Middle Articles

MEDICAL HISTORY

Who Put the George in George Eliot?

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When a doctor reads the novels of George Eliot (1819-80) he is occasionally startled by her acquaintance with physiology. For instance, in *The Mill on the Floss* (1860) she muses on the intense industrial production that underlay Victorian social life: "Good society, floated on gossamer wings of light irony, is of very expensive production; requiring nothing less than a wide and arduous national life condensed in unfraught, deafening factories, cramping itself in mines, sweating at furnaces, grinding, hammering, weaving under more or less oppression of carbonic acid." J. S. Haldane, who explored the role of carbonic acid in the regulation of breathing, was born in the same year 1860.

Again, in *Middlemarch* (1872) the dry-as-dust scholar Casaubon is being discussed, the man who "chose to grow grey crunching bones in a cavern." "He has got no good red blood in his body," said Sir James. "No. Somebody put a drop under a magnifying glass, and it was all semi-colons and parentheses," said Mrs. Cadwallader, who evidently knew that red cells are round; she could hardly suspect sickle-cell anaemia in Casaubon, since it was first described in 1910.¹ The same novel speculates on how many cubic feet of oxygen might be swallowed in a year by a full-grown man; and there are some specific details about the experiments of the novel's Dr. Lydgate. They were galvanic, and involved administering unexplained shocks to frogs and rabbits—unexplained, presumably, from the point of view of the frogs

and rabbits. Clifford Allbutt (1836-1926), distinguished physician and classical scholar, well known to the novelist, wrongly thought Lydgate drawn from himself.²

Even in her first novels³ terms appear like occiput and coronal surface, though these terms were no doubt common coin in an epoch when phrenology was popular. But in later novels characters ponder on what is done by the brain and spinal cord and eye. They do so briefly, since no character is a physiologist, and only one a doctor; their remarks betray an interest not of her characters but of the novelist herself.

Is it possible that educated Victorian ladies, burdened with too much leisure time, were often well read in physiology, among other subjects? Some of them were "poor faded creatures, who toiled in the British Museum over antiquated rubbish which they extracted and incorporated with worse rubbish of their own—women who wrote about the regeneration of their sex, who drivelled in religious tales—compiled inaccurate histories, wrote moral stories for the young, or unreadable verses for the old."⁴

Physiology should, then, appear in the works of other Victorian women novelists. For instance, Mrs. Gaskell (1810-65) hovers over the more harrowing sort of death-bed scene with something akin to gusto. The doctor is at times present, and there is opportunity for the novelist to put her physiological cards on the table. They are very few; she knows physiology exists and that papers are written about it, but their contents are a mystery to her and she betrays no interest in them. Her doctors offer prognosis, and soothe the relatives with sleeping draughts, but expound nothing physiological. George Eliot writes about breathing and oxygen: Mrs. Gaskell refers vaguely to particles in the air which are used up,⁵ but does once⁶ allude to the "difference between apophysis and epiphysis" though not enlarging on what the difference may be. Charlotte Yonge (1832-1901) is equally innocent of physiology. Several doctors play prominent parts in her *The Trial* (1865), a precursor of the detective story, but not a physiological word do they utter.

George Henry Lewes

George Eliot's grounding in physiology did not come from her father, who was a land agent. It came from her consort, George Henry Lewes (1817-78). He lived with her for 24 years, from four years before her first novel until he died. He was an established writer when he met her; he had already written two novels⁷ which are "as poor as an ambitious and sensible man could write,"⁸ plays,⁹ much literary criticism which still retains some interest, a biography of Goethe¹⁰ which is still selling now after 114 years, and a best-selling history of philosophy.¹¹ Though not deeply familiar with

George Henry Lewes (1817-78).

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physiology at the age of 25 ("By his bedside sat Percy three days and three nights . . . without stirring"¹²), Lewes took a persistent interest in it during the latter part of his life, and wrote another widely-used book about it, *The Physiology of Common Life* (1859). It is hard to say what kindled his interest; he came from no medical family, and though as a youth he had toyed with the idea of becoming a doctor, the hospitals were too repulsive for him. Possibly Goethe's influence was at work. For Goethe was more than poet, dramatist, and statesman; he had studied alchemy, and experimented on optics so far as to differ from Isaac Newton; he had been the first to suppose that the skull is a group of modified vertebrae, and he investigated the intermaxillary or incisive bone, separate in animals but fused with the maxilla in man. We have, according to Sylvius in the seventeenth century, been deprived of it as a separate bone because of luxury and sensuality.¹³

So as Lewes's physiology overflowed into George Eliot's novels, it overflowed into his own literary criticism. "When one thinks of Micawber, always presenting himself in the same situation, moved with the same springs, and uttering the same sounds, always confident on something turning up, always crushed and rebounding, always making punch . . . one is reminded of the frogs whose brains have been taken out."¹⁴

His book on physiology was widely read: very widely. It was translated into Russian, where a boy of 10 read it and kept it in his library all his life¹⁵; it led him to study physiology¹⁶ and, as he was Pavlov (1849-1936), to become a Nobel prizewinner. His fellow-countryman Dostoevsky mentions that to have read Lewes's book was a sign of education in the wife of a drunkard.¹⁷

Lewes's Contribution to Physiology

Lewes read physiology, sharing his reading with George Eliot; he visited all the European physiologists of his time; he wrote physiology; and he tried to advance it himself by experiment. He faced severe difficulties, and at the age of 53 attempted to make good the lack of mathematics which prevented him from making measurements and left him unable to criticize them.

For instance, one can trace the origin of George Eliot's remarks about "oppression of carbonic acid" in *The Mill on the Floss* to Lewes's *Physiology of Common Life*. But Lewes was confused about the quantities. Air once breathed was, he wrote, poisonous¹⁸; 18 pages later, several breathings are required to render it poisonous. An atmosphere containing 23% carbon dioxide would be free from ill effect, or so he gathered from his reading¹⁹; the critical physician Austin Flint misquoted the same source 11 years later,²⁰ and, probably because he suspected some error, substituted the more credible figure 2.3%. Not until 1893 was it clearly shown²¹ that even 5% carbon dioxide produced severe panting in man, though, through experimental work on linnets, John Snow (1813-58) had arrived at the same conclusion in 1846²²—the John Snow who was celebrated as Queen Victoria's anaesthetist, and as the hero of the episode of the Broad Street pump.

So it is not surprising that Lewes is not credited with any original contribution to physiology. He observed and experimented, by his own account, on molluscs, bees, beetles, spiders, locusts, crabs, fishes, frogs, tritons, lizards, chickens, moles, mice, rats, cats, dogs, sheep, pigs, calves, oxen, and men—but all to little permanent purpose.

Muscle Sense

Lewes was, however, remembered for some 40 years for his views on "muscle sense." The sensation, if any, originating from muscles is still a live topic. In Lewes's time it was not

evident that any sensory information need be derived from muscles. They receive their instructions from the nervous system; is it not enough for us to know the instructions and assume they are being carried out? But David Hume, the Scottish philosopher,²³ had already pointed out that we do not know the instructions we give to individual muscles, since we cannot answer questions about them by introspection; we know only what movement we intend. Yet some part of the nervous system handles and responds to the instructions; for instance, if the external ocular muscles are paralysed, on attempting to turn the gaze no eye movement can be made, but the external world seems to swing in the reverse direction.²⁴ A compensation is being made which would normally allow the external world to seem stationary. Compensation occurs in response to instructions to the eye muscles, but one is not consciously aware of the details of the instructions.

Lewes's Theory Of Muscle Sense

Such matters were beyond Lewes's ken. But on precarious grounds he believed that sensory information did arise in muscles. Knowing nothing about muscle spindles, he selected a strange route for its conduction: back up the motor fibres. Now that we know much about muscle spindles and their afferent nerve fibres, distinct from the motor nerve fibres, we are inclined to denounce this route as absurd. But there is recent evidence that, even if impulses do not travel backwards up nerve fibres, some molecules do so slowly, and can reach the nerve cell bodies²⁵; and also that the nerve cell body undergoes changes if, for instance, its connexions to a muscle become inadequate for the muscle concerned.²⁶ So a kind of slow information about its axon's terminals can pass back up nerve fibres. But it is not sensory information in any ordinary sense.

In addition, even the information derived from muscle spindles, which travels to the central nervous system very rapidly as nerve impulses along sensory nerve fibres, has apparently, like the motor instructions to muscles, the curious property of not being accessible to consciousness. One's nervous system receives it, yet one cannot answer questions about it by introspection. At any rate, it does not tell us the position of the joint moved by a muscle,²⁷ nor which way the eyes are pointing.²⁸

Lewes's Legacy To Physiology

Although his scientific contributions to physiology were slender, Lewes did more than produce arresting scientific journalism. He was a founder member of the Physiological Society and a member of its first committee, but he had then only two more years to live, and was too ill to do more for it.²⁹ When he died, George Eliot founded a Studentship at Cambridge in his name. It was first held by C. S. Roy (1854-97), whose work is still quoted occasionally. In the distinguished sequence of holders was Sir Charles Sherrington (1857-1952), who wrote of Lewes later as "a weighty adherent of one view on muscular sense."³⁰

George Eliot was the pseudonym of Mary Ann Evans. She was living with George Lewes when she chose it. It is a reasonable hypothesis that the George is the George of her consort. And it is true. At the end of her life, after Lewes was dead, she married a man who asked her why she chose the pseudonym she did. He recorded this very reason for the choice of George. Then why Eliot? She chose it as a "good, mouth-filling, easily pronounced word," she said.³¹

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ASPECTS OF EMERGENCY CARE

Machine for Collecting Accident Data

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The reduction of accidents would be assisted if we knew with reasonable certainty the accident potential of the various combinations of physical circumstances in which men may work. To assess this potential it is necessary to collect and

a man who has suffered an accident, without overtaxing his patience and concentration, and while the details are still fresh in his mind.

This problem is being approached in a new way by investigators of the Safety in Mines Research Establishment, Ministry of Technology, in the course of operational research into accidents on the surface of collieries, undertaken in conjunction with the Doncaster Area of the National Coal Board. The investigators, who are alive to the danger that the inquiry could be defeated by the load it puts on the injured man, decided that the worst possible approach would be to ask a man to fill in a long printed form which, since it would have to deal with the overall accident situation, would necessarily contain many questions that would not apply to his particular accident. They decided to make the fullest possible use of pictorial presentation, both to enable the men to show more precisely the circumstances of their accidents and to hold the men's interest. Collection of accident information from the men normally requires trained interviewers, but this would make heavy demands on staff time for the inquiry being undertaken, particularly as in the mining industry the load tends to concentrate at the end of the working-shift.

"Teaching Machine"

The investigators are therefore examining the possibility of using a machine to ask the questions. A prototype has been built but it has yet to be tested under operational conditions. The man who has had an accident faces the screen of a "teaching machine" and has a small panel of answer buttons. He first sees some simple instructions on how to operate the machine and then starts to answer questions. Each question is posed by a set of pictures and words like those in Fig. 1, and he answers by pressing a button that has the same number as the picture that most nearly represents the condition of his accident. As soon as one question is answered he sees another set of pictures and words and again presses the appropriate button. The principal answer buttons are numbered from one

FIG. 1.—Each question is posed by a set of pictures and words.

analyse information about large numbers of accidents, minor as well as serious. This task presents serious difficulties, not least of which is the need to obtain detailed information from

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