PERINATAL LESSONS FROM THE PAST

Dr Erasmus Darwin (1731–1802) of Lichfield and placental respiration

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Erasmus Darwin was a great philosopher, scientist, inventor, poet, and physician. His creative intellect has been compared with that of Leonardo da Vinci. This brief article draws attention to two perinatal contributions made on placental respiration and management of the umbilical cord.

Erasmus Darwin was one of the most extraordinary men of the 18th century. Hesketh Pearson in his biography introduced him as follows: "It is, perhaps, as the man who gave a creed to Creative Evolution that Dr. Erasmus Darwin chiefly interests us to-day. But his claims to our attention are far wider than that. He was the grandfather of Charles Darwin by his first marriage, and of Sir Francis Galton by his second. There is hardly an idea and hardly an invention in the world of to-day that he did not father or foresee, from the philosophy of Mr. Bernard Shaw to the phonograph of Mr. Thomas Edison, from eugenics and evolution to aeroplanes and submarines, from psycho-analysis to antiseptics. He founded the Lunar Society—the most remarkable group of thinkers and inventors in the eighteenth century—which had a more potent effect upon civilization than that of any other society in history. He was the greatest philosopher and physician of his day, and a poet who won the unstinted praise of Cowper and Walpole. He was a notable humanitarian and reformer, centuries ahead of his time, and, rarer still, an extremely benevolent and reasonable human being."

Erasmus was born at Elston Hall near Nottingham in 1731. He was the fourth son of a lawyer, Robert, and Elizabeth Darwin. From Chesterfield School, he obtained a scholarship to St John's College, Cambridge in 1750 (BA, 1754). This was followed by two years studying medicine in Edinburgh. After qualification (MB, Cantab, 1755) he set up in practice in Nottingham, but moved in 1756 to Lichfield where he rapidly gained the reputation as an excellent doctor. Indeed he came in time to be recognised by many as England's finest physician. George III invited him more than once to become his personal physician, but being at heart a republican he declined. In spite of the demands of his enormous practice, he found time for poetry, science, philosophy, the arts, a large correspondence, innumerable mechanical experiments and inventions, and commercial developments.^{1 2}

Darwin was of medium height, a careless dresser, and rather corpulent (fig 1). He enjoyed his food, while at the same time avoiding alcohol.

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With a sunny smile, a ready wit, and a stammer, he was kindly and sociable and had a genius for friendship. He paid little attention to authority and could be impatient of opposition. For instance, in Lichfield he did not get on well with Samuel Johnson whose despotic manners he disliked. He also had religious differences with him. Darwin stated his own religious philosophy as: "'Do as you would be done by' and 'Love your neighbour as yourself' include all our duties of benevolence and morality; and, if sincerely obeyed by all nations, would a thousandfold multiply the present happiness of mankind." As one might expect, he loathed slavery and war and called for the humanitarian treatment of prisoners. He had a compassion for the poor and homeless, whom he treated without a fee. He was also a far sighted politician who argued against taxation of the American colonists.

Darwin had a love of botany. He was the first person to fully understand and explain the process of photosynthesis in plants, and he translated Linnaeus's system of plant classification from Latin to English. In 1778 he created a botanical garden near Lichfield and published a number of popular botanic works including *Botanic garden* (1789) which was regarded as a literary classic.

Figure 1 Dr Erasmus Darwin, 1731–1802.

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In the 1760s Darwin had become the founder and leading light of the Lunar Society.³ Among its members, all of them his life long friends and drawn together by their common interest in science and the arts, were James Watt, Matthew Boulton, Joseph Priestly, William Withering, Samuel Galton, John Baskerville, William Small, and Josiah Wedgwood. The society got its name because its meetings, often at Galton's house between Lichfield and Birmingham, were held at the time of the full moon in order to lighten the journey home. Its meetings were immensely productive and indeed sparked the industrial revolution.

As a physician, Darwin was a good observer and, after careful thought, an accurate interpreter of nature. He understood the importance of mind over matter, and this helped to make him an outstanding diagnostician. He also made many important contributions to hygiene and medicine. Germs had not yet been discovered but he wrote: "I hope that microscopic researches may again excite the attention of philosophers, as unforeseen advantages may probably be derived from them like the discovery of a new world." On the disposal of sewage he suggested: "The sewage from towns and villages, which is now buried in wells or thrown into rivers, should be removed for the purpose of agriculture; and thus the purity and healthiness of the towns may contribute to the thriftiness and wealth of the surrounding country." And with respect to lunacy he wrote: "No lunatic should be restrained unless he be dangerous. Confinement retards rather than promotes their cure, which is forwarded by change of ideas, etc." "If everyone who possesses mistaken ideas, or who puts false estimates on things, was liable to confinement, I know not who of my readers might not tremble at the sight of a madhouse." Among his other contributions, Darwin championed the proper education of girls and also founded the concept of eugenics: "The art to improve the sexual progeny of either vegetables or animals must consist in choosing the most perfect of both sexes, that is the most beautiful in respect to the body, and the most ingenious in respect to the mind; but where one sex is given, whether male or female, to improve a progeny from that person may consist in choosing a partner of a contrary temperament."

In 1794, after 25 years preparation, Darwin published his remarkable book *Zoonomia*⁴ in which he not only described a theory of evolution but included a comprehensive classification of diseases and their treatments. It is from the 2nd and 3rd editions (1796 and 1801) that the following two perinatal extracts were taken:

On placental respiration⁴

"First, by the late discoveries of Dr. Priestly, M. Lavoisier and other philosophers, it appears that the basis of atmospheric air, called oxygene, is received by the blood through the membranes of the lungs; and by this addition the colour of the blood is changed from a dark to a light red. Secondly, that water possesses oxygene also as a part of its composition, and contains air likewise in its pores; whence the blood of fish receives oxygene from the water, or from the air it contains, by means of their gills, in the same manner as the blood is oxygenated in the lungs of air-breathing animals; it changes its colour at the same time from a dark to a light red in the vessels of their gills, which constitute a pulmonary organ adapted to the medium in which they live. Thirdly, that the placenta consists of arteries carrying the blood to its extremities, and a vein bringing it back, resembling exactly in structure the lungs and gills above mentioned; and that blood changes its colour from a dark to a light red in passing through these vessels.

This analogy between the lungs and gills of animals, and the placenta of the foetus, extends through a great variety of other circumstances; thus air-breathing creatures and fish can live but a few minutes without air or water; or when they are confined in such air or water as has been spoiled by their own respiration; the same happens to the foetus, which as soon as the placenta is separated from the uterus, must either expand its lungs and receive air, or die. Hence from the structure, as well as the use of the placenta, it appears to be a respiratory organ like the gills of a fish, by which the blood in the foetus becomes oxygenated.

From the terminations of the placental vessels not being observed to bleed after being torn from the uterus, while those of the uterus effuse a great quantity of florid arterial blood, the terminations of the placental vessels would seem to be inserted into the arterial ones of the mother; and to receive oxygenation from the passing currents of her blood through their coats or membranes; which oxygenation is proved by the change of colour of the blood from dark to light red in its passage from the placental arteries to the placental vein.

The curious structure of the cavities or lacunae of the placenta, demonstrated by Mr. J. Hunter, explain this circumstance. That ingenious philosopher has shown that there are numerous cavities or lacunae formed on the side of the placenta which is in contact with the uterus; cavities or cells are filled with blood from the maternal arteries, which open into them; which blood is again taken up by the maternal veins, and is perpetually changed. While the terminations of the placental arteries and veins are spread in fine reticulation on the sides of these cells. And thus, as the growing foetus requires greater oxygenation, an apparatus is produced resembling exactly the air cells of the lungs.

The question of the great Harvey becomes thus easily answered. 'Why is not the foetus in the womb suffocated for want of air, when it remains there even to the tenth month without respiration: yet if it be born in the seventh or eighth month, and has once respired, it becomes immediately suffocated for want of air, if its respiration be obstructed?' "

On tying and cutting the umbilical cord⁴

Darwin's observations on management of the umbilical cord at birth remain relevant to the very common practice today of immediate ligation in order to obtain cord blood samples. He wrote:

"Another thing very injurious to the child is the tying and cutting of the navel string too soon, which should always be left till the child has not only repeatedly breathed but till all pulsation in the cord ceases. As otherwise the child is much weaker than it ought to be, a part of the blood being left in the placenta which ought to have been in the child and at the same time the placenta does not so naturally collapse, and withdraw itself from the sides of the uterus, and is not therefore removed with so much safety and certainty."

Darwin had written earlier to his son Robert in 1792: "I am studying my *Zoonomia* which I think I shall publish, in hopes

of selling it, as I am too old and hardened to fear a little abuse." He was right to anticipate criticism. Although translated into German, French, and Italian and praised by the Pope, there were many who thought some of his ideas absurd. George Canning for instance ridiculed his suggestion that humans had evolved from lower forms, that electricity would have important practical applications, that mountains were older than the Bible said they were, and that powered aircraft would eventually become a major weapon of war! Darwin defended himself from critics by claiming "extravagant theories, in those parts of philosophy where our knowledge is yet imperfect, are not without their use; as they encourage the execution of laborious experiments, or the investigation of ingenious deductions to confirm or refute them."

In 1756 Darwin had married a lovely 18 year old, Mary Howard. They had four children before Mary died prematurely at the age of 31. During the 1770s Erasmus had two illegitimate daughters by a Miss Parker, before his second marriage to Elizabeth Pole in 1780. Then at his wife's request he moved to Derby. There he founded the Derby Philosophic Society (1784). A further seven children followed. Erasmus adored each of his wives and his children and they in turn adored him. His daughter, Violetta, by his second marriage gave birth to Francis Galton, while his son Robert by his first wife, became the father of Charles Darwin. The latter built much of his theory of evolution on the ideas propounded by his grandfather 60 years earlier. Erasmus had written⁴:

"All vegetables and animals now existing, were originally derived from the smallest microscopic ones, formed by spontaneous vitality; and they have by

innumerable reproductions, during innumerable centuries of time, gradually acquired the size, strength, and excellence of form and faculties which they now possess."

And in his famous poem, *The temple of nature*⁵, published in 1803 just after his death, he wrote:

"Organic life beneath the shoreless waves
Was born and nurs'd in ocean's pearly caves
First forms minute unseen by spheric glass
Move on the mud, or pierce the watery mass;
These, as successive generations bloom,
New powers acquire and larger limbs assume;
Whence countless groups of vegetation spring
And breathing realms of fin and feet and wing."

Although Darwin suffered from gout towards the end of his life, his health in general was good. At the age of 70 in 1802 he died from a sudden heart attack.

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