer had any salicylic acid in his urine; in myself the elimination lasted for four days; it lasted nine days in my mother. The gradation is therefore closely related to age.

An important fact follows from this, from the point of view of poisoning by substances swallowed in small daily doses, and I will add that it is a fact of which there is actual proof. Observe that my mother, my servant, and myself had healthy kidneys. But how many people are there whose kidneys are affected as a result of some former disease, *e.g.*, of nephritis from scarlet fever, rheumatism, pregnancy, etc. These persons have kidneys which are *older* than they themselves are; their renal lesion may have been completely cured, yet in spite of that they may be subject to the most serious accidents. Let me give you an instance:

A pupil of the Monge school, about 13 years of age, was knocked about by his companions, and struck his loin against the corner of a desk. He returned home, and passed blood

with his urine. A surgeon and I were called in, and we thought there was a contusion with rupture of the kidney. The boy got well. Eighteen months afterwards he suffered from an attack of jaundice, which seemed to be only simple catarrhal jaundice; however, it rapidly assumed the malignant form; albuminuria appeared on the seventh day, there was almost complete suppression of urine, and the boy died.

Remember, then, that an individual who has suffered from damaged kidneys, although all signs of the mischief have disappeared for a long time, is exposed to grave dangers if he catches any infective or eruptive fever. Even influenza may be the cause of these accidents; I can cite two cases to you bearing on the matter.

The subject of the first case was a deputy; that of the second a hospital physician. They had both fought in the war of 1870-71, one in the army of the Loire, the other in Bourbaki's army. Both had suffered during that period from nephritis induced by exposure to cold, but they had completely recovered from it. They suffered from influenza four years ago; in spite of the mildness of the influenza, they showed symptoms of cerebral disturbance, with anxiety, loss of memory, etc. They recovered; but these unusual complications must be attributed, not solely to the influenza, but to the fact that this disease occurred in persons suffering from renal inadequacy.

Here is another case, to which I have already referred with some fulness:

A retail poultry-woman in the market, who had a fine stuffed turkey remaining on her hands, invited her relatives and friends to come and help her eat it; all who partook of this turkey became ill; the stuffing, which was no longer very fresh, contained toxic alkaloids. The woman alone, who had not eaten more than her guests, died, because she had diseased, and therefore inadequate, kidneys. She could not eliminate the toxic substances which she had swallowed.

It is not necessary, however, that the substances swallowed should be of a poisonous nature. A journalist, after a copious repast, went to a house of ill-fame in the Rue Tiquetonne; he was already somewhat intoxicated; nevertheless, he

treated all the inmates of the establishment to champagne, and finally went upstairs with one of them. When he was in bed he defæcated as he lay there. The woman was disgusted, and slipped away, leaving him by himself. Next morning, when the door of the room was opened, the man was found lying dead on the floor at the foot of the bed, with his left side covered with bruises. Naturally, the superintendent of police intervened; the body was removed to the Morgue, and an autopsy was made. The kidneys were contracted and older than their possessor (he was 44 years of age). The champagne that he had drunk had intoxicated him because he could not eliminate it. He had died of uræmic convulsions.

Why does the kidney suddenly cease to perform its excretory functions? Because the organ is irritated and congested, and consequently there is less urine secreted. Therefore, when we have to prescribe a diuretic, we should choose one which is free from irritating properties.

I am not speaking here of invalids, but of those persons who excrete a few grains of albumen daily.

The same is true of arterio-sclerosis and of cardiac affections; there is indeed a very close relation between the heart and the kidney. The question has been under discussion for a long time in Germany. Traube has shown that any renal mischief will determine increase of arterial tension, so that the left ventricle becomes hypertrophied, and thus constitutes a genuine cardiac affection.

It matters little to us, Gentlemen, to know whether the disease of the heart has preceded that of the kidneys, or *vice versâ*. When the heart is diseased, the kidneys are congested, and they can no longer eliminate the offending substances which they ought to remove from the system.

Suppose that you have to make an autopsy on a person who has died under such conditions. It is necessary to seek for albumen in the urine. This search ought to be made, but it would be rash to draw positive conclusions from it. There are, indeed, uræmic patients who pass no albumen. Besides, albumen is always found in the urine of a person who has been dead 48 hours. To assure them-

selves of this fact, MM. Ogier and Vibert took the bladder from a corpse at the Morgue, emptied it, filled it with water, and hung it up in the laboratory; in a few hours' time this water contained albumen. When putrefaction begins, albumen is formed. The discovery of albumen, therefore, does not prove that albumen was present during life.

Pathological anatomy might help us to answer the question. Unfortunately, when we make an autopsy in a case of this kind, we have too often to regret that it is done too late; for, in the first place, the kidneys occupy a dependent position in the body, and therefore become infiltrated by exudation from the blood, and their texture is altered thereby. Death from uræmia may, under certain circumstances, be attributed to poisoning. Now, medico-legal autopsies, when there is a suspicion of poisoning, are most often made after exhumation; thus, the kidneys are putrefied, and there is not much to be learnt from a minute examination of them.

What then, Gentlemen, are the forms of uræmia from which individuals die who have diseased kidneys, and whose rapid death appears suspicious?

There is first of all the *bronchitic form*. The patient is suddenly seized with dyspnœa and pulmonary œdema, with abundant secretion of bronchial froth, which forms a button round the nostrils and mouth after death, just as in bodies that have been drowned. He dies suffocated by bronchial froth. When we meet with this form, the kidneys in most cases are not contracted, but are the seat of desquamative nephritis. Sometimes cardiac disease co-exists and intensifies the amount of œdema. Dr. Lesser, of Breslau, who was formerly Casper's assistant, has paid special attention to sudden death. Out of seventy-five cases which he attributes to this group of phenomena, and in which he finds renal lesions, he only credits the kidneys with seventeen cases of sudden death, there being in these no disease of the heart. For my own part, I believe that the kidneys play a much more considerable part in the production of sudden death than Lesser assigns to them, even when there is some cardiac affection present. It is the kidney

which regulates the amount of liquid discharged from the body, and which sometimes does not permit the removal of poisonous substances at all.

The *gastro-intestinal form* is characterized by coldness of the surface, vomiting, and diarrhœa; in short, by choleraic phenomena. It gives rise to the idea of arsenical poisoning. The disturbance of the gastro-intestinal functions no longer permits the food to undergo the normal transformations in the alimentary canal. Dangerous fermentations are set up. It is from this form that individuals often die, whose kidneys are structurally altered, and who eat tainted or indigestible food which they can no longer assimilate or get rid of in the normal way.

The *comatose form* gives rise to the idea of opium-poisoning. A magistrate was cross-questioning in his court a man who had been arrested shortly before. The man suddenly became comatose and died. He had albuminuria. Coma in this albuminuric subject was probably determined by the mental emotion caused by his arrest and examination.

If this accident had happened in a private house, instead of in a magistrate's court in the presence of a magistrate, officials, and police, all working in broad daylight, poisoning might have been suspected, and a medico-legal investigation would have had to be made.

The *convulsive form* chiefly seizes upon those persons who drink to excess, and especially those who are addicted to certain kinds of liquor, such as absinthe, arrack, and all those which contain essences. M. Magnan has described epileptic fits which are met with especially in those alcoholic subjects whose favourite drinks are liqueurs, etc. We shall return to the subject of the kidneys of alcoholic subjects presently.

The *fulminating form* has been noticed for a long time. It is that form which suddenly strikes an individual, so that he falls down and dies in a few minutes or an hour. M. Alfred Fournier* published the first characteristic case. It had been recognized in England some years before.

* Alf. Fournier, 'Des Formes de l'Urœmie.' Thèse d'agregation.

An individual was taken ill in the street, went to a chemist's shop, and received a draught. He immediately fell dead on the threshold as if struck by lightning. The passers-by fancied that the man had been poisoned by the chemist, so they set to work and smashed everything in his shop. The body was removed by the police, and a judicial autopsy was ordered. Lesions of Bright's disease, which was already well known, were found in the kidneys, and this explained the sudden death.

From what I have already told you, Gentlemen, do not forget that forensic medicine is more closely concerned with uræmia than with any other cause of sudden death, and that it is often difficult to make a certain diagnosis from the results of an autopsy. Remember that the kidney no longer eliminates the substances which it is its function to excrete. Death happens, therefore, by auto-intoxication, and this auto-intoxication has been attributed to the incomplete excretion of urea. It is true that urea is found in the blood, but at the same time the kidney no longer eliminates ptomaines and leucomaines, which contribute in a large measure to poison the system. Remember that certain substances, such as salicylic acid for example, taken in small doses daily, are imperfectly excreted, and accumulate within and poison the system, while a single large dose would have had no ill effects. Acetate of lead is another such substance. You know that in dysentery as much as 22½ grains can be administered in one enema without any risk; but if one-thirtieth part of this dose is given daily for a month, symptoms of poisoning will be produced.

Lead-poisoning may induce convulsive or delirious symptoms. When, about 1864, MM. Ollivier, Cornil, Fritz, and Ranvier made their researches into lead-poisoning, which they confirmed by experiments on animals, they studied the state of the kidneys in this condition with great care, and found interstitial nephritis. The kidney was no longer the perfect filter that it ought to be.

Your responsibility in regard to these accidents may be called in question under other circumstances. An individual may have albuminuria of which he may be ignorant. It

may be unattended by œdema or by any functional disturbance, and you yourself will be unaware of it, unless you systematically examine the urine of all your patients for albumen.

M. Bouchard has related this case: While he was acting for Professor Bouillaud at the Charité Hospital, a woman was admitted under his care suffering from syphilis, and for whom he prescribed mercurial pills. When this woman had taken one pill, she was seized with severe stomatitis and terrible uræmic symptoms. M. Bouchard examined the urine, and found albumen in it. The kidneys were unsound, and thus the mercury was not eliminated.

In 1877 I was consulted about an identical case. The brother of one of my pupils was a cavalry officer, and a student at the Military School. This young soldier was covered with boils. I was invited to see him, and I ascertained that he had no albumen or sugar in his urine. Some days afterwards he contracted a hard chancre, followed by roseola, and after the administration of a single mercurial pill he suddenly became collapsed. The urine was examined at once, and showed an enormous proportion of albumen—34 grains per ounce of dried albumen. You will find this case reported at length by M. Descoust.*

A consultation was held, and, in spite of my advice, the administration of mercury was prescribed afresh. The officer had only taken two mercurial pills, when he became affected with stomatitis, which lasted five months. The use of mercury had to be discontinued. The affection of the kidneys was cured, however. Three or four years after, this officer was sent to Tunis, and there he contracted typhoid fever with renal complications, which caused his death, because his renal filter had not returned to its absolutely normal condition.

Other causes may lead to similar results, without the kidneys being primarily affected.

When I was Aran's house-physician, an old woman who seemed much exhausted was admitted under my care. She

* Descoust, 'De l'Albuminurie survenant dans le Cours des Accidents secondaires de la Syphilis.' Thèse, Paris, 1878.

became comatose one evening, and died in the night. When I reported the fact to my chief the next morning, he said to me, 'That woman had cancer of the uterus.' This proved to be the case. Cancer of the cervix uteri may invade the fundus of the bladder. When it reaches a certain size, it blocks up the orifices of the ureters, and thus causes retention of the urine in the kidneys and their ducts. Evacuation of fluids which ought to be excreted is impossible, and may sometimes lead to hydronephrosis and uræmic poisoning. The same complications may follow stricture of the urethra, prostatitis, stone in the bladder, etc.

B. GOUT.

I think I ought to place sudden death in gout by the side of sudden death from diabetes and of that from renal complications.

Old authors used to say that sudden death in gout was due to visceral metastases.

Since Garrod clearly established the distinction between rheumatism and gout, English authors have observed more and more attentively the state of the kidneys in the autopsies they perform, and they have described the 'gouty kidney,' which they sometimes confound with the senile kidney. English physicians have more opportunities than we have of studying gout. The consumption of beer, and especially of porter, seems to explain its frequency. In France we scarcely ever see the phenomena of gout in hospitals, except in association with lead-poisoning, and outside the hospital we only see it among the richest of our patients.

Gouty metastases, of which the old authors speak, are of different sorts. There is first of all *serous apoplexy*, *i.e.*, abundant serous effusion into the meshes of the pia mater and into the ventricles. Then there is *gout rising into the lungs*. This consists of symptoms analogous to those which I described to you under the heading of pulmonary œdema and capillary bronchitis. The individual dies, suffocated by his bronchial froth, as Piorry said. Finally we have *choleraic intestinal symptoms*. This form is one of the classical manifestations of uræmia.

Gentlemen, in passing under review the 150 cases of gouty metastasis that I have been able to collect from the writings of authors, I have nearly always found that some renal lesion was present. I do not venture to make the unqualified assertion that sudden death in gout always has a renal origin ; I am strongly inclined to believe it, but I have not myself seen enough cases of the kind—a dozen at most—and my experience has not been long enough to make me sure of it.

In what manner may it be necessary for the medical jurist to intervene? All physicians, Trousseau especially, who have seen much of gout, have said : 'You should never try to arrest an attack of gout ; on the contrary, you should try to prevent a retrocession.' Gouty patients, naturally, are not of that opinion. A gouty attack—and it has not varied since Sydenham described it in such a masterly way—is very painful and very hard to bear. So what do the gouty patients do? Their physician does not relieve them, therefore they fly to quacks; they have recourse to secret remedies, or what profess to be such. Now, in this country the secret remedy for gout is nothing else than colchicum, and it must be admitted that it is effectual. Fatal cases of gout have nearly always been treated by some medicine, the basis of which is colchicum—the 'liqueur de Laville,' or something of the sort. Colchicum may act in two different ways : it either increases the quantity of urine excreted, or else it lessens it by causing congestion of the kidneys. If the quantity of urine is increased, the treatment is favourable ; if it is diminished, it is dangerous.

You know, Gentlemen, that a congested organ does not perform its functions properly ; when an individual works at his desk with attention and application, and especially if his shirt-collar is tight, his brain becomes congested, his face becomes purple, and the activity of his brain is not increased, but diminished.

When in any organ the exit of blood is more difficult than its entry, the organ becomes turgid and congested, and its functions are impeded. It is altogether different when an organ is in full activity, when the blood flows to it freely

and no obstacle hinders its return. It is the same with the brain as with the salivary glands (Cl. Bernard). When the kidney is working actively, physiology has taught us that the blood of the renal veins is red. But repeat the experiment in animals in which you have produced congestion of the kidneys by obstructing the renal veins—by a loose ligature, for example ; then the blood of the renal veins is black. The same thing happens in the kidneys of gouty persons; when renal congestion is produced by the ingestion of a substance which irritates the kidneys, the secretion of urine is diminished, and there is retention of products which ought to be excreted.

Moreover, a gouty man is a frail creature. He often has sclerosis of the arteries and of the heart ; he has lesions of the liver ; if some disturbance of the circulation should supervene, his condition immediately becomes grave. As long as the kidneys are working properly, his health is good; but as soon as the functions of the kidney are checked, whether by atrophy or by congestion, he is in danger.

LECTURE XII.

SUDDEN DEATH IN ALCOHOLISM.

GENTLEMEN,—Alcoholism has already engaged our attention on various occasions in the course of these lectures; nevertheless, it is necessary to describe certain phases of it with greater precision.

Alcoholism presents itself in several forms. In the first degree there is the individual who has only been guilty of a single excess, which is fatal only in exceptional cases; such is the individual who is picked up dead drunk. Then comes delirium tremens, and lastly chronic alcoholism.

A. DRUNKENNESS.

How does death take place in a fit of drunkenness, the consequence of a single excess? It is by the body becoming cold. You know that in slight degrees of intoxication the face becomes flushed and turgid; when drunkenness is more profound, the capillaries of the surface dilate, and a peripheral vaso-motor paralysis takes place. Consequently the individual radiates a large amount of heat. When a man who has been found dead drunk is taken to the hospital, the thermometer in the rectum shows that the central temperature has fallen to 75·2° F. Two cases of this class have been recorded—one by M. Laborde, the other by M. Bourneville.

Is this the only mode of cooling to which people in the state of drunkenness are exposed? I do not think so. Magnus Huss, a Danish physician, demonstrated the presence of little globules of fat in the blood of individuals who died while drunk. I myself observed in 1871, when

making experiments on the blood of persons suffering from small-pox, scarlet fever, and delirium tremens, that the blood corpuscles lost an appreciable amount of their oxidizability; as they no longer retain oxygen, they cannot distribute to the various parts of the body the gas which maintains combustion, regularity of respiration, and calorification.

In former times a method of treatment was adopted towards drunkards which recent researches have justified. They placed the drunkard on a dung-hill and covered him up; as the dung-heap is warm, it counteracted the tendency of the drunken man to become cold.

This method still prevails in Brittany and Normandy; sometimes persons who are dead drunk are placed in a baker's oven; but the effect of this is a matter of chance, for the oven may be too hot or may have already become cold. When you read descriptions of the anatomical lesions which the organs present in the bodies of those who have died in a state of intoxication, you will be told that the stomach is contracted with prominent ridges, and that spots or ecchymoses are scattered over the mucous membrane. Only a short time ago I had to make an autopsy on a girl who had committed suicide by swallowing absinthe; a paper that was found by the side of the girl left no doubt that the case was one of suicide.

That girl had taken about 25 oz. of absinthe. We thought at the time that we should be sure to find in her viscera the characteristic signs of acute alcoholic intoxication; we could not, however, detect the smell of alcohol or of absinthe: the stomach was empty and not shrunken; the mucous membrane was normal, and the rest of the viscera were perfectly sound. If this girl had not given evidence, by her writing, of her determination to commit suicide, and if a bottle holding $1\frac{3}{4}$ pints of absinthe had not been found by her side, do you think that an autopsy would have afforded an explanation that would satisfy the law? Not at all. Remember, then, that death from ingestion of alcohol may leave no mark on the body that will guide you in your search, and that will reveal to you the mode of death in the case you are examining.

B. DELIRIUM TREMENS.

The second form of alcoholism is characterized by delirium tremens. It is familiar to you, and I will not describe it at length. A long while ago a distinguished physiologist demonstrated how frail a being Hercules may be when drunk. You know that this delirium is often accompanied by acts of violence; you know that a large number of alcoholic subjects of this class have to be confined in a madhouse. The superintendent of the asylum does not fail to warn those who bring the patient that the latter is in a condition which exposes him to great danger, even from the delirium itself, and that he may die suddenly. In fact, it sometimes happens that one of these patients dies in a paroxysm of excitement the very day after his admission into the asylum. The superintendent and attendants of the asylum may be held responsible, and you should know that in the immense majority of cases they are quite free from blame.

C. CHRONIC ALCOHOLISM.

I have already told you that chronic alcoholism, *i.e.*, the third stage of alcoholism, has the power of making acute diseases run their course in a latent manner; this applies to cases of pneumonia, meningitis, etc., of which I have cited examples to you, so that I need not return to them. Alcoholism, moreover, creates lesions in every organ, and the subject of it is thus exposed to the danger of sudden death in every form which may, in fact, result from lesions of these organs.

This is not all: sudden death often overtakes alcoholic persons who have recovered from their primary disease, and have become convalescent; is this because the myocardium is affected? The lesions from which alcoholic subjects suffer are so numerous and of such variety that it is difficult to enumerate them. Sudden death occurring in them is attributable, above all, to fibroid degeneration of the heart, kidneys or liver.

The same phenomena are wont to appear as a sequence

of injuries or of surgical operations. Dupuytren was accustomed to say that he did not lose any of his operation-cases, except those who were attacked by delirium tremens. Dupuytren practised at a period, Gentlemen, when the classification of diseases was less precise than it is now, and when purulent infection was not uncommon. I am inclined to believe that among these cases of 'delirium tremens' were included many cases of septicæmia.

D. MEDICO-LEGAL INTERVENTION.

Two important points still await our attention: the intervention of the medical expert in alcoholism constitutes one of the longest chapters in medical jurisprudence. The individual whose condition is to be investigated may be either the author or the victim of a criminal act; he may be a culprit in such a way as this: You have all seen tipsy people; you know that a person who has taken rather too much is sometimes amusing for a time; he says whatever comes into his head, he becomes confidential, and, however stupid he may be, his sallies are often very comical. But he does not always content himself with exuberance of language; in an individual under the influence of alcohol there is no barrier between the idea and the act; there is no room for reflexion. He sees a ditch and leaps over it, without thinking whether he will clear it or fall in. The idea of hanging himself enters his head, and he does hang himself, without knowing why, and this idea is so firmly rooted in his mind that nothing can erase it.

Laségue has reported the following suggestive case, bearing on this subject:

A sentinel heard a noise one night by the side of his box. He wished to ascertain where the noise came from, and saw a drunken woman who had fastened a twisted cord to the window of the sentry-box and was going to hang herself. The soldier ran after her, but saw that she stopped a little way off in order to make a fresh attempt. He called the attention of the guard to her, and the woman's attempt was thwarted again, and her life was saved; but she managed to carry out her project by turning round a corner of the street, where the sentinel could not see her.

Nearly thirty years ago a wine-merchant's porter, who was an alcoholic subject, threw himself from the top of the Bastille column; at that time the railings which surround the monument were undergoing repairs, the weather-cocks at the top were being gilded, and a large well-stretched awning had been put up all round the base of the column. The man fell on to this awning, rebounded, alighted on the ground, and walked away without having sustained any injury. But the police ran after him and arrested him; and when taken before the superintendent he stated, now that he was sober, that he had no motive for committing suicide, and that the idea of throwing himself down had come into his head suddenly while he was on the top of the column. This man afterwards became a hospital porter, and has acted as porter in the *post-mortem* theatre for 15 years, yet the idea of suicide has never returned, and he has never been able to explain why he ever wanted to commit the act.

The alcoholic subject does not make attempts on his own life merely. He is a dangerous man both to his relatives and to his neighbours. He sleeps badly; he imagines that he sees glittering objects, and fancies that he is surrounded by animals, which make offensive remarks and insult him; he has hallucinations of touch, and believes that he is exposed to violence of greater or less severity; in short, he has hallucinations of sight, touch, and hearing.

Allow me to remind you of a certain butcher-boy who imagined one night that his wife struck him on the head with a boot; he got up, took his knife and cut her throat; then he chopped her in half, as if she were a carcass of veal or pork, and set to work to cut her body into joints as if he were preparing meat for sale. He was arrested, and confined in Mazas Gaol, and at the end of three weeks his alcoholic delirium had entirely disappeared.

This man was instigated by an impulse whose direction was determined by his professional habits; the murderer literally butchered his victim, and seemed to act in a blind attack of epileptic fury. Individuals who commit crimes of this sort are those who display the greatest propensity to commit suicide.

Statistics prove that the number of crimes and suicides is in proportion to the consumption of alcohol. The curve which indicates the consumption of alcohol in each department is identical with that of suicides and crimes against the person. The consumption of alcohol is ten times as large as it was twenty years ago; the number of suicides has increased to the same extent.

Gentlemen, if, disregarding the interests of society, we answer the question which is put to us, whether or not the man who commits such a crime is or is not conscious of what he is doing, and responsible for his actions, we might be tempted to say, when brought face to face with a crime committed by an alcoholic subject: 'This man is not responsible, because he delivered the blow during an attack of alcoholic insanity.'

Well, Gentlemen, these words have never crossed my lips in the court of assizes. I cannot admit the irresponsibility of persons under the influence of alcoholic excess; it is not the same thing as insanity. He has become enraged because of his vicious habits, and he is at least responsible for those preliminary acts which led to the perpetration of the crime. A madman, a poor lunatic, is not responsible; but a man under the influence of alcohol, a man who knows that his drunken habits will by degrees bring him into such a condition that he may kill his fellows, is responsible for his actions.

Moreover, the question which the Code lays before us is badly worded. We know how dangerous persons suffering from alcoholic delirium are. If we state that they are not responsible, they will be set at liberty. Now, the more a man is addicted to alcohol, the more dangerous he is; but he would be deemed irresponsible all the more, and, therefore, the more dangerous an alcoholic subject is, the more surely would he be set at liberty.

Here is a typical example:

An individual, after a good luncheon at a restaurant in the Cannebière at Marseilles, was sitting on the terrace of a café amusing himself with shooting at the passers-by with a revolver. He was arrested, but was declared irresponsible,

and was confined in a lunatic asylum. In a few months his alcoholic insanity had passed off; he was discharged, and went to Toulon, and again after luncheon fired at the passers-by, wounding one or two of them. He was again arrested and sent to an asylum. This time he remained eleven months in an asylum in the department of Vaucluse; at the end of this time, as he appeared to be in perfect bodily and mental health, he was restored to liberty. He took the train to Dijon, and there, after luncheon, tried to strangle the station-master on the platform of the station. He was taken back to the asylum, and at the end of three years the same scruples took possession of the superintendent, and he thought that he had no right to keep a man shut up who no longer had anything the matter with him, and discharged him.

This time he went to Paris, and after a good luncheon there he again openly fired at the passers-by near the Odéon omnibus station in the Boulevard des Italiens, and wounded several persons more or less dangerously. The unfortunate man was sent to an asylum for a fourth time, and has now been in confinement about three years. What will happen when he is again discharged?

You see that the medical jurist has a somewhat delicate duty to discharge in deciding as to the responsibility of alcoholic subjects and lunatics.

Medico-legal intervention is called for equally on behalf of the victim of the drunkard. Works on forensic medicine are full of such cases as the following:

Some men were drinking at a tavern, when a discussion arose, which became heated and led to a quarrel, and at last one of the drinkers gave another a box on the ear. The latter did not return the blow, but withdrew to another table, put his head on his arm as if he were going to sleep, and remained motionless. The proprietor of the tavern heard him snoring, but took little notice of him at first, thinking that the man was sleeping himself sober. But after a while he went up to him and shook him, in order to wake him; the man was dead. At the autopsy, meningeal hæmorrhage was found, covering the surface of the brain; the skull was

not fractured, and the brain itself was normal. All the other organs of the body were healthy.

Tardieu has reported the following case: A father and son were quarrelling; at the end of the dispute the father gave his son a slight box on the ear; the latter fell down, and died a few hours after from meningeal hæmorrhage.

The gravity of the lesions in these cases depends on the victim, not on the culprit; the blows exchanged are actually insignificant. The medical jurist should lay stress in his evidence on the slight nature of the injury, and explain that the same blow would not have been followed by any disastrous results in a person who was not addicted to drink.

I could multiply such cases and examples; I will only remind you that alcoholic subjects recover very badly from surgical operations, as M. Verneuil has shown,* and that erysipelas is a frequent and dangerous complication of wounds in them.

In the kitchen of a restaurant in one of the boulevards, the plate-washer and a scullion were quarrelling. They became more angry, and the scullion threw a plate at the plate-washer's head; the plate did not break, but the plate-washer received a small superficial wound on his forehead. He was taken to a druggist, who gave him a 'vulnerary' draught, and he then took several nips of spirits to steady his nerves. Two days afterwards erysipelas set in, and he died. The little scullion was in great measure responsible, you see. A medico-legal autopsy on the plate-washer's body was ordered; we learnt thereby that the kidneys were contracted, and that the liver was in the condition of classical cirrhosis. It is evident that the blow caused by the plate would not have caused a fatal result in a person not addicted to alcoholic excess. The culpability of the little scullion was therefore much diminished.

* Verneuil, 'De la Gravité des Lesions traumatiques et des Opérations chirurgicales chez les Alcoöliques.' Paris, 1871.

LECTURE XIII.

SUDDEN DEATH IN CHILDREN.

GENTLEMEN,—Sudden death in children is different, as regards pathogeny, from that which we have studied in its various forms in adults. The predominant feature is the readiness with which, in children, extremely violent attacks of congestion are brought on, which may be accompanied by certain reflex actions, owing to the excitability of the nervous centres.

However, I think it would serve no useful purpose to recapitulate, from the point of view of sudden death in children, all the diseases and disorders which we have studied together one after the other when we were engaged with sudden and suspicious death in the adult.

I shall content myself with laying before you the principal factors, and with pointing out their dominant features.

Sudden death is of frequent occurrence in children. West states that, out of 627 cases of sudden death dealt with by the London police in 1854, 272 were those of children under the age of five years, and 126 of these were under one year. Sudden death in children is usually due to one of five principal causes, viz., syncope, convulsions, asphyxia, pulmonary congestion, and intestinal troubles.

A. SYNCOPE.

Before going further into the study of these cases, allow me, Gentlemen, briefly to elucidate a certain point which has sometimes led to unfavourable conclusions being drawn,

and has given rise to the suspicion that death was due to foul play. I refer to *syncope*. Syncope is common in children; should it be attributed to a violent pain, to reflex action, or to inhibition?

Devergie, Rilliet, and Barthez were of opinion that syncope was a frequent cause of sudden death in children. Barthez cites several such cases happening at the age of six or seven months—Devergie at the age of one year.

This kind of death may be due to some cardiac affection, which may be present in a young child even at birth, and may be due to patency of the foramen ovale or of the ductus arteriosus, or to a communication between the two ventricles, etc. These cases are more frequent than those due to inflammatory mischief. But fatal syncope may take place in children quite apart from all lesion or malformation of the heart, and it is far from being rare.

B. CONVULSIONS.

It is not uncommon for children to die in convulsions. In former times, Gentlemen, physicians as well as the public unanimously believed that convulsions were of cerebral origin, and therefore regarded them as extremely serious. Trousseau headed a reaction against this belief, and did not admit that convulsions were so very dangerous.

Gentlemen, a child in convulsions is always in danger. Convulsions may be due to various causes; sometimes they are caused by some lesion of the brain, such as hæmorrhage, softening, tumours, or large masses of tubercle, as in a case recorded by Parrot. These cases appear all the more suspicious because children at that early age are not expected to suffer from diseases of the kind.

One of the most frequent causes of death at this age is congenital syphilis, which may produce vascular lesions simulating hæmorrhage or meningitis, and which may lead to sudden death. Sometimes caries of the bones and peri- or end-arteritis are found *post-mortem* in such cases.

Another cause is meningeal hæmorrhage. This is more often met with in children at the period of dentition. At

this time congestive attacks may take place, including lesions of the parietal arachnoid, which becomes vascular. The little vessels newly formed therein may burst, and sudden death follows, due to meningeal hæmorrhage.

When you are called to attend a child in a fit of convulsions, ascertain first of all if it is feverish.

If pyrexia is present, the case is probably one of the exanthemata in its initial stage. In children, convulsions are the equivalent of a rigor in the adult. Sydenham observed that convulsions at the commencement of an eruptive fever are of little importance. It is quite the reverse when they occur at the end of the eruption.

If the child is not feverish, you may confidently say that the cause is situated between the lips and the anus. Nine times out of ten, convulsions are due to the process of dentition, indigestion, constipation, diarrhœa, or a collection of worms in the intestines. In ninety-nine persons out of a hundred affected by tapeworm, there will be no nervous symptoms, but in the hundredth such symptoms will be present. Children are always in this exceptional condition. They are strongly predisposed to suffer from convulsions when their alimentary canal is out of order. These convulsions are never quite free from danger, so give your opinion guardedly. Through omitting to do so, I once put myself into rather an awkward position, as I will tell you :

When I was a young doctor, I was called in to a child in convulsions. As my mind was deeply imbued with the teachings of my masters, Trousseau especially, I reassured the parents, telling them that it was an everyday occurrence, and that there was no danger. Before I had finished speaking the child died.

The truth, Gentlemen, is neither on the side of Trousseau, who underrated the gravity of convulsions, nor on the side of the physicians of the last century, who overrated it. Remember that an accident of this kind is not necessarily fatal, but at any rate do not regard it as trivial, and mind that you never neglect to attend to the state of dentition and of the alimentary canal.

C. ASPHYXIA.

I come now to the study of sudden death due to *asphyxia*. Let us first consider the phenomena which nurses call 'inward convulsions.' Nurses are not altogether wrong, although these convulsions have a different origin from those which we lately discussed. 'Inward convulsion' most commonly implies spasm of the glottis, due to laryngeal irritation, or stridulous laryngitis, such as may take place in the course of measles, bronchitis, or a common cold.

Stridulous laryngitis presents this characteristic feature, viz., that the stridulous attacks always take place between the hours of 10 *p.m.* and 4 *a.m.* These spasms (for no other name can be applied to the symptom) are due to slight inflammation of the mucous membrane of the larynx. Every form of laryngeal inflammation may give rise to spasm of the glottis. Croup is one form. When we make an autopsy on a child who has died of croup, we often find only thin membranes no thicker than paper, which are quite insufficient to block the *lumen* of the trachea and larynx; but the inflammation of the mucous membrane has induced spasms which contributed largely to diminish the entry of air into the bronchi, and led to suffocation.*

These spasmodic attacks are usually easily cured, except in very young children and in those suffering from diphtheria.

A special form of asthma used to be described, viz., 'thymic asthma,' to which Millar attached his name. Then the existence of the disease was forgotten, and it has been brought to light again within the last few months. A few isolated instances had, however, attracted attention in the interval. Some years ago, as I was making an autopsy on a child 3 or $3\frac{1}{2}$ months old, which was supposed to have been suffocated by its mother, I found the thymus very much hypertrophied. Normally, according to Sappey's observations, the thymus weighs 90 to 120 grains, and measures 2 inches in length, $\frac{4}{5}$ inch in breadth, and $\frac{2}{5}$ inch in thickness. The thymus in the case of which I am speaking weighed

* In English text-books of medicine it is too often omitted that laryngismus stridulus may be the cause of sudden death in infants.—TR.

360 grains, and measured $3\frac{1}{2}$ inches in length, $1\frac{1}{5}$ inches in breadth, and $\frac{1}{5}$ inch in thickness. Before my case happened, Hérard in 1847 and Bontemps in 1882* had reported similar ones, without drawing any medico-legal conclusions from them.

Dr. Grawitz, a German physician, made some researches on this subject in 1888. He noticed that all the children in whom an abnormally enlarged thymus was found *post-mortem* died in the same manner; they were in good health, when, while sucking or drinking out of a cup or a spoon, they threw back their heads and died without a cry or convulsion, or even any movement at all.

Some weeks ago M. Marfan found a thymus weighing over an ounce, and measuring 3^1 inches in length, $1\frac{1}{5}$ inches in breadth, and $\frac{2}{5}$ inch in thickness, in an infant. The dimensions in this case are almost the same as in that which I met with myself, and which I have just mentioned to you.

Dr. Grawitz does not think that death is due to pressure on the trachea and bronchi; he bases his belief on the fact that the calibre of the air-passages was not reduced in any of his autopsies. This agrees with my own observations; I have never found the trachea distorted. But the trachea and bronchi are very elastic in children, and resume their natural form directly the sternum is removed. No conclusion can therefore be drawn from this fact. For my part, I believe, as does M. Marfan also, that the thymus does compress the trachea; this compression gives rise to a slight degree of spasm, which rapidly causes the child's death.

Subpleural ecchymoses and ecchymoses on the thymus are found in these cases. You see at once how necessary it is, in presence of these phenomena, always to examine the thymus in a child who has died suddenly, in order that no suspicion of crime may fall upon an innocent person.

Polypi of the trachea also give rise to analogous spasms.

Whooping-cough has not a very bad reputation, generally speaking, among the public; however, it may end fatally by

* Bontemps, 'De la Mort subite chez les jeunes Enfants.' Thèse, Paris, 1882.

broncho-pneumonia, or by laryngeal spasm. M. Ducastel* collected, in 1872, 10 cases of sudden death in whooping-cough in children under the age of 4 years.

Lastly, fragments of food may enter the trachea and bronchi; it is always necessary to see whether these tubes are clear in making medico-legal autopsies. Parrot has reported several cases of the kind. It happens nearly always in a child lying on its back and suffering from indigestion, so that food regurgitates into the respiratory passages.

M. Miquel,† of Amboise, relates a curious instance of this accident:

It happened in a child 20 months old, whose father had just returned from work, and gone to bed. The child, which was on its nurse's lap, began to cry. The father was out of temper, and went towards the child and said: 'Will you not be quiet, then, you ugly little monkey!' The child became silent, drew a deep breath, and died immediately. The child was strong, and had been healthy hitherto. It had eaten nothing that morning, though it had just been drinking some sugar-and-water. Its death was put down to emotion, to the fear which the father's exclamation had aroused. This was evidently the starting-point of the untoward event.

Post-mortem.—The trachea was found full of food, sticky yellowish liquid similar to the contents of the stomach. The child had had a regurgitation as a result of emotion, and died because the trachea was obstructed by fragments of food.

D. PULMONARY CONGESTION.

Another common cause of sudden death, in children 5 or 6 months old, is bronchitis. The following example shows how suspicion may arise in such cases:

A child is found dead in its cradle one morning, and its nurse and mother, especially if the mother is an unmarried girl, are accused of having smothered the child by pressure with the arm. An autopsy is ordered, and this is what is usually

* Ducastel, 'De la Mort par Accès de Suffocation dans la Coqueluche.' Paris, 1872.

† Dr. Miquel, d'Amboise, *Gaz. des Hôp.*, 1848.

found:—You know that, in what is called 'capillary bronchitis' or 'suffocating catarrh of children' (Laennec), intense pulmonary congestion now and then occurs, which places the child's life in jeopardy for several hours. When the child is strong, and is more than 7 or 8 months old, it seldom dies of the first attack of congestion. But when the age is less than 6 months, death may occur in the first attack, and at the autopsy Tardieu's* subpleural spots and froth in the bronchi are found. On examining the lungs, some portions of the tissue are felt by the finger to be rather hard, though they float in water. When you have to deal with such a case, squeeze these portions of the lung between your fingers, and you will make little rods of muco-pus emerge from the divided ends of the bronchial ramifications.

This experiment is the only one which will enable you to recognize positively the existence of bronchitis in the newborn or very young infant: it ought always to be practised when any one is accused of murdering a child; it may help you to exonerate an innocent person.

Bronchitis is one of the most dangerous diseases to which children are liable: the child cannot cough; it does not know how to expectorate, or how to free itself from the obstruction to its breathing; part of the respiratory area thus becomes useless, and the lesions just described, of atelectasic portions of the lungs, are found *post-mortem:* it is Laennec's 'suffocating catarrh.'

Pulmonary congestion is an accident which may complicate any sort of fever: it is a serious condition, but it is rare for pulmonary congestion to give rise to rapid and suspicious death under these circumstances.

Pulmonary tuberculosis has been the cause of many medico-legal autopsies that have been made at the Morgue: the presence of tubercle had been absolutely unsuspected, and yet the little patients had sometimes been in our hospitals under the care of our most eminent physicians. These cases, it is true, mostly happened some time ago, when nothing was known of micro-biology, and no one dreamt of looking for Koch's bacillus, the existence of which was

* Tardieu, 'Étude médico-légale sur l'Infanticide.' 2e édition, 1880.

unknown; it is plain that such things cannot happen so frequently nowadays.

M. Vibert has three times made an autopsy on children under one year of age who have died of typhoid fever; these cases have been published. In none of them was the child suspected to be suffering from typhoid fever; none of them had been seen by a medical man. When interrogated, the mothers or nurses all replied that the children had not taken the breast well for some days; but they all declared that there had been no fever, and nursing-women know very well whether the child has fever or not by the heat of its mouth. *Post-mortem:* M. Vibert found hypertrophy of Peyer's patches, which is an indication of typhoid fever, but the immediate cause of death in each case was pulmonary congestion.

E. INTESTINAL DISORDERS.

The disorders of the alimentary canal which may give rise to sudden and suspicious death are *cholera infantum*, which is sometimes attributed to poisoning, and is generally due to bad feeding; and *intestinal hæmorrhage*. Intestinal hæmorrhage has been supposed to happen in tuberculous children, but Bouchut long ago called attention to the frequency of these hæmorrhages in children where it is impossible to assign any definite cause for them.

I repeat, in conclusion, that the three affections which dominate the pathogeny of sudden death in children are convulsions, spasms of the larynx, and pulmonary congestion.

THE END.

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