veins, and convey the blood from one system into the other, for he had no microscope by which he could possibly discover them, but he demonstrated clearly enough that such a conveyance must take place. It was not until four years after Harvey's death that Malpighi with the microscope, then newly invented, demonstrated the existence of the minute capillary vessels by which the conveyance is effected.

Harvey's great work, the "*Dissertation on the Movement of the Blood in Animals,*" was not published until 1628, when he was in his 50th year. He had taken sixteen years in which to study and establish his theory after he first conceived it before he taught it in his lectures; and he had taken twelve other years in which to complete his demonstration of it by means of further examinations of living animals before he made it known to the world in a treatise. Though for a number of years there was no opposition to this theory, yet in course of time opposition did come, and come so bitterly that he was loath to give to the world other results established by his acute powers of observation and reasoning. It was only because admiring friends and followers took the matter into their own hands, and published his other demonstrations almost against his will, that we have evidence other than the dissertation of 1628 of Harvey's genius and ability as an original scientific investigator. But the subjects in which, after the discovery of the circulation of the blood, Harvey was specially interested (for example, the growth of the chick in the egg was one of them) were such as could be properly investigated only with the aid of the microscope, and, as we have seen, the microscope was unknown in Harvey's time. But, notwithstanding his lack of the microscope, Harvey

observed enough, and demonstrated enough, to win the reputation of being the greatest physiological investigator of his age, and his reputation as a skillful practical physician and surgeon was equally notable. He acquired an ample fortune, and as his wife died before him and he had no children, he found his chief pleasure in his later years in making substantial benefactions to the College of Physicians. Of this institution for many years he had been the most illustrious member, and as a crowning honor of his life he was chosen its president. One of his benefactions was to the effect that an annual oration was to be given before the fellows of the college to exhort them "to study and search out the secrets of nature by way of experiment, and for the honor of the profession to continue mutual love and affection among themselves," and this oration has been given annually until this day. A generous provision, a noble object, a wise and notable compliance. Harvey died June 3, 1657, in the eightieth year of his age.

custom, I interposed by observing "How free you yourself are from the fault you indicate all know who are acquainted with you; and this is the reason wherefore the learned world, who are aware of your unwearied industry in the study of philosophy, are eagerly looking for your farther experiments."

"And would you be the man,"* said Harvey, smiling, "who should recommend me to quit the peaceful haven where I now pass my life and launch again upon the faithless sea? You know full well what a storm my former lucubrations raised. Much better is it oftentimes to grow wise at home and in private, than by publishing what you have amassed with infinite labour, to stir up tempests that may rob you of peace and quiet for the rest of your days."—*From the "Epistle," written by Dr. George Ent, prefixed to Harvey's "Treatise on the Generation [or Development] of Animals," published in* 1651.

HARVEY COMPARED AND CONTRASTED WITH HUNTER

William Harvey may perhaps be compared more fitly with John Hunter† than with any single scientific man

* The conversation here recorded took place at Christmas, 1650, when Harvey was in his 73rd year. The defeat and ruin of the royalist party had given him a somewhat gloomy view of life. Though he had made many observations and some important discoveries, he was averse to further bringing himself before the world. Nevertheless during this interview Dr. Ent persuaded him to consent to the publication of his "*Treatise on the Generation of Animals*," almost his last literary effort. "I gladly charge myself with the whole business of correcting the press," said the faithful Ent.

† John Hunter (1728-1793) physiologist and surgeon, and one of the great founders of the modern science of comparative anatomy—to be distinguished from his brother, William Hunter (1718-1783), a physiologist and physician, and the first great teacher of anatomy in England.

who either preceded or followed him. Harvey laid the foundation of modern medicine by his discovery of the circulation of the blood. Hunter laid the foundation of modern pathology not by any single and striking discovery, but by a long course of careful observation. Harvey, like Hunter, was a careful and competent observer; both were skilled anatomists, both were ardent pathologists, both were comparative anatomists of a high order. By singular ill fortune we have lost the records of many years of careful work done by each of these great men. Harvey's work was destroyed or scattered by the violence of the times in which he lived, and we can only be grateful that so much is spared to us; Hunter's work was lost irrevocably by the crime of his trusted assistant and brother-in-law. Harvey, like Hunter, was choleric, but his nature was the more lovable, though each had the power, innate in every great teacher, of attaching to himself and enrolling in his work all sorts of unlikely people. The collecting or acquisitive spirit was equally developed both in Hunter and Harvey, but the desire for knowledge was less insatiable in Harvey.

The influence of breeding and education is nowhere more marked than in these two great men, otherwise so nearly allied. Harvey's knowledge is always well within the grasp of his intellect. He can formulate it, often in exquisite language, and it is so familiar to him that he can afford to use similes and images which show him to be a man of wide general education. He thinks clearly so that his unerring conclusions are drawn in a startlingly

easy manner. Yet he was often hampered by the theories of the ancient philosophical schools of medicine. Hunter's knowledge was gigantic, but it was uncontrolled. His thoughts are obscure, and so ill-expressed that it is often difficult to discover what he would say. His conclusions too, are sometimes incorrect and are frequently labored, yet the advance in knowledge in the hundred years and more which separated him from Harvey afforded him many additional data.

Harvey's acquaintance with the literature of medicine enabled him to cite apposite examples, and must evidently have been of the greatest service to him in elucidating his problems. Hunter too often traversed paths which were already well-trodden, for his defective education prevented him from knowing the works of his predecessors. The atmosphere of courts and of the refined and learned society in which Harvey spent most of his life, has given a polish to his writings and a gentleness to his character which were wholly wanting to John Hunter, upon whom the *res angustae domi* *—absent in Harvey's case—had impressed a certain ruggedness of character; but in both there was a native strength and robustness of constitution which render them not dissimilar.—D'Arcy Power, F. S. A., F. R. C. S., *in "William Harvey," in "Masters of Medicine" Series.*

READERS' AND STUDENTS' NOTES

1. Perhaps the biographical account of Harvey most available to the ordinary reader is that in the series of monographs, entitled

* "Narrow circumstances of his life."

"Masters of Medicine," edited by Ernest Hart, D. C. L., editor of the *"British Medical Journal,"* published by Longmans, Green & Co., New York, at $1.25 each. The work in the series on *"William Harvey"* is written by D'Arcy Power, F. S. A., surgeon to the Victoria Hospital, Chelsea, London.

2. A brief but very excellent account of Harvey's discovery of "the circulation of the blood" is given in Arabella B. Buckley's *"Short History of Natural Science"* (New York: D. Appleton & Co.).

3. Harvey's great work is principally known by its English title: *"On the Motion of the Heart and Blood in Animals."* It was written in Latin. An edition of the standard translation of this work is edited by Alex. Bowie, M. D., C. M., and published by George Bell & Sons, London. Dr. Bowie prefixes to the work a short but interesting biographical account of Harvey.

WILLIAM HARVEY

SELECTED STUDIES AND REMINISCENCES

HARVEY'S GLORIOUS LEGACY TO RATIONAL PHYSIOLOGY

That there is one blood stream, common to both arteries and veins; that the blood, poured into the right auricle, passes into the right ventricle; that it is from there forced by the contraction of the ventricular walls along the pulmonary artery through the lungs and pulmonary veins to the left auricle; that it then passes into the left ventricle to be distributed through the aorta to every part of the animal body; and that the heart is the great propeller of this perpetual motion, as in a circle;—this is the great truth of the motion of the heart and blood, commonly called the circulation, and must forever remain the glorious legacy of William Harvey to rational physiology and medicine in every land.—ALEXANDER BOWIE, M. D., C. M., *Editor of Harvey's "Motion of the Heart and Blood in Animals."*

HARVEY'S DEMONSTRATION COMPLETED BY MALPIGHI

In one point only was the demonstration of the circulation incomplete. Harvey could not discover the capillary channels by which the blood passes from the arteries to the veins. This gap in the circulation was supplied several

years later by the great anatomist, Malpighi, who in 1661 saw in the lungs of a frog, by the newly invented microscope, how the blood passes from the one set of vessels to the other. Harvey saw all that could be seen by the unaided eye in his observations on living animals; Malpighi, four years after Harvey's death, by another observation on a living animal, completed the splendid chain of evidence.—DR. P. H. PYE-SMITH, *in "Encyclopaedia Britannica."*

A GLIMPSE OF HARVEY'S CHARACTER, MIND, AND VIEWS

Harassed with anxious and in the end not much availing cares, about Christmas last, I sought to rid my spirit of the cloud that oppressed it, by a visit to that great man, the chief honour and ornament to our college,* Dr. William Harvey, then dwelling not far from the city. I found him, Democritus like, busy with the study of natural things, his countenance cheerful, his mind serene, embracing all within its sphere. I forthwith saluted him and asked if all were well with him? "How can it be," said he, "whilst the Commonwealth is full of distractions, and I myself am still in the open sea? And truly," he continued, "did I not find solace in my studies, and a balm for my spirit in the memory of my observations of former years, I should feel little desire for longer life. But so it has been, that this life of obscurity, this vacation from

* The College of Physicians, London. The "Epistle" of which this abstract forms a part was addressed:—"To the Learned and Illustrious, the President and Fellows of the College of Physicians, London." It was written in 1650, not long after the execution of Charles I, who had been a friend to Harvey, and a patron of his studies. The writer was Dr. (afterwards Sir) George Ent, a faithful disciple of Harvey.

public business which causes tedium and disgust to so many, has proved a sovereign remedy to me."

I, answering said, "I can readily account for this. While most men are learned through others' wits, and, under cover of a different diction and a new arrangement, vaunt themselves on things that belong to the ancients, thou ever interrogatest Nature herself concerning her mysteries. And this line of study, as it is less likely to lead into error, so is it also more fertile in enjoyment, inasmuch as each particular point examined often leads to others which had not before been surmised. You, yourself, I well remember, informed me once that you had never dissected any animal—and many and many a one you have examined—but that you discovered something unexpected, something of which you were formerly uninformed."

"It is true," said he; "the examination of the bodies of animals has always been my delight, and I have thought that we might thence not only obtain an insight into the lighter mysteries of Nature, but there perceive a kind of image or reflex of the omnipotent Creator himself. And though much has been made out by the learned men of former times, I have still thought that much more remained behind, hidden by the dusky night of nature, uninterrogated: so that I have often wondered and even laughed at those who have fancied that everything had been so consummately and absolutely investigated by an Aristotle or a Galen, or some other mighty name, that nothing could by any possibility be added to their knowledge. Nature however is the best and most faithful interpreter of her own secrets; and what she presents, either more briefly or more obscurely in one department, that

she explains more fully and clearly in another. No one, indeed, has ever rightly ascertained the use or function of a part who has not examined its structure, situation, connection by means of vessels and other accidents, in various animals, and carefully weighed and considered all he has seen. The ancients, our authorities in science, even as their knowledge of geography was limited by the boundaries of Greece, so neither did their knowledge of animals, vegetables, and other natural objects, extend beyond the confines of their country. But to us the whole earth lies open, and the zeal of our travellers has made us familiar not only with other countries, and the manners and customs of their inhabitants, but also with the animals, vegetables and minerals that are met with in each. And truly there is no nation so barbarous which has not discovered something for the general good, whether led to it by accident, or compelled by necessity, which had been overlooked by more civilized communities. But shall we imagine that nothing can accrue to the wide domains of science from such advantages, or that all knowledge was exhausted by the first ages of the world? If we do, the blame very certainly attaches to our indolence, no wise to nature.

"To this there is another evil added. Many persons wholly without experience, from the presumed veri-similitude of a previous opinion, are often led by and by to speak of it boldly, as a matter that is certainly known; whence it comes, that not only are they themselves deceived, but that they likewise lead other incautious persons into error."

Discoursing in this manner and touching upon many topics besides with wonderful fluency and facility, as is his