

in certain cases of impaired innervation,—no free hydrochloric acid may be detected, though sought for repeatedly with the utmost skill and the aid of every appliance and reagent.

It also appears that hyperacidity, though a frequent, is by no means a constant, accompaniment of peptic ulcer.

Indeed, it is impressed upon us that the pathology of an organ which varies so widely physiologically in the same individual within such short periods of time is a very complicated thing; and the lesson is again enforced that it is not in pathologic signs, but in careful weighing of each piece of evidence and in the painstaking collocation of them all, that accurate diagnosis is to be attained.

Before leaving this subject I must say a word in praise of Ewald's remarkable work on diseases of the stomach,¹⁵ and of the balance which he preserves while enthusiastically pursuing his subject.

Morton Prince¹⁶ was led by his duties as examiner of applicants for the Boston Fire Department, and by the frequency with which he heard temporary murmurs in vigorous men, to a study of their mode of origin. It has been believed for some years that in debilitated states leakage may take place through the mitral valve, the curtains of which are not tightly closed by reason of the insufficient force of the ventricular contraction. It will be at once appreciated that Prince's cases were the reverse of debilitated; and his ingenious explanation of the murmurs heard in them is that under conditions of great excitement, such as many of the applicants presented, the valve may be forced by ventricular contractions of a power disproportioned to the resistance of the valve. It is not easy to detect a flaw in his argument, and it seems as if he had made an important addition to our knowledge.

There are many other subjects of which I should like to speak did time permit, and were the programme less attractive. Very likely another in my place would have selected quite a different series of topics. The highly important and interesting subject of cerebral localization, for instance, has not been mentioned. But the work which has been done in that direction the past year has been rather in popularizing previous studies, and in the application of their results to practical surgery, than in new discovery.

Prudden's¹⁷ studies of diphtheria and the constancy with which he finds a streptococcus in diphtheritic lesions deserve more than passing mention. So also Hare's Fothergillian prize essay on mediastinal disease.

To sum up the results of the year, it may be stated that it has been one of real though not of brilliant progress. Knowledge has been advanced almost all along the line, more in some parts than in others; bacteriology in its broad sense, including the chemical poisons generated by or accompanying the microbes as well as the identification and life-history of the organisms, offering an enormous field for patient research. One fact seems to me to stand out in strong relief; namely, that our countrymen

are on the high-road leading to the attainment of a reputation for scientific research equal to that which they have long enjoyed in the more immediately practical branches of medicine and surgery.

The future glows with a promise which the achievements of the past assure us will be realized; and it is the part of each one of us, if he cannot discover, at least to do all that in him lies to make the highest and best use of the discoveries of others more gifted than himself.

Original Articles.

A MURDERER'S DYING CONFESSION DISPROVED

BY SURGICAL AND ANATOMICAL FACTS;

Read before the Massachusetts Medico-Legal Society, June 11th, 1889

BY BENJAMIN E. COTTING, M.D., &C.,

Senior Consulting Surgeon to the Boston City Hospital, Associate member of the Society.

On the afternoon of July 1st, 1874, a woman, twenty-two years of age, of no very uncertain character, was brought to the Boston City Hospital. She was completely paralyzed on the right side; seemed nearly or wholly unconscious; and had fearful and bloody injuries about the head. The story that came with her was that she had been found in this condition, a few hours before, in her "own hired" room, and in her own bed. When found she was motionless, and was at first supposed to be without life. Her head, neck, and shoulders were red with blood; and under them the pillows, sheets, and bedding were saturated with it. This blood had flowed freely from a number of open wounds on the left side of the head; but there was no spattering on the walls or objects near by. She was lying on her right side, with face towards the middle of the room, in the exact position apparently that she had taken on first going to sleep. Her night-gown and the bed-clothing about her body had not been perceptibly disturbed. Her day garments and smaller articles were orderly distributed about the room, as left on retiring. There was no sign discoverable that indicated the presence of any other person during the night. The room-door was locked, and the key remained in the lock on the inside. The windows were closed, but one was found unbolted. Through this a person could have entered, or escaped, as the room was on the ground floor; yet a most diligent search failed to reveal even the slightest evidence that anything of the kind had been done. At what hour she retired no one could tell; and no response had been gained to repeated applications to her door in the course of the forenoon. Although an adjoining room on the same floor had been occupied that night, its inmates declared that they had not heard a groan or a sound from her apartment.

•So far as known she had not an enemy; yet doubtless had angered some one, inasmuch as an unrecognized man had asked for her the evening before, and, not finding her at home, had vowed terrible vengeance as he left the house.

¹⁵ *Klinik der Verdauungskrankheiten*, Bd. II., Berlin, 1888.

¹⁶ *N. Y. Medical Record*, 1889, i. p. 421; *Boston Med. and Surg. Journal*, 1889, i. p. 109 *et seq.*

¹⁷ *Am. Journal Med. Sciences*, March and April, 1889.

Who did the deed, and what the instrument, were mysteries that seemed at the time to be past finding out.

On examination at the hospital several extensive and complicated fractures of the skull were discovered, with considerable depressions, thought to be chiefly in the outer tablet and not requiring trepanning. On and through the scalp were a number of bleeding wounds, — the hospital record says "nine on the left side of the head, besides several others near the left ear which cannot be separated." The ear itself was "greatly lacerated," caught as it must have been several times on the edge of the instrument when it passed into the scalp. Its helix also, with the cartilage, was cut through at its anterior upper part. These wounds were all of a curved or crescent shape, clean cut, each "little more than an inch long." From two of them "brain substance protruded in a mangled state;" and into one of them, the only one mangled, the finger could be passed, and carried through the broken skull to a considerable depth, without force, in the injured brain — the record states "fully two inches," and Dr. Cowles markedly (on his finger) confirms this statement. The lines of these wounds turned generally in one direction, inclining towards each other at various small angles; in several instances running together or crossing; some mingling in a confused or inseparable manner — particularly at the spot where the finger could be passed into the brain. The little points or tongues of skin, wherever these wounds crossed each other, were perfect to their very tips, and showed no sign whatever of rent or bruise.

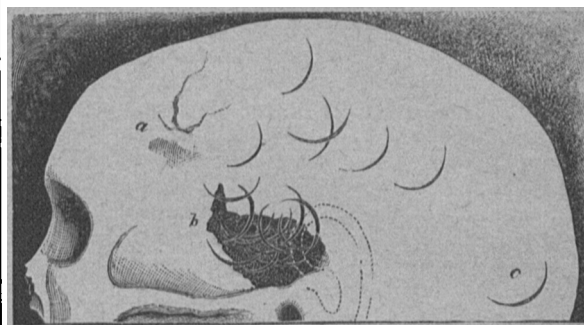
The hair was very long and very thick: "We noticed it," Dr. Cowles writes, "to have been cut off quite sharply in correspondence with the cuts in the skin. . . . I am quite clear as to the cutting of the hair."

From the worst wound (it being indeed where were several of those "which cannot be separated") a few fragments of bone of considerable size were taken; and from just within the external opening of the wound some chopped hair, mixed with the mangled tissues there, required removal. The injuries to the bones, including depressions, were estimated to be within an irregular space of about three inches long and nearly or quite two inches wide, somewhat semicircular at its upper or widest part. The external wounds or cuts, also, with one or two exceptions, particularly one in the occipital region (diagram at *c*), were within the limits of such a space.¹ There were no wounds on top of the head, or any other part of the body.

Now, it is evident that a first blow must have instantly stunned and paralyzed this woman — else there would have been movement of her body or derangement of clothing, of which there was neither. This blow may have been given by a bludgeon, a mallet, or a hammer of suitable size, form, and weight.

¹ The following diagram may assist in forming an idea of the number, nature, and situation of the curved wounds in the scalp; and also of the location of the injuries in the skull, at *a*, *b*, and *c*, as seen afterward in the specimen. Most of the heaviest blows, with the cutting end of the weapon, excepting that at *c*, must have been in front of the upper lobe of the ear, towards *b*; that is to say, where the skull was much cut through, where "brain protruded in a mangled state," and where fragments of bone were taken out. The temple was evidently aimed at by the assailant.

Such blow repeated would naturally extend the fractures, comminute them, and cause any amount

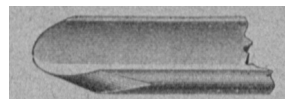


of depression in the bony skull. But open wounds in the fleshy scalp by such instruments would as naturally have crushed or bruised edges (not the linear cuts here present) and the blows that made such wounds would have caused a spattering of blood all about — not the free bleeding which in this instance blanched the victim and saturated everything near by.

To account for the fractures and depressions then did not seem so very difficult, — any heavy club might answer. But what produced the curved and curiously situated incisions was a more difficult problem; and experts, professional and lay, called upon to solve it, as well as detectives and friends, all failed to suggest an adequate solution.

Several days after her admission, Dr. Cowles, superintendent of the hospital, called me in, as a consultant, to look at these wounds, to see what I could make of them. The parts had been shaven and fomented. The surface of the skin was quite smooth and uniformly convex — still notably swollen — the swelling covering rather more than the space originally thought to include the injuries to the skull bone. Some of the cuts near the ear gaped a little, but the others were generally in a satisfactory condition, and all had the appearance heretofore described. After hearing the whole story, and a careful consideration of the matter in all its bearings, I suggested that such wounds required a sharp instrument (as all admitted), and that the deed had been done by a mechanics' inch-wide *gouge*, — a tool resembling a chisel, but having, instead of a flat, a "hollow" cutting blade, a longitudinal third or trisection of a cylindrical tube. This is bevelled off, like a chisel, to a cutting edge, which in this way becomes curved or crescent-shaped. If the corners also are ground off, as on turners' gouges (*vide fig. inf.*)² the cutting end partakes of a rounded, spear-like form, and presents a drawing edge to whatever may be brought in contact with it. Hence it might cut hair almost as easily as a razor. Its handle is usually nearly or quite cylindrical, and of firm hardwood. Thus the tool might be just the club for heavy blows, if held by its metallic end, while its cutting edge would most certainly make wounds like those in question.

² The figure below represents the cutting end of a turners' gouge, — showing its curved shape, and the rounded outline of its edge.



Such an instrument had not been thought of; but the suggestion evidently made an impression; for, on the next day, Dr. Cowles came to my house, bringing a turners' gouge, of inch-wide blade, a new one procured from a shop as a specimen by a police officer who wished to know whether that was the kind of instrument I had spoken of,—as it certainly was. The tool brought to me was nearly or quite two feet long—its inch-wide steel or cutting portion and its handle being of about equal lengths. Its handle was a heavy billet of hardwood, smooth, cylindrical, slightly ovoid at the end. Such a tool usually weighs thirty-five ounces, at least a pound more than a policeman's billy. Held by the metallic portion, a blow, given by it as with a club, would be quite capable of crushing in a skull and instantaneously stunning a victim to unconsciousness. Indeed, this would be almost inevitable; and without necessarily breaking the scalp. Repeated blows would have the effect heretofore indicated. This done the operator, without removing his hand, but by simply turning the tool nearly or quite vertical, with edge downwards, could stab the fleshy parts as rapidly and as many times as he chose, before the victim could have time to revive or even move. He could do this after premeditated intention, or on the impulse of the moment, to thoroughly complete the deed. Such stabs would make clean-cut and curved or crescent-shaped wounds naturally turned in the direction of those found; and when the instrument was driven with force it would not be apt to slide or make grooves in the flesh, as a blunt tool would; and might pass directly through the already comminuted bone into the brain itself.

As the skull injuries showed that they could have been made by the handle of a gouge such as that brought to me, so the flesh wounds indicated the blade of a similar instrument. Indeed, Dr. Cowles had already tried the cutting end of the tool he had with him, and found that it would fit the wounds exactly.

Thus the problem seemed to be satisfactorily solved.

Dr. Cowles then went on to say further, that among those interested in the woman was a young mechanic, who was, in fact, so tremulously anxious about her possible recovery as to excite suspicion, and induce the surveillance of the police. Since my visit to the hospital this man had been taken into custody. Proving to be a turner by trade, his workshop and tool-chest had been searched. The chest contained the usual tools, having a series of gouges complete, with the exception of the inch-bladed one. That was missing! The arrested man could not explain its absence, or give any account of what had become of it. He could not even tell when he had used or seen it last; and it was too large a tool to be lost without notice. These were rather damaging circumstances, but he stoutly asserted his entire innocence of the whole affair; and no other evidence was ever found against him. He had, it appeared, known the woman for some length of time, and had always seemed to be anxious for her welfare.

The woman did not in any way connect him in the matter, nor even recognize him; in fact, she was never able to recall the assault or any thing or person of the evening previous—an ante-accident

oblivion not uncommon in those who have been severely stunned. The detained man made out an *alibi*; and was subsequently set free. He was generally accounted guiltless of the assault. I am not aware that the missing tool has ever been found, or its loss accounted for.

(As merest conjecture, in solution of this part of the mystery—possibly the man who with "horrid oaths" had threatened vengeance the evening before the assault, while in search of a club, may have robbed the chest of this tool—a very natural thing for a mechanic to do, and not unnatural in anyone on felonious intent. This may have suggested itself more readily to him if he knew the owner was an intimate of the threatened woman, as in such case the missing tool would tend to divert attention from himself and to turn it upon another man. Besides, the carrying a tool would not attract notice; whereas the possession of a club might arouse suspicion. The deed done, he could easily throw the tool into the waters of the dock near by, nevermore to be seen of men. There was, moreover, as rumor had it, an unaccounted-for disappearance from the neighborhood of a man quite competent to all this.)

The injured woman, after a protracted convalescence (during which the paralysis gradually disappeared) and a residence for a time at an asylum, at length regained her usual health and sanity. Before she was discharged, however, she declared her fixed determination to return to her old mode of life; and was soon lost sight of, except by the local police of her own immediate neighborhood.³

In May, 1876, nearly two years afterward, a condemned murderer, a few days before his execution, made a "confession" of many of his misdeeds, and claimed this assault as one of the number. He stated that by chance that evening he had met upon the street this woman, before unknown to him; that he went with her to a restaurant; thence to her house, and passed the night there; that, in the early morning, while she was yet sleeping, he pounded her on the head with a hammer, and then left her for dead. He further stated that the hammer might be found buried in the earth in a cellar he had access to at that time. He had had other things there, for murderous purposes, awaiting opportunity. The finding of a hammer gave credence to the story, which was pretty generally acquiesced in. But having had much to do with the case for which this man was to suffer (his last victim having been my patient), I distrusted the narration. Yet what motive, it may be asked, as it has been, for a man so situated to make misstatements? Although now concerned with facts, not motives, here is one among others, quite conceivable. At about that time, in another case, a death-sentence was delayed and a commutation expected (afterward actually granted) on the open avowal of murders and other revolting crimes,—on the ground that "irresistible impulse," or something of the kind, had rendered the villain *not responsible*. More than one murder was

³ Dr. Edward Cowles, now superintendent of the McLean Asylum for the Insane, at Somerville, Mass., kindly permits me to say, that to the best of his knowledge and belief the case in my paper, so far as it came under his observation and cognizance, has been related by me in a true and faithful manner.

chargeable to this last convict. A long list might save his *life*, if his philanthropic sympathizers (after having denounced his sentence as unmerited and too hasty) could be induced to urge upon the government the plea that "he couldn't help it." It would have been the venture of desperation; but it was too late.⁴ He soon became "much mixed," and finally broke down.

As to my patient, I had, as her murderer at last acknowledged, given in open court more correct details of the deed than he was able to recount when, in sight of the gallows, he attempted a narrative of his now admitted crime,—admitted to his amazed legal defender, whom he had deceived, up to that moment, into full belief of his innocence.

In regard to the injured woman, his statements were so defective, or so at variance with my observations as a medical man, that, for myself, I soon became convinced that he never had anything whatever to do with her, unknown to him, as he admitted, up to the day of the assault.

But the hammer! It was (I have seen it), a smiths' hand- or riveting hammer,⁵ with circular face of seven-eighths of an inch in diameter, not very sharply defined at the edge, but enlarging almost at once into a square form of an inch and three-eighths diagonal line; weighing only rather more than a pound, handle and all; not very likely on a first blow to completely stun in an instant, and thoroughly paralyze one struck by it, or to cause, with its small face, large fractures or depressions in the skull, or any fracture at all without leaving small, local, pulpy bruises in the scalp where struck, and not a uniformly smooth swelling as in this case. The *pein*, or wedge-shaped end of such a hammer, if the blow were of sufficient force, might cause a fracture, but then the wound left in the scalp would be a *straight*, mangled furrow or indentation. In like manner its round face would have a soft or pulpy and somewhat cup-shaped depression. If an open wound of the full size of its face could be so made, it would be circular, of course; but if less complete and of an inch in length (more than the diameter of this hammer's face), it could not be of a lesser area than a semicircle. One, or two such wounds segregate, might be *imagined*, perhaps, but half a score or so would be clearly impossible. Now, the wounds we had to deal with were crescent-shaped, not semicircular; were sharply defined incisions, all of equal lengths, variously inclined and running into or crossing each other, and in themselves hardly conceivable as the work of a hammer, or as made by anything else than a sharp, cutting instrument. Besides, no hammer's blunt face could be forced into and through the skin, except at an angle, and then the opening would be bruised down on one side and crushed off on the other, according as the instrument slipped, as it inevitably would more or

less, on a rounded skull. Furthermore, we repeat, wounds made by a blunt tool might spatter their blood, but not set running so many freely flowing vessels. Bruised wounds do not bleed like incised ones. Again, and fatal it would seem in themselves to the "confession,"—

(a) No hammer, however keen its circular face-edge, or other blunt tool, could make such "sharp" *cuts* in and through the mass of hair this woman had,—no, not one such; much less a score; (b) Nor is it possible, supposing a human arm had the power, that a hammer-head, being only one inch and seven-eighths in length from its face to the hole for its handle, could be forced through such hair, scalp, and skull, into the brain to a depth in all of "fully two inches," without making a much larger opening, carrying in to the very depths hair, flesh, and fragments of bone, and leaving a very different state of things on the outside from that here found.

All that was done, however, could have been easily effected with a turners' gouge.⁶

Not long ago, March 20th, 1889, fourteen years after the injured woman left the hospital, a notice appeared in the newspapers that her body had been received at the morgue. I immediately called on Dr. Harris, medical examiner, who at once, with most courteous readiness, offered all facilities possible at so late a period. He had not known anything of her previous history; but had been told that after a prolonged drunken debauch, of which she had had many, nature giving way, she fell into a state of exhaustion, and in a few days thereafter had a painless and peaceful death. The cause of death had been officially reported "alcoholism."

Even in the grimness of her present surroundings and after such a life she was not ill-looking. Her face and features were not disfigured. She had "never had disease," except from alcohol, and was not wasted. Her head-of-hair was quite extraordinary in abundance, great length, softness, and glossy blackness. It had been well cared for; even the officials of penal institutions had respected it; and, contrary to their usual custom, had left her in full possession.

There had been an autopsy, and everything had been replaced in proper order; not then to be further disturbed. I sought out, however, the external scars in the scalp—an important matter. They were not at first easy to find on account of the thickness of the hair. They were there, nevertheless; and, except near the ear, where was a wrinkled group, they were delicate, linear, crescent-shaped scars, unmistakably the result of clean cuts, or incisions healed by first intention,—not of bruises. There could be no doubt in the matter.

Some weeks later I had a chance to see the "specimen,"—deprived of most of its integuments. Looking at it in front, a general depression of the middle of the left side, as compared with the right,

⁴ This supposition is not necessary to the argument, and perhaps it implies too great facility in expedients; but a man who could thoroughly hoodwink his friends and advocates at will, could readily take a new tack when convinced that the one he was on was soon to prove fatal.

⁵ A friend reminds me that the murderer said that he used a plasterers' (i.e., masons') hammer—quite a different tool from that found; an instance of his inability to give details correctly. The hammer, as found, was so defective and weak in its handle, where attached to the metallic head, that a very feeble blow would have broken its head off.

⁶ A small matter, perhaps, but tending to show the kind of instrument used,—almost all, if not all, the curved wounds had their points forwards or somewhat turned diagonally upwards, precisely as if made by a gouge held as one, when about to strike such blows, would naturally hold it—at its middle near the junction of the handle, with the tips of the fingers resting high up in its metallic, "hollow" part.

was quite evident; and this occupied about the space estimated in the first examinations at the hospital. Such a uniform and shallow depression suggested the result of blows by a weapon of considerable size, without angular projections,—a smooth club, most probably.

On side view, about two inches above the anterior third of the zygomatic arch, there appeared evidences of former fractures (diagram, at *a*). From a point on the frontal bone near the parietal several lines of old callus radiated at acute angles as from a centre. Between two of the uppermost of these was a double triangular prominence about an inch long and quite an inch and a half or more wide as it diminished off towards the base.

Very likely the fractures at this place came from the first blow the woman received from her assailant.

On, or just above, the level of the zygomatic arch, there was an oblong opening in the skull—beginning at the largest portion, just in front of the anterior part of the temporal ridge, and extending forwards about two inches (diagram, at *b*). The upper and lower bony edges of this opening, irregular in outline, were not rough, having been smoothed off naturally in progress of time since the injury. The lower border seemed to be of two nearly equal lines, each very slightly curved and joined together at an angle, open upwards, of about a hundred and twenty degrees. The upper border of the opening was rather more irregular, but equally smooth. The anterior limits ended in a point, almost, while the posterior or aural portion was three-fourths of an inch, or more perhaps, across. From this space undoubtedly came the fragments of bone removed at the first examinations. Here too, near the ear, the finger could be passed into the brain, but no hammer of the size and form of that found could have ever made an entrance through such an opening. A gouge could have done this, and easily have shaped the lower border of this cavity.

On the occipital bone, about three inches behind the meatus auditorius, was (at *c*) a well-marked curvilinear depression of about an inch chord, which, with a slight ridge inside, gave strongest evidence of a former wound by an instrument that had gone completely through the skull at this point. This was where (in Dr. Cowles's trials, before mentioned) the gouge would most exactly fit the fleshy wound; and the prolonged depression of the enclosed fragment of skull showed with what difficulty the tool must have been wrenched from its impaction in the bone. Now, indeed, if any one can conceive of anything better adapted to produce such a wound than a gouge, he must have greater powers of imagination than I can lay claim to. Even with such an instrument the blow must have been given with very great force. Not to insist that, in the position the victim was lying, the blow of a hammer in the hand of an assailant, if it made a curved indentation, must have made one in a different direction,—no hammer-head, even if held as a punch and struck by a sledge, could be driven through all the coverings of the skull and the skull itself at that place, and simply cut out, or force in, a circular, or as in this case an almost semicircular, fragment.

A general crush of all the neighboring parts would be inevitable. A small hammer in the single hand of one person would seem wholly out of the question.

There did not appear to be anything else in the "specimen" attributable to the assault now under discussion.⁷

To recapitulate,—it appears from the length and width of the space involved in the fractures, and the depressions being in the outer table chiefly, that the victim had been struck by a club of some kind,—one of considerable size, and smooth also, inasmuch as the scalp was not laid open by it;

That, instantly stunned and paralyzed, her motionless insensibility permitted other blows, and the infliction of any number of open wounds;

That the wounds actually made, a score or so scattered or inseparable, were curved or crescent-shaped, with clean-cut edges, the little points, at the crossing of any two, whole and clearly defined, not bruised; that these wounds were of nearly equal size, each a full inch in length; and, further, that they were cut through thick hair "quite sharply," and through the scalp also, in one or two instances going quite through, and deeply into the brain; all evidently done by some kind of sharp-edged instrument;

That these wounds bled freely, as cut wounds generally do;

That a turners' gouge fulfils all the requirements of the case; while the hammer utterly fails in regard to the open wounds, and, as we think, in every particular.

Such are the premises; and such the offered solution.⁸ An adequate explanation, however, ought to be enough to hold against the improbable, or the defective.

To some persons the circumstances attending the "confession" may seem to add credibility to the murderer's story, but they should not. The confession of criminals, even when without motive and only tending to increase their infamy, are not received by courts of justice unless supported by other and more trustworthy evidence. Dying persons, in their feeble and imperfect utterances, seldom fully know what they are talking about, as momentary revivals often prove. In the partial delirium of weakness, as in half-sleep, a person striving to say one thing may utter something very different from what he wishes, semi-consciously, and in spite of himself. Last words, ordinarily of little moment, should be construed with caution, for too seldom can they bear the interpretations one would gladly give to them. Death-bringing illness, while killing the body, generally, even where and when least expected, clouds or nearly obscures the

⁷ There were three little depressions in the outer table near the vertex, two on one side of the sagittal suture and one on the other side,—as if it were at the corners of a right triangle. They were each capable of holding half a large pea, flattened. They were out of the reach of a weapon of any kind as the woman was then lying; and, as there were no wounds of any kind in that region when she was admitted to the hospital, they could not have had anything whatever to do with this assault.

I have the support of the highest authority in saying that there is nothing in the "specimen" inconsistent with the theory that a gouge was the instrument used by the assailant.

⁸ Its elucidation an after-thought—also more thorough in details—incited by the last notice in the newspapers of the woman and her avowed assailant.

intellect, and fills the mind with baseless delusions, while the crushing terrors of impending destruction seem at times to start up in a culprit's mind remembrances of crimes which he never committed.⁹ What wonder then, that, broken down by despair, the last straw of hope floating away, with mental powers utterly demoralized,¹⁰ a doomed man, with or without rational motive, magnify his many misdeeds, assuming the acts of others which he had gloated on, and incorporating them with his own.

At all events, this portion of the murderer's "confession" I did not believe at the time. I do not believe it now. Facts in the case disprove it.

N. B.—After reading my paper a friend called my attention to an article in the London *Lancet* (Apr. 20, 1889, p. 819) wherein the writer asks, "Are most dying declarations unreliable evidence, and how may we differentiate them?" and then says, in answer, "If a human being be *aboulie* . . . if suffering from extreme nervous exhaustion through terror or otherwise . . . his [dying] statements are unreliable as evidence, . . . and the sooner medical jurists insist on the alteration of the position and value of such testimonies the better it will be for society and for mankind."

THE MOVEMENTS OF THE LOWER JAW.

BY CHARLES E. LUCE, HARVARD DENTAL SCHOOL.

This paper presents the results of certain original investigations conducted in the physiological laboratory of the Harvard Medical School under the direction of Prof. Henry P. Bowditch. The results obtained are interesting, as they indicate the exact movements of the jaw, and prove that certain errors exist in all descriptions of this articulation as given by the eminent anatomists and physiologists.

These discrepancies may be briefly noted as follows:—

Monro¹ wrote, "that the mouth could not be opened, if the lower jaw was protruded, without withdrawing it from its advanced position;" this is clearly incorrect, as will be indicated later.

Ferrein² was quite accurate in his description, but he wrote that "the condyle advances under the eminence;" in many cases it goes under it and mounts the other side, which he omitted to say.

Humphrey³ falls into the same error and said that "the condyle advances upon the glenoid ridge and should not go quite to the summit," which in many cases it certainly does.

Morris⁴ was in error when he wrote that the condyle itself never reaches quite so far as the summit of the glenoid ridge.

Küss⁵ wrote that the lower jaw, as it rises and falls, represents a lever moving around a supposed axis centred at the condyle, which remains in the glenoid cavity in small openings; and in greater

separation the supposed axis is placed at, or near, the dental foramen; this is also incorrect, as will be proven later.

Quain⁶ states "that the condyle rests on the convex root of zygoma when the mouth is opened. As stated above, in most cases it advances farther forward than he states.

The error of Gray⁷ is in the statement that in openings of slight extent, the condyles simply rotate on a transverse axis against the cartilages, whereas the condyles begin to move forward simultaneously with the beginning of opening. Again, he says the condyles simply "glide on to the articular eminence."

The first requisite in the study of jaw movements is to move the jaw and get a permanent record of the movement; the method used was the photographic, the same as that used by Marey and others, and may be described as follows: a bright silver bead was fastened to a wooden pin or dowel, which was firmly inserted between the inferior-central incisors; with the subject in a strong sunlight, so that a bright spot should be reflected from the bead, a pure profile or side view was photographed, and the sensitive plate was exposed during the opening of the mouth; the bright spot reflected from the bead during the motion was continuously photographed and its excursion recorded on the negative as a line, giving the actual movement of the place upon the jaw to which the bead was opposed.

The earlier experiments dealt solely with the simple tracing at the symphysis, and while the results obtained with one bead were both instructive and interesting, the more valuable results were found by getting the relative movements of condyle, angle, and symphysis; to get tracings at these points, a light framework was constructed, which simply reached around the face from the lower incisor teeth, to which it was securely fastened, nearly to the ear; adjusting devices held bright beads which could be placed directly opposite the con-

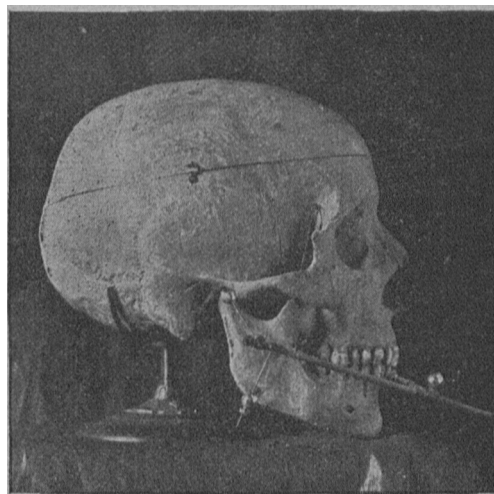


FIG. 1.

dyle, angle, and symphysis; the photographing took place as before, each bead making its tracing.

⁹ "An instance of remembering events that never occurred."—H. W. B. on testimony in another noted case.

¹⁰ A recipient of another part of the "confession" says of it that it was "true so far as a person, with a mind so thoroughly demoralized as his had been, could make it." In fact, it is to be surmised that his statements generally would require corroborations from other testimony.

¹ Medical Essays, Edinburgh, 1735.

² Collection Academique, Paris, 1785.

³ Humphrey's Human Skeleton, 1858.

⁴ Anatomy of the Joints, Morris.

⁵ Lectures in Physiology, Küss, Duval.

⁶ Quain's Anatomy, 1883.

⁷ Gray's Anatomy, 1887.