Special Contribution

Sir Christopher Wren: Compleat Philosopher

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Doctor (Sir) Christopher Wren, was one of the most extraordinary characters ever known, possessing the extremely rare qualification of uniting both theory and practice in a very eminent degree, being highly accomplished in the mathematical and philosophical sciences, as well as in the theory and practice of architecture. He was born in 1632, and made great advances in mathematics at 16 years of age. Being an Oxford scholar, he was one of those learned men who first associated together there for their mutual improvement in natural and experimental philosophy, and which at length produced the Royal Society, of which he was an original, and all his life, one of the most distinguished members. Soon after the great fire of London in 1666, from his skill in architecture, he succeeded Sir John Denham in the Office of Surveyor-general of the King's Works; and from this time, he had the direction of a great many public edifices, by which he acquired the highest reputation; as in the Theatre of Oxford, St. Paul's Cathedral, London, the Monument, the Churches of St. Stephen Walbrook, St. Mary-le-bow, with upwards of 60 other churches which that dreadful fire had rendered necessary; also Chelsea College, one of the wings of Greenwich Hospital, the modern part of Hampton Court, etc. He was one of the commissioners who, on the motion of Sir Jonas Moore, Surveyor-general of the ordnance, was appointed to find out a proper place for erecting the National Observatory; and he proposed Greenwich Park, which was approved of. He became architect and commissioner of Chelsea College; also principal officer or comptroller of the works in Windsor Castle; and he sat twice in Parliament, as a representative for two different boroughs. He died in 1723, at 91 years, and was interred with great solemnity in the Cathedral of St. Paul's. As to his person, Sir Christopher was of low stature, and thin frame of body; but by temperance and regularity he enjoyed a good state of health, to a very unusual age. In his manners he was modest, devout, virtuous, and very communicative of his knowledge, of which he possessed an extraordinary fund. Sir Christopher never printed anything himself; but several of his works have been published by others. His drafts and posthumous works were published by his son.

CHRISTOPHER WREN is quite naturally chiefly famous for his architectural contributions—the glory of St. Paul's Cathedral, London, and his surviving churches and other edifices and his influence on ecclesiastical architecture, which with its many fine spires soon found its way into the American colonies. Less appreciated are his contributions in many other fields of knowledge, including medicine.

In order to assess the full impact that Wren left upon society in general and the profession of medicine, the age in which he lived should be considered briefly. It was one filled with a flood of treasures: the flowering of the arts and sciences, of exploration, and of commerce. The great migration to the New World was underway, and there was increased commerce and exchange of ideas from the Near and Far East as well. Several universities had already been founded in the western hemisphere in the 16th and mid 17th centuries. The Renaissance had swept north from Italy, and in the mid 16th century Vesalius had opened the doors to scientific and experimental medicine. The religious wars were over, and the Elizabethan age with Marlowe, Ben Johnson, and Shakespeare had just come to an end. Shortly before the birth of Wren, William Harvey, who was at the height of his career in London and the European world, had published his "De Motu Cordis" which revolutionized medicine. Sir Francis Bacon, scientist and philosopher, had recently died, and the whole world was seething with the ferment of discovery and new learning. "Galileo had imbued his listeners from every land with an appreciation of experiment on exact measurement as scientific tools." In his early years, Wren, because of his own avidity for mathematics (particularly geometry), must have been influenced by Descartes and the iatromathematical school. In his maturity he showed the influence of the iatrochemists.

In music, there were Vivaldi and Scarlatti in Italy; Rameau, Couperin, and Lully in France; Purcell and Locke in England; and in his later years, Handel and Bach were already in the vanguard of a new era in music.

In literature there were John Milton, John Dryden, John Bunyan, Robert Burton, Sir Thomas Browne, Samuel Pepys, Daniel Defoe, and Isaac Walton as examples in his own country; and during the latter part of the 17th century and in the early years of the 18th century Swift, Addison, and
Pope came upon the scene. In France were Molière, Racine, Fontaine, and Rochefooucauld, with Voltaire in the ascendant during Wren’s last years.

As to statecraft in England, these were the years of the Commonwealth under Oliver Cromwell and then of the restoration with Charles II, James II, William and Mary, and Queen Anne. Other prominent figures were: Sir Henry Vane, at one time the Royal Governor of the Colony of Massachusetts; George Fox, the founder of the Quaker faith; William Blake, who recreated the Royal Navy, and Samuel Pepys, who furthered its reconstruction. John Milton was prominent in politics as well as literature, and Locke and Hobbes, philosophers and economists, were actively promulgating their theories.

In France, this period fell almost entirely within the reign of Louis XIV with cardinals Richelieu and Mazarin as prominent policy makers in the government. From the architectural side, Mansart rose to fame as an architect in the development of a type of roof, since known by his name.

In the fine arts, in Holland this was the age of Hals, Rubens, and Van Dyke, followed by Rembrandt, van Ruisdael, and van Steen. Rembrandt and van Steen reflected the interchange of ideas between medicine and the fine arts in their paintings. Spinoza was the major figure in philosophy, contemporary with Pascal in France and Leibnitz in Germany. In Spain, under the reigns of Philip IV and V, we find a very apogee in art with Velazquez, Zurbaran, Ribera, and Murillo.

As to the scientific world at the time, Galileo and Descartes have already been mentioned. In Holland, van Leeuwenhoek was well known for his studies as a naturalist and as the inventor of the microscope. In medicine, DeGraaf was an outstanding anatomist and experimental physiologist, and in the latter part of the 17th century Boerhaave was fast becoming the most famous physician in Europe.

In Italy, there were Ramazzini, father of industrial medicine, Lancisi, a well known physician and epidemiologist, and Malpighi, anatomist and the first real pathologist. Malpighi became a member of the Royal Society of London, visited London, and presented observations before the Society.

During his long life, Wren was privileged to be a part of that galaxy of the 17th and early 18th centuries, and although his greatest contributions were in mathematics and architecture, he also was a pioneer in environmental and experimental medicine. In his earlier years he corresponded with Pascal on geometrical problems, and during his youthful days at Oxford he formed an acquaintance and interest with the leading scholars and scientists of that era. Quite apart from his close associations with the scientists and natural philosophers, he was sensitive to the humanities and arts.

At the age of 9 (1641), he could write good Latin. A few years later, shortly after he left Westminster School, he was chosen by Dr. (Sir) Charles Scarburgh as an assistant in demonstrating and making anatomical preparations. He also assisted him with experiments and with making lectures on anatomy at the Surgeons Hall. During that period he translated into Latin William Oughtred’s work on geometrical dialling.

Wren entered Wadham College in Oxford in 1649 or 1650 and immediately joined the Society of Philosophical Inquirers. He graduated with a bachelor degree in 1650 or 1651 and received his master’s degree in December, 1653. He became a Fellow of All Souls College where he remained until 1657 engaged in scientific study and experiment. It was during this period that he began his initial experiments with intravenous injections in animals. Earlier (1653), he had invented a system of double writing with 2 pens (pantographia), and about the same time, he had illustrated Thomas Willis’ book on The Anatomy of the Brain.

From the standpoint of medicine, Wren’s most fruitful period extended for a period of perhaps 7 or 8 years, beginning in 1656 or 1657. His experiments, begun while at Oxford, were continued in London when he succeeded Lawrence Rooke in the Chair of Astronomy at Gresham College in 1657. Here his rooms became the meeting place for men of science, who subsequently founded the Royal Society in 1663. In 1660-1661, he was elected Savillion Professor of Astronomy at Oxford, and in 1661 he was given the degrees of D.C.L. and LL.D. by Oxford and Cambridge. He retained this professorship until 1673 but turned more and more to architecture. He was considered next to Sir Isaac Newton as a scientist.

To go back to his physiological and anatomical experiments in London, during this period he was interested in chemistry and in furthering the dissection of animals, especially rabbits, in the study of the physiology of respiration, and in the study of diseases of cattle. He was also interested in the growth of grains, in the study of seasons, in birds and insects, in optics, in the effect of weather on diseases and wounds, in the study of mortality tables, and in the incubation of eggs. These observations were not only made by himself, but in a communication to the Royal Society about 1664, he recommended that further studies be made in all of these areas. He became interested in studies of fish and animals and in the course of his dissections discovered that lymph-ducts emptied into the receptaculum chyliae.

In 1657 he began the injection of certain liquors into the veins of animals with resulting purging, vomiting, retching, and death. "Hence arose . . . many new experiments, and chiefly that of transfusing blood, which the Society has prosecuted in sundry instances, that will probably end in extraor-

* Cf., Thomas Jefferson exhibit at Monticello, Charlottesville, Va.
dinary success.\textsuperscript{4} In 1656, he wrote to a friend, "The most considerable experiment I have made of late, is this; I injected wine and ale into the mass of blood in a living dog, by a vein, in good quantities, till I made him extremely drunk, but soon after he played it out. . . . It will be too long to tell you the effect of opium, scaramony, and other things which I have tried this way. I am in pursuit of further experiments, which I take to be of great concernment, and what will give great light to the theory and practice of physick."\textsuperscript{4} Robert Boyle witnessed these and suggested human experiments. One such with \textit{Crocus metallorum} (antimony) was tried in a timid fashion by a foreign diplomat by infusing one of his servants of whom he wished to be rid. After a very small amount of material had been injected, however, the diplomat lost his nerve as he saw the effect that was being produced. Fortunately the servant recovered!\textsuperscript{4}

Boyle in a letter in 1665 speaks of these experiments, "started with Rwen at Oxford six years agoe, long before others, as we know thought of such a thing."\textsuperscript{5} Christopher Wren, Jr., in "Parentalia," however, speaks of the first experiment on infusion being made in 1656.

Following these experiments, there was considerable dispute as to the originator of the idea of transfusion of blood. The French immediately claimed that a Benedictine friar, Robert de Gabet, had suggested transfusion 10 years previously. Not to be outdone, the Italians then came forward and stated that Andreas Libavius, a Roman, had outlined a method for blood transfusion in 1615. Libavius, however, described transfusion of blood only to condemn it and ridicule it as dangerous.\textsuperscript{6, 9}

To carry further the work with transfusion of blood, Dr. Edmund King reported to the Royal Society in November, 1667, on 2 transfusions of 9 and 10 oz. of arterial sheep's blood given into the veins of humans. These were performed successfully at Arundel House by Dr. Richard Lower and Dr. King.\textsuperscript{7} Soon similar work was reported by M. J. Denys, Professor of Mathematics and Natural Philosophy at Paris. He described how he had given calf's blood to a psychiatric patient twice with benefit. The patient was described by his wife as very irrational, a scold, constantly fault finding, and accustomed to running about the streets naked.

As this second transfusion was larger, so were the effects of it quicker and more considerable. As soon as the blood began to enter into his veins, he felt the like heat along his arm and under his arm-pits which he had felt before. His pulse rose presently, and soon after we observed a plentiful sweat over all his face. His pulse varied extremely at this instant, and he complained of great pains in his kidneys, and that he was not well in his stomach, and that he was ready to choke unless they gave him his liberty.

Presently the pipe was taken out that conveyed the blood into his veins, and whilst we were closing the wound, he vomited much bacon and fat which he had eaten half an hour before. He found himself urged to urine, and asked to go to stool. He was soon made to lie down, and after two good hours straining to void divers liquors which disturbed his stomach, he fell asleep about ten o'clock, and slept all that night without waking till next morning about eight o'clock. When he awoke, he showed a surprising calmness, and great presence of mind, in expressing all the pains, and a general lassitude he felt in all his limbs. He made a great glass full of urine, of a colour as black as if it had been mixed with the soot of chimney's. . . .

He remained sleepy all the rest of that day, spoke little, and prayed those that came to importune him with interrogatories, to give him rest. And he went on to sleep well also the whole night following. Friday morning he filled another urinal with his water, almost as black as that of the day before. He bled at the nose very plentifully, and therefore we thought it proper to take two or three small porringer of blood from him.

(This is an excellent description of the reaction to a heterologous transfusion: rapid hemolysis followed within the next 48 hours by thrombocytopenia and marked increase in fibrinolysis.) Following his recovery from the second transfusion, there was a change in his mental attitude, and he became more calm in spirit and was relatively easy to get along with. (Was this an unrecognized forerunner of shock therapy?) On the return of his symptoms, however, a third transfusion was decided upon. It was the custom to bleed the recipient of a small amount prior to transfusion. As the tubes were inserted, the patient had a convulsion and died before any blood was given. Dr. Denys was sued by the wife and dishonest legal advisers for the death of the patient as a \textit{transfusion death}, although the transfusion had been arranged largely upon the insistence of the wife and against the better judgment of Dr. Denys who was completely exonerated at the trial. The plot of the widow with the conspiring lawyers was completely exposed.\textsuperscript{6, 9}

Following the experiences of Dr. Denys, however, a law was passed in France which forbade transfusions of blood into humans. And so this valuable method of therapy, which in recent years has been abused with \textit{over} transfusions, was forgotten and lapsed into desuetude for well over 2 centuries.

From the evidence at hand, however, it would appear that Sir Christopher Wren undoubtedly was the first to have the vision and to entertain the concept of the tremendous potential of transfusion and intravenous therapy.

The similarity here is identical with the initial experiences with the healing of wounds \textit{per primum} as propounded from 1266-1320 by Lanfranc, Theodoric and de Mondeville, and their associates, only to be forgotten for over 500 years until finally firmly established by Lister.

It is interesting to note that the sheep and the calf, particularly the former, were considered the donors of choice in those days. There is no record in this initial phase of transfusions wherein a human was used as donor for a recipient. It was believed that a young animal with healthy blood made a more suitable donor than an old animal,
and it was reported that in experiments from one
dog to another that an old dog would be remark¬
edly rejuvenated by an exchange transfusion with a
young dog. Here we have a glimmer of hormones
and also exchange transfusions. Why was a calf or
a lamb preferred? One can speculate at will. Is it
possible that idea might conceivably have origi¬
nated in the references in the Old Testament to
bullocks and sheep? The bullock was commonly
the sacrificial animal. The sheep (lamb) was a
great friend of mankind in that it furnished food
and clothing, subsisted on a relatively small amount
of the scant pasturage available in the countries
of the Near East, and was a gentle creature. In the
Bible and in the Mass, there is reference to the
Lamb of God—"Agnus Dei," and "The blood of
the lamb." Hence, the lamb was traditionally the
great friend and benefactor of mankind, and therefore
its blood must perforce be beneficial.

Not only were transfusions given, following
Wren’s original experiments, but also other intra¬
vavenous therapy was attempted. A Dr. Fabricius
d of Danzig reported the intravenous administration of
laxatives with good results, although after consi¬
derable initial pain in the arm used for the
infusion.4

Robert Boyle was closely associated with Wren
during this period and participated in some of his
animal experiments. Wren likewise safely splenec¬
tomized dogs and wrote a treatise on "Motions of
Muscles" illustrated with cardboard models.5

The best known physicians in London during this
period were William Harvey (during Wren’s early
years), William Petty, Charles Scarburgh (rough),
Thomas Sydenham, Richard Lower, Edmund King,
and Thomas Willis (an anatomist). Others in his
circle were Edmund Halley, an astronomer, and
Stephen Hales, who determined the blood pressure
in a horse by a canula inserted into the jugular
vein. Another of this brilliant coterie was Robert
Hooke, physicist and physiologist, who demon¬
strated in dogs with the chest open that the lungs
themselves had no muscles of respiration and that by
a continuous stream of air into the lungs a state of
apnoea could be produced with continued beating
of the heart.6 Independently, Richard Lower had
demonstrated that section of both phrenic nerves
caused "a dog to draw his breath exactly like a
wind-broken horse" thereby stating that he had
been induced to believe "that the diaphragm is the
chief organ of respiration" and the lungs do not
possess any intrinsic respiratory muscles.7

Some of Wren’s other works closely associated
with medicine were his interest in the barometer,
which was invented at his suggestion by Robert
Boyle. During his second stay at Oxford, he be¬
came interested in the variations of the barometer
and Descartes’ theory that they were caused by
lunar actions.8

About 1661-1662, he was requested by Charles II
to prepare some drawings of insects, enlarged
through the microscope. About the same time he in¬
vented "(a planting apparatus) which, being drawn
by a horse over land plowed and harrowed, shall
plant corn equally and without waste, and the meth¬
od of making fresh water at sea."9 During these years
he also became interested in optics and invented a
method for grinding lenses.10

Following the fire of London in 1666 which de¬
stroyed most of the city and also vast numbers of
the plague-harboring rat population, Wren’s in¬
terest turned more and more to architecture, and
he was appointed Assistant Surveyor-General un¬
der Sir John Denham; upon the latter’s death he
became Surveyor. His architectural ideas for
reconstruction of St. Paul’s were too advanced for
that period so that his initial plans were rejected.
At first he thought the building could be recon¬
structed, but then he found that this was not prac¬
tical and in order to build a new cathedral on the
same site he had to develop a method of razing the
old. At first he tried gunpowder, but this was un¬
successful. And then, remembering the battering
ram of the Romans, he devised a method which we
still use today, that of a crane and heavy ball
swinging against the side of the building at strat¬
egic places so that the wall finally becomes weak¬
ened and tumbles. In 1697, 22 years after the start
on the plans for the new building, the choir was
finally opened. Wren remained at work for another
19 years when the cathedral was finished in its
main essentials, but he did not live to see the full
and final construction.

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