



DISPUTATIONS TOUCHING  
THE GENERATION OF  
ANIMALS

BY  
WILLIAM HARVEY

TRANSLATED WITH  
INTRODUCTION AND NOTES BY  
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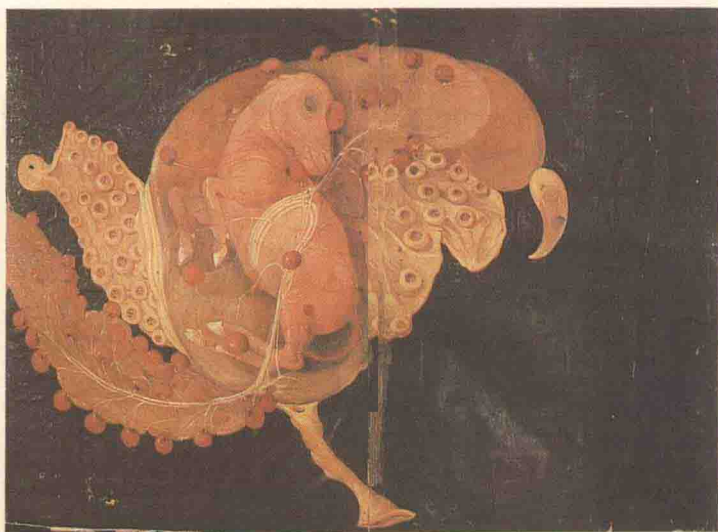
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FRONTISPIECE The foetal sheep. From the original painting attributed to Fabricius in the Bibliotheca Marciana.

But . . . how in the Cicatricula or little pale circle formation first beginneth, how the Grando or tredle, are but the poles and establishing particles of the tender membrans firmly conserving the floating parts in their proper places, with many observables, that ocular Philosopher and singular discloser of truth, Dr Harvey hath discovered, in that excellent discourse of generation, so strongly erected upon the two great pillars of truth, Experience and Reason.

SIR THOMAS BROWNE  
*Pseudodoxia Epidemica*, III, 28

## PREFACE

Whereas everyone knows *De motu cordis*, Harvey's second major work, *De generatione animalium*, has been read less often. Neither the Latin text nor an English translation has been easily available for many years.

*De generatione animalium* was first translated into English by an unknown writer and published in London in 1653. In 1847, it was retranslated by Dr Thomas Willis and published for the Sydenham Society in *The Works of William Harvey*. Neither version has ever been reprinted.

Both translations have certain shortcomings. The seventeenth-century version is to be preferred in that it reflects well enough the vigour and turn of phrase of Harvey's Latin style, but it is not always immediately understandable to anyone unfamiliar with the language of the period. Its actual mistakes in translation are not numerous and there are only a small number of omissions. Willis's version, though considered by some to be more correct, is not really so. It contains a number of misunderstandings and some actual mis-translations. His disregard for Harvey's precise use of *cerva* and *dama* for the hind of the red deer and the doe of the fallow deer has led to a certain amount of confusion with regard to the breed of deer on which Harvey worked. Not only has Willis translated these names at random but on occasion has rendered one or other of them as 'roe deer'. Willis's style, moreover, is dull and plantigrade and at times unnecessarily reticent in its choice of words.

In making this translation, I have followed the first English version, for its simplicity and directness are much to be preferred to Willis's verbose style. I have tried to avoid the use of words whose meaning is not immediately obvious and of archaic turns of phrase, while at the same time I have tried to keep something of the flavour of the original. Everywhere I have done my best to translate and not to paraphrase.

The precise translation of some of the words has presented certain difficulties. For instance, the philosophical connotation of *ratio* has

not been easy to render and I have not been consistent in its translation. The word has no exact English equivalent and the most generally accepted translation is 'concept' or 'conception', though this falls short of the full connotation of *ratio*, λόγος. Willis has side-stepped the problem by using '*ratio operis*', and the 1653 translator has been content with 'reason' or 'ratio'. The names of some of the animals also present difficulties. In the absence of any system of taxonomy, the English equivalents for some of these as provided by dictionaries of classical Latin can be misleading. For example, when Harvey refers to a 'larger mouse' I was uncertain whether he really meant a mouse or a rat, but have opted for 'rat'. *Mus* was used for both from classical times onwards and though *rattus* appears in one or two texts written in England from the twelfth century, the word has every appearance of being a barbarous neologism from the vernacular and does not seem to have been in general use. The names of fish also are troublesome. Willis has been guilty of introducing the 'lamprey' into Harvey's list of elasmobranchs (p. 406) as a translation for *galeos*, a shark or dogfish. The lamprey is one of the cyclostomata and its manner of reproduction is quite different. Throughout I have translated *anima* by the direct equivalent 'soul', for it is clear enough from the context that Harvey is using the word with the different Greek connotations and never with the Christian meaning of the immortal soul of man.

In the original there are many footnote references to the sources of quotations. These I have identified as far as possible with modern editions. A few of the references to Aristotle I have failed to find, presumably because Harvey was using a contemporary Latin Version of which the text differs from the present-day accepted canon.



Willis attributed the 1653 English version to Dr Martin Llewellyn (1616-81) for a poem by him was prefixed to the translation: 'To the Incomparable Dr Harvey, On his Books Of the MOTION of the HEART and BLOOD, And of the GENERATION of ANIMALS.' Apart from this juxtaposition, however, there does not seem to be any reason to connect Llewellyn with the author of the vernacular version. Llewellyn does not claim to have made the translation and the difference in style between the poem, which is mere doggerel, and the simple elegance and vigour of the prose translation is such as to

render the suggestion that they came from the same pen well-nigh inconceivable. Llewellyn graduated at Christ Church, Oxford, in 1643 and then joined the Royalist army. He was admitted as a Fellow of the College of Physicians in 1659 and in 1660 became physician to Charles II and Principal of St Mary's Hall, Oxford. Four years later he left the University, settled in Great Wycombe where he practised medicine and in 1671 became mayor of the town. He produced four volumes of verse. It is possible that he knew Harvey and he certainly admired his work. The greater part of the poem prefixed to the 1653 translation celebrates the discovery of the circulation:

There thy *Observing Eye* first found the Art  
Of all the *Wheels* and *Clock-work* of the *Heart*:  
The *mystick causes* of its *Dark Estate*,  
What *Pullies Close* its *Cells*, and what *Dilate*.  
What secret *Engines* tune the *Pulse*, whose din  
By *Chimes without*, *Strikes* how things fare *within*.  
There didst thou trace the *Blood*, and first behold  
What *Dreames* mistaken *Sages* coin'd of old.  
For till thy *Pegasus* the *fountain brake*,  
The *crimson Blood*, was but a *crimson Lake*.  
Which first from Thee did *Tyde* and *Motion* gaine,  
And *Veins* became its *Channel*, not its *Chaine*.  
With *Drake* and *Candish*<sup>1</sup> hence thy *Bays* is curld,  
Fam'd *Circulator* of the *Lesser World*.

After referring to the controversy provoked by Harvey's discovery, Llewellyn devotes the last fourteen lines of the poem to *De generatione*:

A Calmer welcome *this choice Peice* befall,  
Which from *fresh Extract* hath deduced all,  
And for belief, bids it no longer begg  
That *Castor* once and *Pollux* were an *EGGE*:  
That both the *Hen* and *Housewife* are so matcht,  
That her Son *Born*, is only her Son *Hatcht*;  
That when her *Teeming* hopes have prosp'rous bin,  
Yet to *Conceive*, is but to *Lay within*.  
*Experiment*, and *Truth* both take thy part:  
If thou canst scape the *Women*! there's the Art.  
Live *Modern Wonder*, and be read alone,



Thy *Brain* hath *Issue*, though thy *Loins* have none.  
 Let fraile *Succession* be the Vulgar care;  
 Great *Generation's* selfe is now thy *Heire*.

★

I completed most of the actual translation of *De generatione* in Delhi, and there I learnt that while Harvey was observing the behaviour of farmyard cocks and hens, the Mughal Emperor Jahangir (1605-27) observed over a period of five years a pair of cranes, called Laila and Majnun, who travelled everywhere with him. Thinking that it had never before been recorded, Jahangir watched their mating behaviour and wrote of it in his diary.

The female having straightened its legs bent down a little; the male then lifted up one of its feet from the ground and placed it on her back, and afterwards the second foot, and immediately seating himself on her back, paired with her. He then came down, and, stretching out his neck, put his beak to the ground, and walked once round the female.

Two eggs were produced and the birds took turns in sitting on them, signifying by a sharp peck on the neck of the sitting bird that it was time for a change. But when the weather became cold and damp, they sat for longer periods and this Jahangir believed was to prevent the damp air from getting to the eggs. After thirty-four days the first egg hatched and the second after thirty-six. The mother bird fed them with locusts and grasshoppers from her mouth. When hatched they were about the size of a month-old peafowl.

Although sometime between 1656 and 1668, the French physician, François Bernier, discussed with his learned friend, the Governor of Delhi, Harvey's discovery of the circulation, neither Jahangir's example nor the Governor's curiosity had any effect in producing further investigation into Nature and Nature's secrets.

#### NOTE

1 Thomas Candish or Cavendish (1560-92) was the second circumnavigator of the globe. Eight years after Sir Francis Drake, Candish left Plymouth in July 1586 and returned in September 1588. He received popular acclaim for his exploit and various ballads (mostly now lost) were written to honour him and Drake. An account of his voyage is contained in Hakluyt's *Voyages*.

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As usual, many friends have helped me with their advice and I should like to thank them for putting their specialized knowledge so generously at my disposal. Among them are Dr R. V. Short who allowed me to witness the dissection of the uterus of a pregnant hind in the very early stages of gestation, and who gave me much information from his vast store of knowledge on the behaviour of the red deer. I should also like to thank Dr Morrell Draper for his long discussions on the reproductive tract of the hen and on egg formation. They both illuminated for me problems that were previously hidden in the deepest night. Dr Pamela Mackinnon has generously provided me with the illustrations of the pregnant uterus of the sheep and of the human foetus.

I should like to thank the President of the Royal College of Physicians of London and Dr Charles Newman, formerly Harveian Librarian, the President and Fellows of Magdalen College, Oxford, and the Librarian of the Bibliotheca Marciana of Venice, for their kindness in allowing me to reproduce illustrations from books in their libraries.

My thanks are also due to Professor David West and to the curators of the Pybus Collection in the library of the University of Newcastle upon Tyne for permission to transcribe and translate Harvey's manuscript notes in their copy of *De generatione animalium*.

As usual, I have taxed my husband's patience with my many questions relating to Harvey's views on matters anatomical and physiological.

Lastly, I should like to thank my publishers for their kindness and cheerful assistance in technical problems.

All mistakes appearing in this book are entirely my own.

## INTRODUCTION

### I *The date of the composition of* *De generatione animalium*

In the Letter addressed to the President and Fellows of the College of Physicians and which serves as a preface to this book, Dr George Ent tells how he had collected the manuscript from a somewhat unwilling and reluctant Harvey 'about Christmas last'. This was almost certainly Christmas 1648, when the fate of Charles I still hung in the balance; Cromwell had returned to London and the decision that the King should stand his trial was being taken by the House of Commons. Everywhere the Royalists were in the depths of gloom. Ent was a much younger man than Harvey (he was born in 1604), but like Harvey he had been educated at Cambridge and Padua where he had taken his doctorate in medicine in 1636. It was in that year that he and Harvey had met for the first time when they were both in Rome. Three years later, Ent became a Fellow of the College of Physicians and in 1641 he defended Harvey's doctrine of the circulation by publishing his own treatise, *Apologia pro circulatione sanguinis*. It is more than likely that Ent already knew of the existence of Harvey's book on generation before visiting him and that the purpose of the visit was to relieve Harvey (who was then 70 years old) of the tedious task of overseeing the printing, and, by making himself responsible for the correcting of the proofs, to prevent the recurrence of the printing errors which had marred the text of *De motu cordis*, occasioned by Harvey's 'obscure' handwriting. But that Harvey did in fact have some hand in the final revision of the text of *De generatione* is clear from two letters which he wrote in 1651. In the first, sent to Paul Marquand Slegel to accompany a copy of the newly-published book and dated 25 March, Harvey excuses the dilatoriness of his reply by saying that his thoughts had been entirely taken up with his Disputations on animal generation, and in the second, written on 15 July to Giovanni Nardi of Florence,

he again excuses himself for not having written sooner, partly because of the troublous nature of the times and partly because the expediting of his book to the press had hindered him. The finished book appeared in March 1651, printed in London by William Dugard and published by Octavian Pulleyn the elder. The original intention had been that a portrait of Harvey should serve as the frontispiece, but in the event the project was dropped and replaced by a mediocre figure of Jove, sitting on a pedestal with his eagle beside him, and holding in his right and left hands two halves of an egg from which are seen issuing forth, as if from some Pandora's box, a number of different kinds of tiny animals. On the egg is the inscription *Ex ovo omnia*, 'all things from an egg'.

The publication of *De generatione animalium* coincided with the last acts of the Civil War. On 14 December 1648, the Council of Officers decided that the King should be removed from Hurst Castle and brought to Windsor while arrangements were made for his trial which opened at Westminster on 8 January 1649. The mood of London was sullen, apprehensive and gloomy. It is not surprising that Harvey replied to Ent's question, 'Are all things right and well?' by saying:

How can they be . . . when the Commonwealth is full of intestine troubles and I myself as yet upon the high seas? And truly, . . . if the comfort of my studies and the remembrance of many things long since fallen under my observation were not some solace to my mind, I know not what could prevail upon me to wish to survive the present time (p. 3).

That Harvey's sympathies were whole-heartedly with the King is clear enough from the many courteously formal yet affectionate references which he makes to him in this book. Furthermore, we know on the authority of Sir Charles Scarborough that Harvey had intended to endow a professorship of experimental philosophy at Cambridge and to provide that University with a laboratory and a herb garden, but that he was deterred from so doing by the thought that he might be supporting views and doctrines reflecting the religious and political opinions of the Commonwealth which was so distasteful to him.

The University lost . . . this most splendid Institute, projected by our Harvey, robbed by the iniquity of those most wicked times. I see, he said, (for he often spoke to me of this matter and not without tears in his eyes and mine), I see plainly that, were I to dedicate my fortune, as I had intended, to the promoting of the knowledge of truth and to the

public weal, I should do nothing other than make Anabaptists, Fanatics and all manner of thieves and parricides my heirs.<sup>1</sup>

We know little enough about Harvey's movements during the years of the Civil War. He was present at the opening battle, the Battle of Edgehill, on 23 October 1642, when he was in charge of the young princes, Charles, prince of Wales, and James, duke of York. We know that he was in Oxford towards the end of that year for on 7 December he incorporated as a Doctor of Medicine in the University. It has been assumed that he stayed in Oxford more or less continuously until the surrender of the city to General Fairfax on 24 June 1646. In October 1643, he was sent by the King on a brief visit to Milton Abbott where Prince Maurice of the Netherlands was then lying sick of a fever. But we know of no other such visits or expeditions which Harvey may have made during these years. From January 1645 he was Warden of Merton College, put in by Charles I to replace the absent Warden, the Parliamentary sympathizer, Nicholas Brent. But Harvey's tenure of that office left no appreciable marks on the College which, when the siege was ended and the Court had left the city, made haste to reinstate its former Warden. During his short stay at Merton, Antony à Wood says that Harvey worked in a small room beyond the library of the College and overlooking Mob Quad. John Aubrey tells of visits to Trinity College to examine eggs that had been set to hatch in the rooms of George Bathurst, visits which must have occurred before 1644 when Bathurst died of a wound which he had received fighting on the King's side in the defence of Faringdon.

After leaving Oxford on 27 April 1646, King Charles rode north to join the Scots at Newark only to be conveyed by them within a few days to Newcastle where he was virtually though not technically their prisoner. On 24 November 1646, Parliament graciously acceded to Harvey's request to join his royal master as he was in duty bound to, being his Physician-in-ordinary. But on 30 January 1647, the Scots marched out of Newcastle leaving the King in the hands of the Parliamentary soldiery who took him, a prisoner and unattended by his personal servants, to Holmby House in Northamptonshire. We may, therefore, be certain that it was in January 1647 that Harvey saw the King for the last time. All Charles's subsequent requests for the attendance of his own chaplains and physicians were refused. By this time Harvey had been proclaimed

a 'delinquent' and ordered to pay a fine of £2,000 for his adherence to the King. After the King's execution on 30 January 1649, Harvey was living as a proscribed Royalist either with his brother Eliab at Roehampton, or in the house of his nephew Daniel at Combe near Croydon. He was forbidden to come within six miles of the City of London or to visit any of his patients there without the express permission of the Parliament. Sometime during the Civil War and perhaps during the winter of 1642-43, Harvey was robbed of many of his books and papers.

While I was attending upon our most serene Highness, the King, in our late troubles and more than civil wars, some rapacious hands, and that not only by Parliament's permission, but by its express command, not only spoiled me of all my household goods but also, and this is the heavier cause of my lament, my enemies stole from my study my notes which had cost me many years of toil. And so it came about that very many observations which I had made, particularly those concerning the generation of insects, were lost . . . (p. 354).

John Aubrey refers to the same incident, saying that these

papers, together with his goods in his Lodgings at Whitehall, were plundered at the beginning of the Rebellion, he being for the King, and with him at Oxford.

Such then is the background against which Harvey's *Disputations touching the Generation of Animals* made its appearance in 1651. It is not altogether surprising that there have been some critics to assume that it was written during these gloomy years and that it was the product of Harvey's old age. Some indeed have assessed it as being little better than the idle ramblings of senility. But even if it had been written between January 1647 and Christmas 1648, it would be dangerous to assume that Harvey's intellectual powers were in any way diminished, for it was in the Letter which he wrote to Slegel in March 1651 that he described the new experiment which he had only recently performed and by which he proved incontrovertibly that there are no porosities in the interventricular septum of the heart. In fact, the writing of this book belongs to a much earlier period of Harvey's life.

News of the existence of Harvey's work on animal generation had already reached several people by 1648. Among them were Samuel Hartlib and Sir Thomas Browne who is reported to have said, according to a letter written in 1648, that Dr Harvey had 'an excellent

tract *De generatione* coming forth', that he himself had seen it ten years previously and that it was full of 'admirable experiments and various learning'.<sup>2</sup> If Sir Thomas Browne had seen a draft of the book or even some part of the manuscript, as early as 1638, it would seem to follow that Harvey was working on it in the years immediately after the publication of *De motu cordis*, that is to say approximately between 1630 and 1640, in any case before the outbreak of the Civil War in 1642. This would account for Ent's remark that the work had lain 'long concealed' (p. 5).

The book itself does not provide many clues as to its date of composition but there appears to be no reference in it to any event which can be positively dated as having occurred after 1642. One of the latest references might be to the meeting of the King with the young Hugh, the eldest son of Viscount Montgomery of Ireland (pp. 249-51). Hugh was born c. 1623. He succeeded to his father's title in 1642, so that the visit must have occurred before this event. As Harvey says that Hugh came to London when he was 'about eighteen or nineteen' it is possible that he met the King at Hampton Court in November 1641, a suggestion which accords well enough with the remark which Charles is said to have made to him: 'Sir, I wish I could perceive the thoughts of some of my nobilities' hearts as I have seen your heart.'

After the outbreak of the Civil War, King Charles is unlikely to have had any time or leisure to witness Harvey's experiments on the royal deer. The only date which Harvey mentions in connection with this work is 1633 (p. 355). But he also says that these observations had been made 'over many years together' (p. 336), a phrase which could mean at least five or six years of which 1633 was one.

Two other events to which Harvey alludes can also be dated. His visit to the Bass Rock occurred in 1633 when he accompanied Charles I to his coronation in Edinburgh. The meeting with Aromatarius, 'a most famous physician' (p. 69) took place when Harvey visited Venice in 1636.

There are several references in this book to *De motu cordis* and to Harvey's discovery of the circulation, but only one appears to give any possible clue as to the date at which it was written.

I see that the wonderful circuit of blood which I discovered some time since is agreed to by nearly everyone, and till now no one has raised any objection to it which was greatly worth a confutation (p. 248).

This might suggest that it was written before the publication of Riolan's attacks on Harvey, for, apart from the private letter written to Caspar Hofmann in May 1636,<sup>3</sup> Harvey is not known to have answered any of his critics, and he certainly published nothing relating to them, until he replied to Riolan in 1649. Riolan's first public criticism of Harvey was made in Paris on 7 February 1645.

If Harvey's work on the deer took place during the 1630s, his investigations of eggs had begun much earlier. By the time that he wrote his *Anatomical Lectures* for 1616, his observations on the developing embryo of the chick were already sufficient to have led him to the conclusion that it grows by epigenesis, and that the blood is in being before either the heart or the liver:

WH nor is the heart the chief part by virtue of its origin, for I think that the ventricles . . . are made from the drop of blood which is found in the egg and the heart is fashioned along with the remaining parts, as sprouts come forth in an ear of corn, all together from something which is too small to be seen (p. 251).

A great many other observations also recorded in these Lectures and touching different aspects of the problem of generation likewise reappear in *De generatione*. That he used his knowledge of the foetal heart, of the ductus arteriosus and of the foramen ovale in *De motu cordis* is no surprise for by 1628 he knew that the foetus had its own circulation, distinct from that of the mother.<sup>4</sup>

*De generatione* is the background to the whole of Harvey's work, the source which can amplify his views on many subjects, particularly on topics not fully explained in *De motu cordis*, such as blood, spirit, innate heat, the soul and the heart, but it is not possible to put any actual date on its composition. The chapters recording his observations on the deer can well have been written while that work was in progress in the 1630s. His descriptions of the growth of the chick can have been begun much earlier, before he wrote *De motu cordis*, and they can have been added to and revised several times. The theoretical chapters based on these observations can have been begun before the investigations of the deer and altered where necessary to include later additions. But the period of time during which it seems most probable that Harvey collected his notes and assembled them into a coherent whole is between 1628 and 1642. *De generatione animalium* should no longer be considered as the last of his writings, but be situated between *De motu cordis* and the publica-



tion of his Letters to Riolan. As we know that he was working on the proofs of *De generatione* as late as 1650 to 1651, the references to 'our late Majesty' or 'our late Sovereign' were all most probably introduced at that time.

## NOTES

1 From Sir Charles Scarborough's Harveian Oration, Oxford, Bodleian Library, MS Rawlinson D 815, f. 6<sup>v</sup>. The remark was presumably made to Scarborough at the time when Harvey was thinking of making his will, that is some time in 1652.

2 The information is contained in a letter written by Thomas Smith of Christ's College, Cambridge, to Samuel Hartlib on 30 October 1648.

Last weeke I heard from Dr Browne of Norwich. . . . He saith likewise that Dr Harveigh hath an excellent tract *de generatione* coming forth which himself saw ten years ago, full of admirable experiments and various learning. If my memory mistake not he mentions that and another peece *de respiratione* in his booke *de motu sanguinis*.

(C. Webster, 'Harvey's *De Generatione*: its origins and relevance to the theory of the circulation,' *Br. J. Hist. Sci.*, III, 1967, 262-74.)

In his 'Observations on eggs', Sir Thomas Browne refers to Harvey's opinion concerning the formation of the shell of the egg and mentions his chance discovery of one with two shells. Presumably this is the egg which Harvey describes in *DGA* and which he showed to King Charles (pp. 64-5), but there is no means of knowing whether Sir Thomas Browne found the reference in Harvey's manuscript or in the printed book.

That the shell was made in the uterus & plastick power wh. formeth other parts of the egge, not by induration or hardening upon exclusion, is evident to observation in such as are found hard in the egge poke, wh. Dr. Harvey handsomely confirmeth from an egge found within another, wherein the inmost is fully shelled & hard.

(*The Miscellaneous Writings of Sir Thomas Browne*, ed. Geoffrey Keynes, London, 1931, subsequently re-issued, p. 322.)

3 The full text of Hofmann's letter and of Harvey's reply will be found in my *WH and the Circulation of the Blood*, pp. 238-52.

4 The extent of Harvey's knowledge of the foetal blood supply in 1616 cannot be ascertained for there is no discussion of the foetus in these Lecture notes. Harvey promises it for a subsequent occasion. See *Anat. Lect.* p. 233.