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Milestones in Forensic Science

Rather than presenting a static picture of the history of the forensic sciences and more particularly of legal medicine as the textbooks tend to do, I think this is an opportunity to show to what extent progress in these fields has been linked to the forward march of the basic sciences generally.

In this paper my primary concern will be to repair as much as possible the harm caused by the two world wars—especially the first—to the diffusion of information, and to give their due to men who have outstanding achievements to their credit but who, nevertheless, have remained as unknown as the proverbial "unknown warrior." Science was surprisingly well under way when the first upheaval occurred in 1914 and brought about such chaos that much work had to be started all over again.

Though one can never sufficiently underline the merits of pioneers of centuries gone by, it is undoubtedly wiser to entrust this task to professional historians conversant with Latin and, accessorily, other classical languages. I can, however, safely recall a few giants.

My compatriot Andries van Wesel, better known in the United States by his latinized name of Andreas Vesalius Bruxellensis (1514–1564), is the founder of modern anatomy [*1,2*]. He was well familiar with the legal medicine of his time, since his research depended entirely on cases of violent death. He was on excellent terms with judges and hangmen alike and attended capital executions [*3*]. In that golden age for anatomy executions could occasionally be scheduled to meet the needs of the master and his students [*4*].

Ambroise Paré (1510–1590) was the surgeon of kings and the king of surgeons of his century and the father of French legal medicine [*5*]. He was self-taught, having begun the hard way, as apprentice to a barber, when still a boy, before becoming a skilful "chirurgien barbier" and, later, the greatest surgeon of his time. When one explores his monumental treatise in three volumes totaling 2499 pages, one is dumbfounded by the universality of his knowledge of medicine [*6*]. He was apparently the first to describe firearm wounds scientifically, to deduce the location of a bullet in the body by asking the victim's position when he was hit, and to find a bullet by palpation of the surface of the body. He accomplished sundry other diagnostic feats which implied an astonishing knowledge of what we now call forensic ballistics [*7*]. He posited the problem of the so-called crib death but gave the wrong explanation, namely that of "overlaying" or smothering (Vol. III, p. 658 of Ref *6*). In his description of Caesarian section on a dead woman, he describes in a few sentences with extraordinary lucidity the breathing mechanism of the fetus (Vol. II, pp. 716–717 of Ref *6*). He was not far from the truth concerning carbon monoxide poisoning. In his description of a double accident with recovery, on the 10th of March 1575, he attributed the cause to: "la fumée maligne du charbon ardent" (Vol. III, p. 663 of Ref *6*).

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He was also the first to teach his contemporaries how to write a medicolegal report properly (Vol. III, pp. 651–675 of Ref *6*). A humanist in the full meaning of the word, he was terribly conscious of the incredible sufferings of his fellowmen in those somber days. He took the considerable risk of pleading the cause of many a poor woman who had resorted to abortion and would otherwise have incurred the death penalty, by invoking the authority of St. Augustine (the latter had laid down the doctrine of the *foetus animatus* as opposed to the *foetus inanimatus*) (Vol. II, pp. 652–653 "De L'Ame" and Vol. III, p. 658 of Ref *6*). His writings not only bear witness to his outstanding technical skill but also make him the pioneer of modern medical ethics. In 1550 his famous motto—"soigner souvent (attend often), guérir parfois (heal sometimes), consoler toujours (comfort always)"—provided an unsurpassed lesson of ethics for the generations to come.

Paolo Zacchias (1584–1659) occupied a key position as the personal physician of two successive Popes, Innocent X and Alexander VII, and as first medical expert of the Holy Catholic Church Tribunal or Rota Romana. The author of the monumental treatise *Quaestiones Medico-legales*, he is considered by most to be the mastermind of the legal medicine of his day [*8*].

Another Italian, Giovanni Lancisi (1654–1720) deserves a special mention because he was the first to manifest scientific interest for the all-important problem of sudden death. With the full approval of the Church in the person of three successive Popes (Innocent XI, Innocent XII, and Clement XI), an indispensable prerequisite in those insecure times, he actually performed systematic postmortem examinations of the Rome cases. Thus, he succeeded in unveiling at least one cause for sudden death—cerebral hemorrhage—a noteworthy achievement [*9*].

In those days, a lot of pluck was needed to dare question the accepted dogmas and what the Germans call "Autoritätsglauben." Johann Schreyer, a German physician of the 17th century, possessed the necessary audacity. When, in 1681, he threw a newborn's lungs into a basin of water to determine if the child had been born alive, he was asking for trouble and got it. This simple gesture led to Court proceedings which lasted many years and caused him no small amount of unpleasantness, but the battle was won and the method, from then on, joined the meager armory of the medical expert of those days. The reader will find the story in Zeldenrust's textbook [*10*]. Though written in Dutch, it is a little more accessible than Schreyer's paper in Gothic German [*11*].

At the turn of the century, another giant made his appearance on the scene: Giovanni Battista Morgagni (1682–1771), a pupil of Valsalva. He is considered to be the father of modern morbid anatomy. His classic work *De sedibus et causis morborum* [*12*] has been translated into English [*13*] and is a gold mine for the historians of legal medicine.

From this time forward it becomes easier for the layman interested in the history of sciences to reach a personal opinion regarding the work of past scientists, since these men had begun to write in their mother languages. They have left us masterpieces.

With the end of the 18th century, chemistry made its definitive entry on the scene. With Scheele's (1773) and Priestly's (1774) approximately simultaneous discovery of oxygen, the way was open for Lavoisier to unravel the mystery of combustion (1776) and, in one stroke, to clarify completely the mechanism of respiration, thereby putting an end to centuries of obscurity. May I remark in passing that there was a time when arteries were considered to be simply pipes ensuring the distribution of air in the body![2] Though

[2] The role of the lungs had actually been largely unraveled more than two hundred years earlier, by the Spanish-born anatomist Miguel Serveto (Servede) (1511–1553). In 1553, he described the pulmonary circulation and proved that the blood becomes red in the lungs by mixing with the inspired air. The unfortunate man, who was at cross-purposes with Calvin, was arrested that same year in Geneva and burned at the stake on the charge of heresy.

Lavoisier's momentous discoveries were ended by the French Revolution, which bears the entire responsibility for his untimely death (the French Revolutionaries condemned him to death and refused his reprieve on the extravagant grounds that France had no need for scientists: "la France n'a pas besoin de savants"), he had succeeded in his short life in opening unlimited horizons to science. From the forensic point of view his discovery provided the key to the whole problem of asphyxia. It may be necessary to remind the reader that, until then, death by drowning, for instance, was attributed to the excessive penetration of water into the gastrointestinal tract (hence, the German word "Ertrinkung" and the Dutch expression "verdrinking," meaning too much absorption of drink). The poor creature who was unfortunate enough to be recovered alive underwent the ordeal of enemas destined to evacuate the water from his gastrointestinal tract.

From this point onwards, it is not an exaggeration to speak of the permanent fireworks of major discoveries in all fields of endeavor. The forensic sciences, until then in the cradle, received their share of the booty. Fortunately, from this time on we can keep track of the discoveries, thanks to the new textbooks and journals. They bear testimony to the amazing skill and foresight of the men of science of those days. Major trials usually provided them the opportunity of giving the full measure of their genius.

The first spectacular murder by poison which was the occasion for a major advance in forensic toxicology took place in Belgium, in the middle of the 19th century. It is the *Visart de Bocarmé* case, the first "scientific" crime on record to my knowledge [*14–16*]. The personality of the culprit, as well as the remarkably high standard of the scientific evidence for the Crown, give this case a place of honor among famous trials. Before examining the facts, one should remember that chemical toxicology was then in its infancy. Nothing worthy of mention existed before the appearance of M.-J.-B. Orfila (1787–1853). Orfila, a Spaniard endowed with exceptional gifts, had come to France in 1807. He succeeded in overcoming the difficulties of pursuing his medical studies in Paris all through the Napoleonic Wars and graduated brilliantly in 1811. He was the first to prove that metallic poisons are not only absorbed by the gastrointestinal tract, but that they then reach other organs, where their presence must be detected and their amount assessed.

Only a few years before the *Visart de Bocarmé* case Orfila had been summoned to give evidence for the Crown in a notorious poison trial in France—*l'affaire Lafarge* [*17*]—where, for the first time in history, convincing scientific testimony was given. It was the first occurrence, to my knowledge, in which the defense attempted to rebut the scientific evidence for the Crown by calling in its own expert. The accused was an attractive young widow who, after the death of her husband, married a certain Monsieur Lafarge, by the intermediary of a matrimonial agency. Their union was an unhappy one. In December 1839 Lafarge, who was alone on a business trip in Paris and who was in perfect health, ate a cake which his wife had sent him. He immediately became very sick and complained of symptoms consistent with arsenic poisoning. His condition worsened after his return home, where he was within easier reach of his wife, and he died on 13 Jan. 1840. It was proved that, as far back as 15 December, Madame Lafarge had bought arsenic at a chemist's. The postmortem having been followed by unconvincing chemical investigations, the court consulted Orfila and ordered an exhumation. The exhumation led to analyses, the results of which were again contradictory, so that at last Orfila was called in personally from Paris to Tulle, 300 miles to the south. He demonstrated arsenic in the viscera by the Marsh test, which was performed, as was then customary, on porcelain plates and he assured the jury that the earth of the cemetery was free of it. The accused, who had in the meantime fallen in love with one of her lawyers, was condemned to penal servitude by the assizes before the unfortunate expert for the defense, F.-V. R. Raspail (1794–1878), whose

mad rush to Tulle had been retarded by a fall from horseback, reached his destination. Raspail is supposed to have contended at the time that he could have extracted arsenic from the President's own chair. I recount this to depict better the vivid controversial background peculiar then, as now, to trials for murder by poisoning: from the start these have always tended to become tournaments. There is no field which lends itself better, in my experience, to the avenging of old feuds between forensic experts than a case of criminal poisoning.

Orfila's figure was to loom in a most unfortunate fashion in the Bocarmé case. Count Bocarmé, a ruthless man facing ruin, decided to save himself from imminent bankruptcy by murdering his wealthy brother-in-law. With extraordinary perseverance and cunning he first studied chemistry and thus learned, by reading the 1843 edition of Orfila's treatise, that nicotine was unidentifiable in the dead body. He thereupon grew tobacco, acquired the necessary equipment, and attempted to extract pure nicotine out of it. He failed. A persevering man by nature, he then actually applied for private tuition in chemistry in Ghent and ultimately succeeded in his purpose. The stage was set. He then invited his unfortunate brother-in-law, an invalid, to dinner on 20 Nov. 1850. Having sent the servants away, he suddenly threw himself on the victim, overpowered him, and then, when his brother-in-law lay on the ground, poured (with or without the help of the Countess) the nicotine into the victim's throat, thereby bringing about fulminant death but nearly causing the Count's doom, some of the poison having spilled in his own face. The Crown was fortunate enough to obtain the services of one of the greatest chemists of the day: Jean-Servais Stas (1813–1891). Stas not only accomplished the feat of detecting the nicotine in the dead man's body, but worked out the whole method for the identification of alkaloids, by the process which now bears his name. Stas's evidence was so overwhelming that Orfila, though he attended the trial, declined to give evidence for the defense.

This major discovery by Stas led to a painful incident which has since been entirely cleared up by the historians of medicine [*18–22*]. Orfila, who had heard of the sensational murder in Belgium shortly after its committal and knew of the identification of the poison by Stas, wrote to the latter immediately, pretending he wanted to obtain technical information destined for the fifth edition of his treatise on toxicology. Once in possession of the information, he hastily published a modified version of Stas's method, taking advantage of the fact that the latter was tongue-tied by the forthcoming trial. An unpleasant polemic ensued which was given much publicity at the time. Orfila having been caught redhanded, so to speak, had his great reputation somewhat tarnished at the very end of his career. Stas's discovery of the method for the detection of alkaloids is no doubt one of the major contributions of the nineteenth century to forensic toxicology.

Another outstanding man in that remarkable period of scientific advance, was Lambert-Adolphe-Jacques Quetelet, citizen of the city of Ghent (1796–1874). Quetelet was one of the greatest statisticians of the 19th century [*23*]. A great friend of England, he was a member of the Royal Society and belonged, in fact, to the group of young Turks who founded the Royal Statistical Society of Britain [*24*]. Two great achievements have immortalized his name. The first is his treatise entitled *Physique Sociale*, the first edition of which appeared in 1835. It is a quantitative study of man and of human activities, heralding the new science of sociology of which he was the founder. As far back as 1828 [*25*] and 1831 [*26*] he also published statistical studies on crime, and the second edition of *Physique Sociale*, which was published in 1869 [*27*], embodied a wealth of information on this subject. This treatise inspired no less a person than Florence Nightingale [*28*]. Her letters to Quetelet are now much treasured relics, as are also those he himself wrote to H.R.H. the Duke of Saxe-Coburg-Gotha, the future husband of Queen Victoria (of whom

he had been preceptor) on the theory of probabilities applied to moral and political sciences. It is, however, his monumental work entitled *Anthropométrie ou mesure des différentes facultés de l'homme* [*29*] which has the most direct bearing on forensic sciences. It is to Quetelet that the credit goes for having applied, to biology in general and to anthropometry in particular, the law of Laplace-Gauss and for having made an attempt to develop an archetype of the human being, the famous "homme moyen" or "average man." The so-called Law of Quetelet was to be the keystone on which Bertillon later based his classic system of identification [*30*].

In the meantime, the study of asphyxia had made giant strides from both the chemical and the morbid anatomy approach, with such outstanding men as the chemist Felix Leblanc and the medicolegalist Tardieu. To the former we owe the description of carbon monoxide poisoning as early as 1842 [*31*]. Ambroise Tardieu (1818–1879), a pupil of Orfila, curiously enough immortalized his name by the description of the petechia which bear his name, notwithstanding the fact that they had already been fully described by H. Bayard in a case of infanticide in 1847 [*32*], as Tardieu himself reluctantly admitted [*33*].

From this time on the story of the forensic sciences, at least on the continent of Europe, identifies itself increasingly more with a very few Schools which rose progressively, so to speak, from the ground up in large cities such as Paris (1795), Vienna (1804), Berlin (1850), etc—the places where they were most needed. Their prestige was ensured from the start by their total intellectual independence and their universally accepted reputation of absolute integrity under all circumstances, thanks to which they successfully survived a succession of political upheavals and much clashing of swords. I will not attempt to retrace their respective histories, a task which has already been achieved by men better placed to do so, such as L. Dérobert and V. Balthazard [*34*], F. Reuter [*35*], L. Breitenecker [*36*], and W. Krauland [*37*].

Special tribute must be paid to Austria at this stage which, by its fundamental contributions, must be considered as the cradle of the forensic sciences. Humanity owes a tremendous debt of gratitude to that country for the outstanding achievements of so many of its citizens—Carl von Rokitansky, E. von Hofmann, A. Kolisko, A. Haberda, J. Wagner Jauregg (Nobel prize in 1927), Hans Gross, Sigmund Freud, K. Landsteiner (Nobel prize in 1930), S. Jellinek, and others—whose names have now become household words and who each, directly or indirectly, brought a major contribution to the advancement of the forensic sciences.

I cannot refrain from dwelling a little longer on the special merits of the mastermind of the Vienna School: E. von Hofmann.[3] Because of his exceptional qualifications he had been wisely called from Prague to Vienna in 1875 and appointed to the leading chair of legal medicine of the Empire. It is quite unnecessary to dwell on the overwhelming responsibilities often imposed upon the forensic expert at a moment's notice and when least expected. That is precisely what happened to von Hofmann when, on the 30th of January, 1889, the heir to the throne of the Austro-Hungarian Empire, Archduke Rudolf, took his own life at Mayerling after having shot his mistress, Baroness Maria Vetsera. It is superfluous to evoke the story in detail, since it has been excellently retraced in D. A. Crown's recent paper [*38*]. I differ with the latter author when, on p. 339, he casts aspersions at von Hofmann and his colleagues for having expressed the view that the abnormalities of the skull of the Prince justified the conclusion the latter was mentally disturbed at the time. I don't see why this explanation should necessarily be presented as nonsense. That, of course, is a matter of opinion. And I would like to seize this occasion

[3] I would like to point out that "von Hofmann" is written with one "f" only, since he was Czech by birth and not German (personal communication of Professor W. Holczabec to the author).

to remind the reader that the implications of premature closure of sutures and other causes of intracranial hypertension at present know a renewal of interest. The Mayerling affair had far-reaching consequences. The Catholic Church, through Cardinal Rampolla, at first denied the prince a religious burial on consecrated ground, only changing its mind belatedly. The Emperor remembered this terrible slight when, at the death of Pope Leon XIII, in 1903, Rampolla was on the point of being appointed his successor. The Emperor actually availed himself of his right of veto and another candidate had to be sought.

The incredible sufferings of the ill-fated imperial family of the Habsburgs could easily fill a chapter of a textbook. One now tends to forget that they were to have incalculable political repercussions and, in fact, actually changed the face of the world. On 4 May 1897 the princess of Alençon, sister of Elisabeth, Empress of Austria, perished in the historic fire of the "Bazar de la Charité" (a fancy fair) along with the flower of French nobility. This was the occasion for O. Amoëdo (1897) [*39*] to lay the basis of "forensic odontology." The victims, it must be remembered, were among the few in those days who could afford dental care. On the 10th of September, 1898, in Geneva, Empress Elisabeth herself was stabbed by an anarchist, when she was about to step aboard one of the picturesque white steamers which cruise the peaceful Lake Leman. The wound, caused by a shoemaker's awl, seemed only superficial. The Empress went aboard. The ship departed but, to everybody's amazement, it soon after turned round and made for the harbor at full speed. Elisabeth was already dead. She had succumbed to a hemopericardium. This drama nearly led to war between Austria and Switzerland. Finally, on 28 June 1914, Archduke Franz-Ferdinand, who was to succeed to Franz-Joseph who was left without an heir by the death of his son Rudolf, was shot dead at Sarajevo. This tragedy was to have incalculable consequences, as it triggered World War I.

The merits of von Hofmann, however, are not limited to the unraveling of what we now call headline cases. His major claim to the gratitude of his contemporaries is that of having clarified once and for all the tragic subject of sudden death. He himself wrote a fundamental paper on its causes in 1884 [*40*], thereby clearing the way for A. Kolisko, whose monumental treatise (it covers 795 pages) remains the most authoritative book ever written on the subject [*41*]. This breathtaking piece of work never received the recognition it deserved, simply because it was published on the eve of World War I.

Professor Holczabec informed me that von Hofmann mentioned coronary occlusion in his routine autopsy procedures, a fact which seems to have escaped the attention of the historians of medicine. I have not found it mentioned in Leibowitz's recent monograph [*42*]. Von Hofmann also described death from rupture of tubal pregnancy as far back as 1888, suggesting then the possibility of salvation by surgery.

I would like, at this stage, to put on record parenthetically a number of spectacular discoveries which, during the second half of the 19th century, were to have providential repercussions for the welfare of mankind. If, in 1873, E. K. Abbe of Iena [*43*] had not, at the initiative of Carl Zeiss, invented the condensor of the microscope and, in 1878, with Stephenson, given it its finishing touch by the added improvement of oil immersion, biology would have had to wait much longer before unraveling the well-guarded secrets of nature and the hygienists would have had to grope in the dark still further in their search for the causal agents of infectious diseases. The interdependence of scientific disciplines was becoming more obvious from day to day. Abbe's discovery had opened unlimited horizons to modern bacteriology and Robert Koch rightly paid tribute to this great physicist, his compatriot, when he underlined the immense debt of gratitude science

owed him. Hence, as was to be expected, famous Schools rose in Paris, Berlin, and other centers.

Because of this 1894 proved, in its turn, to be a very fruitful year for science. Jules Bordet (1870–1961), who had just finished his medical studies in Brussels and was only 24 years old, was sent to the Pasteur Institute of Paris with a Belgian Government Fellowship and entrusted to the tutorship of E. Metchnikoff. In only one year a series of breathtaking discoveries in the field of fundamental immunology ensued, among many others the discovery of the *complement system* (1895), which heralded the entry of the test tube in the biological laboratory and the ultimate triumph of *in vitro* techniques, for which Bordet shares the honor with a handful of his contemporaries. His subsequent discoveries of the specificity of hemolytic sera and of the biochemical specificity of proteins in the different species (1898) led straight to the introduction of the serodiagnosis in forensic medicine, to which Paul Uhlenhuth was to dedicate his whole life. Uhlenhuth [*44*] expressed himself in the following terms on the subject: "Bordet fand dann weiterhin, dass sich auch nach Einspritzung von *Kuhmilch* im Blutserum vom Kaninchen *Präcipitine* bilden, welche das Casein der Kuhmilch ausfällen." (Bordet further discovered that, after injection of cow's milk to rabbits, a precipitin is formed in the blood serum, which has the property of precipitating cow milk casein.) Bordet, whose centenary has just been commemorated, was awarded the Nobel prize in 1919 [*45*].

To measure at their real value the merits of these pioneers, it is indispensable to bear in mind the appalling conditions in which they had to work. Dr. R. B. H. Gradwohl actually told me that Metchnikoff, who needed monkeys for his experiments but could not afford to buy them, relied on the friendship of sailors for his supply.

Among the flow of discoveries which marked the end of the 19th century, yet another one deserves being rescued from oblivion. When, in 1894, P. Mégnin published his classic monograph entitled *La Faune des Cadavres* [*46*] in which he proved convincingly that the onslaught of insects on human remains tends to occur in a definite sequence, he provided a valuable new means of assessing the time of death. Though it was, in fact, not his discovery, Orfila having already noted the phenomenon, Mégnin provided the first comprehensive study of the subject. Mégnin's contribution undoubtedly inspired my compatriot M. Leclercq, when he wrote the chapter on the entomology of the cadaver in his excellent book in English [*47*].

It was at this time (1895) that Bacillus botulinus was discovered in my native country by one of my predecessors, E. van Ermengem, in the course of a purely medicolegal investigation [*48*].

Among the many citizens of Italy who contributed to the greatness of their fatherland in those days, I will only select one, Cesare Lombroso (1836–1909), the founder of criminal anthropology [*49*]. As is the case for most pioneers, his life was a constant uphill struggle and he did not live quite long enough to be awarded the laurels he so richly deserved. Among the many criticisms leveled at him was the reproach that his doctrine was solely based on anatomical characteristics. His detractors ignored the fact that the basic knowledge one had to rely on in those days was very limited indeed, and that the time had yet to come when, for instance, the laws of Mendel would at last take their place in the panoply of biological sciences and help to clarify many problems. The state of mind which then prevailed is exemplified by the discourteous exclamation (recorded by Lombroso's nephew) by his arch opponent, the Franciscan A. Gemelli, after Lombroso's death: "I funerali di un uomo et di una dottrina" (the funeral of a man and of his doctrine) [*50*]. Times have, however, changed for the better. The chromosomes now have their say in the

matter and such feelings belong to a distant past. The name of Lombroso now again shines in the firmament of the criminological sciences.

The forensic sciences in Holland have always been reduced to the role of poor parent, in sharp contrast to the other forms of scientific endeavor, which have permanently flourished. A noteworthy contribution from that country must, however, be put on record. In 1899 the Dutch free lance, M. L. Q. van Ledden Hulsebosch, published his classic atlas [*51*] on human excrements, a mine of information for the criminalist on the microscopical structure of all imaginable nutriments during their transit through the gastrointestinal tract.

In passing, I would like to put on record that Christiaan Eijkman, who shared the Nobel prize in 1929 with Fr. G. Hopkins for their fundamental work on vitamins, was professor of hygiene and *forensic* medicine from 1898 to 1928 at the University of Utrecht, and that H. F. Roll, a Dutch pupil of A. Kolisko, is the author of one of the best treatises on legal medicine ever written. It is entitled *Leerboek der Gerechtelijke Geneeskunde voor de Scholen tot Opleiding van Indische Artsen* and, as the title emphasizes, was more particularly destined for the native doctors of the Dutch East Indies. The first edition was published in 1908–1912, in Batavia [*52*], and covered 1056 pages. A revised second edition was published in Holland in 1918–1927 [*53*], and is a classic in that country.

One would be tempted to think that events in the field of the forensic sciences would, from now onwards, move more quickly. Actually this was not the case. The reason must be sought in a certain reluctance on the part of forensic scientists to trust any spectacular discovery before they were absolutely convinced of its reliability. This is probably the reason why the stupendous discovery of the blood groups in 1900, by K. Landsteiner, only found its real forensic echo nearly a quarter of a century later, although it had long since triumphed in clinical medicine. Perhaps it is because of the first world war that the so-called forensic serology only started getting under way so late, notwithstanding the fact von Dongen and L. Hirschfeld had already provided the proof of the Mendelian heredity of blood groups in 1910, thereby definitively opening the way for the scientific investigation of disputed paternity. World War II likewise retarded the beneficial consequences for mankind of the momentous discovery by Landsteiner and Wiener, in 1940, of the Rhesus factor, which in due course was to ensure further headway in forensic serology [*54,55*].

It may be wise to remember that scientific firearms identification also came into being soon after the turn of the century. It was the outcome of magnificent research by a handful of pioneers whose respective merits have been duly recalled by the present author in a previous paper [*56*].

I will not dwell on the more recent advances in the field of the forensic sciences in general, since information is readily available in all textbooks and journals and the subject will be dealt with by colleagues much more qualified than I to acquit themselves of the task. Suffice it to say that, whereas the underlying basic principles laid down in the past remain unchallenged, progress nowadays is essentially linked to the staggering improvement of equipment, which has completely changed the outlook of our laboratories.

Before ending, I will review briefly a few notorious trials, some of which turned into deplorable miscarriages of justice. The events narrated now belong to the histories of the nations where they occurred. Some undoubtedly convey a message to the forensic expert of today. I will not examine in detail the trial of Socrates, in 399 B.C. The scanty information available reached us mostly through Plato and may be distorted. All we know for certain is that Socrates was condemned to death by poisoning and forced to drink a concoction of hemlock. He accepted the verdict with exemplary resignation. Before dying he presented characteristic symptoms which have been described with remarkable precision by Plato [*57*].

We are better informed about the trial of Galileo in 1633. He was then nearly seventy. That poor astronomer was severely condemned by the Tribunal of the Inquisition on the serious charge of having confirmed, in his writings, the Copernican theory of gravitation!

Quite involuntarily Marc-Antoine Calas, of Toulouse, when he committed suicide by hanging on 13 Oct. 1761, contributed directly to the atmosphere which was to trigger the French Revolution a few years later. The tragedy which ensued originated from the family having committed the classic, if understandable, mistake of attempting to disguise a typical suicide, precisely the sort of situation with which every forensic expert is conversant nowadays. Jean Calas, the youth's father, a Calvinist, confessed under torture to a crime he had obviously not committed, and was condemned to the wheel on the charge of having killed his own son because the latter intended to abjure his father's religion. This scandalous miscarriage of justice provided Voltaire, exiled at the time in Geneva, a unique opportunity to exercise his redoubtable talents as polemist in the defense of a just cause, thereby helping to dig the grave of the French monarchy [*58*]. The abridged story can be found in Ref *59*.

The execution of the Duke of Enghien at Vincennes, after a mock trial, on the night of 20–21 March 1804 (he had been kidnapped by the emissaries of Napoleon five days before), has always been considered a major political blunder on the part of the Emperor. At the end of his life, Napoleon was aware that this incident would tarnish his legend in the eyes of posterity and, on his deathbed in St. Helena, he took great pains to justify it in a codicil to his will. To my knowledge this sordid crime has never raised any forensic problem whatsoever and I will leave it at that.

The notorious "Affaire Dreyfus," at the end of the nineteenth century, was, on the contrary, to put the forensic sciences of those days very much in the foreground but to do them grievous harm [*60*]. The drama is universally known. For our purpose it can be summed up as follows. In September 1894 a secret message, the historical "bordereau," was recovered from a wastebasket at the German Embassy, by French counterespionage. Amateur handwriting experts came to the conclusion it had been written by Captain Alfred Dreyfus, a probationer on the General Staff. The document was therefore submitted to a commission of three "qualified" experts. Alphonse Bertillon, who had already been entrusted with making some photographic enlargements of it in his position as Head of the Criminal Identification Department, was invited to join the group. Whereas the first three experts disagreed in their conclusions, Bertillon surprisingly enough (see further) imputed the handwriting to the unfortunate officer. He was never to change his mind at any moment throughout his life. Only much later was it discovered that it was not Dreyfus at all but a certain M. C. F. W. Esterhazy who was the culprit but, in the meantime, Dreyfus had been condemned to imprisonment for life in a fortress, deprivation of rank, and degradation and he was deported to Devil's Island accordingly. His sufferings there have been put on record by others. Under incessant pressure of public opinion, Dreyfus was retried in 1899, to be again condemned, though more lightly. Only in 1906, on the basis of new evidence, which included this time the confession of Esterhazy himself, was Dreyfus fully rehabilitated.

Practically the entire responsibility for this historical miscarriage of justice rested on the shoulders of Bertillon. The latter had resorted to probabilistic methods, probably inspired by Quetelet's treatises, but he had applied them in the wrong way. In 1904 the High Court had, in despair, turned to the "Académie des Sciences" which, at the Court's request, picked out three of its most eminent members, one of whom was no other than Henri Poincaré, the greatest French mathematician of his century and professor of the calculus of probabilities at the Sorbonne. Their evidence was absolutely devastating for Bertillon. The reader will find the dramatic story in Locard's [*61*] fascinating appraisal of

Bertillon's report and of his true role in the "Affaire" and how the unfortunate pioneer of identification got involved against his better judgment. We know Bertillon had warned, in all honesty, that he had no personal experience with questioned documents. He apparently changed his mind in due course, thus becoming the principal artisan of a historical tragedy that brought his country to the brink of revolution and that had, moreover, incalculable long-range consequences. It is universally recognized today that this unbearable iniquity and the hostile state of mind towards Jews in general prevailing at the time in France, triggered Zionism, of which Theodore Herzl was to become the mastermind and the symbol. It is indeed reassuring for the welfare of humanity that civilized people should always have been infinitely sensitive to any form of injustice!

Regrettably enough, the masterly report of Henri Poincaré and his colleagues [*62*], which covers 123 pages, was never given the attention it deserved. The page was turned and, with World War I in the air, everybody in France was beginning to realize that still graver issues lay ahead. As a matter of fact, only the conclusions were ever produced in Court. Now that passions are subdued, it would be well worth while to give this historic forensic monument the dissemination it deserves, so as to make available the many teachings it conveys. With the help of our colleague, Miss Suzanne Hotimsky of Paris, I recently raised it from its dusty lair in the French Ministry of Justice, where it was safely tucked away. It is now at everyone's disposal.

The tumultuous course of the "Affaire" was highlighted by a number of tragedies (including two suicides) in true Italian operatic style for which Brouardel, professor of legal medicine in Paris, or one of his colleagues, had to be called in [*63*]. The events culminated on the evening of 16 Feb. 1899 with the sudden death of the President of the French Republic, Felix Faure, who was 58 years old, from an attack during a gallant rendezvous with a young lady who uttered a loud scream and thereupon fled by the back door. Public opinion wrongly connected his demise with the Dreyfus case. That same afternoon the President had received the reigning Prince of Monaco, Albert, who had come to speak to him in favor of Dreyfus. Dreyfus's enemies went as far as insinuating that Albert had presented the President with a poisoned cigar. The story makes fascinating reading [*64*].

Mathematical probability was used for the first time in evidence on striation matching in a Belgian court in a 1929 headline case [*65,66*]. Basic data, mostly from the USA, have now ensured everywhere the entry in Court of probabilistic methods in the evaluation of legal evidence.

A feature common to nearly all miscarriages of justice or alleged ones is that the catastrophe could have been so easily avoided. Prevention in general, however, postulates the firm conviction that, when a case turns up, one never can know beforehand in what one is getting involved and whether or not it will be easy going; hence, it is an imperious necessity to call in the right man at the right time, that is, from the very start, and not when irretrievable harm has already been wrought. But mankind is incorrigible by nature. This sort of thing has been going on for ages everywhere, with eternally the same consequences (sometimes of stupendous magnitude), as is borne out by the examples cited above. There is no reason to think it will stop.

Among the more recent examples, the first which comes to one's mind is the notorious Marie Besnard case, which caused so much commotion in France some twenty years ago. The widow Besnard was accused in 1949 of having poisoned, by means of arsenic, most of the members of her family and also some friends, 13 persons in all, including her mother. She underwent five years of preventive imprisonment, three successive trials, and was eventually acquitted in 1961. The investigation had promised in the beginning to be

easy going because of the number of victims. Unfortunately, the wrong people were called in to deal with it. By the time competent experts took over, the case was hopelessly lost, with most damaging and undeserved consequences for the reputation of French toxicology. Perhaps the only consolation was of a scientific character, namely that the case shed new (if disquieting) light on the possible behavior of arsenic in bodies buried in the earth. Much has been published since in France on this important subject, mostly in the *Annales de Médecine légale* and in the *Annales des Falsifications et de l'Expertise Chimique*.

The same slovenliness marked the beginning of the Montesi investigation in Italy and led to the same disastrous consequences. The body of Wilma Montesi, an Italian girl of sixteen, was discovered on the beach of Tor Vaianica, near Rome, on the morning of the 11 April 1953 [*67*]. The cause of her death was never satisfactorily determined because the first autopsy had been bungled [*68*]. The case became irretrievable and the whole affair degenerated into a notorious political scandal which shook the country and caused much ill feeling.

Our English friends also had their troubles recently with the Evans case, which is still in everybody's mind. If one can give credence to the four books successively dedicated to it, one cannot but help fearing the worst [*69–72*]. The case has all the appearances of a grievous miscarriage of justice and led to the abolishment of the death penalty. It is worthy of notice that at no time did pertinent criticism bear on its forensic implications. This is in no way surprising. Legal medicine, chemical toxicology, and the forensic sciences in the more restricted sense of the word have always been at their best in Great Britain. Such outstanding scientists as A. S. Taylor, Thomas Stevenson, H. Littlejohn, Sydney Smith, J. Glaister, B. Spilsbury, W. Wilcox, L. C. Nicholls, and many others, only to speak of the dead, all deserved well of their country and, though a biographer has from time to time recorded their achievements—accomplished, so to speak, with their bare hands— there still is a need for a more ambitious survey of their contributions considered collectively. This task, however, should preferably be undertaken by an English historian of medicine.

The list of alleged miscarriages of justice and other forensic muddles is interminable but I will stop here. The reader will find a whole array in Thorwald's books [*73,74*], which are an inexhaustible mine of information.

At a time when it seems the most normal thing in the world that events should move fast, I end by expressing the hope that those who do me the honor of reading this paper will measure the magnitude of the effort it cost our forefathers to lay the foundations on which we ourselves are now building, with less suffering than was theirs. I apologize if, in my endeavor, I have laid too much stress on the contribution of my own country and of its neighbors. As a matter of fact, as I understand, it was part of my mission.

Summary

In this paper I have attempted to review, in chronological order, the respective merits of the men of science who, in the past centuries and more particularly from the Renaissance to the second world war, in 1939, have played a significant part in the advancement of the forensic sciences. Some of these pioneers are giants whose immortal names are landmarks in the memorial of mankind. Their contribution to the forensic sciences, it must be emphasized, was often completely overshadowed by their great discoveries. Others, less fortunate apparently, are now entirely forgotten, though they, too, have major contributions to their credit. Not all of them were, by any means, primarily interested in our field of endeavor; their participation in forensic work was sometimes of a purely fleeting character.

My primary concern was to repair, as much as possible, the harm wrought by the two world wars—especially the first—to the diffusion of information, and to give their due to

men who deserve much credit for their achievements. To measure the real value of the extent of their merits, it is indispensable to keep in mind the precarious conditions in which they had to work.

The paper ends with comments on a number of historical tragedies and more or less recent miscarriages of justice, some with far-reaching consequences. The features the cases have in common are stressed and the message they convey to the forensic expert of today is discussed.

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