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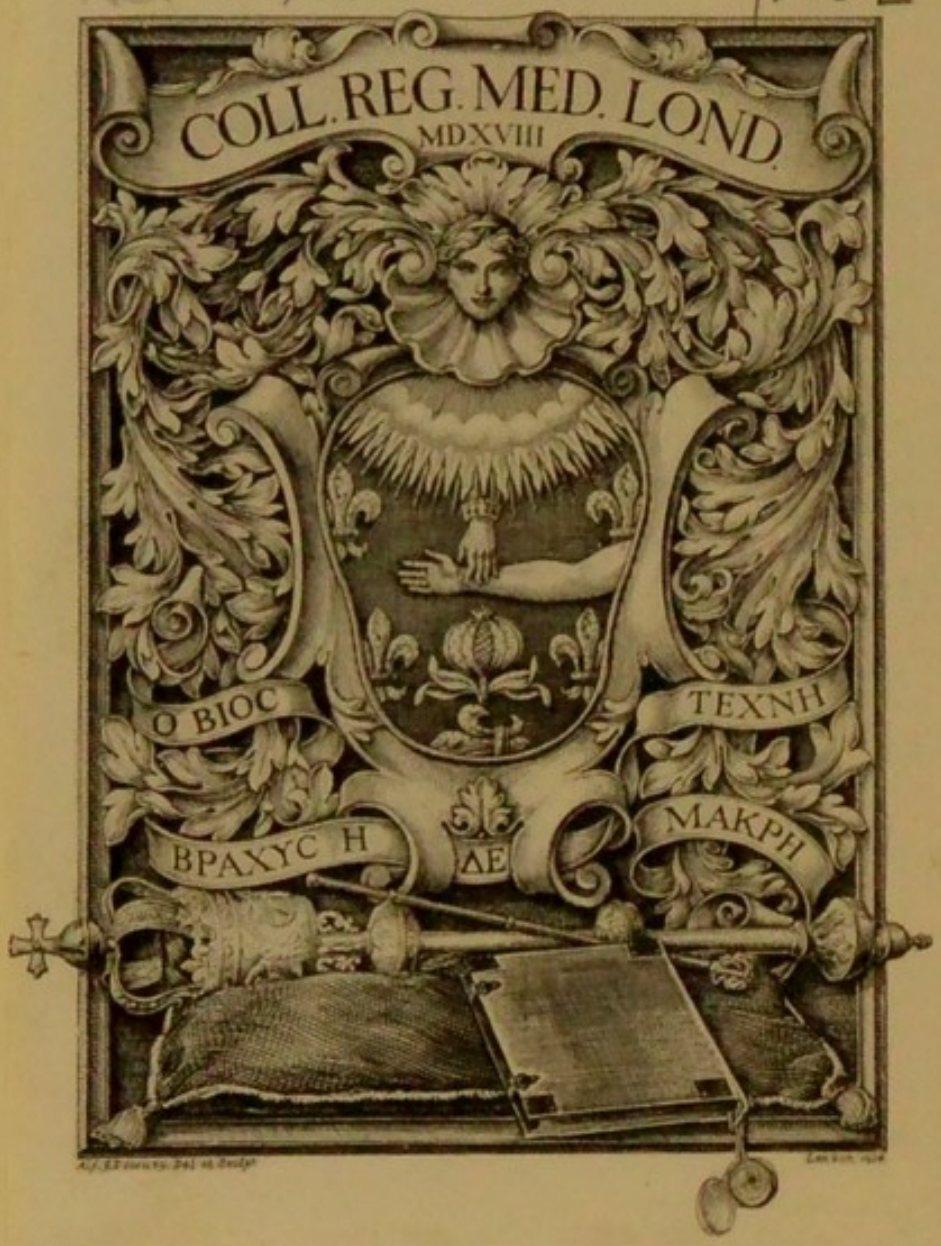

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RICHARDSON
(Sir Benjamin Ward)

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William Gilbert, the First Electrician.

TWO or three months ago a few men belonging to the walks of Science met in the rooms of the Society of Arts, with Sir William Thomson at their head, to found a new club, and to dedicate it to the name of a scholar belonging to the Elizabethan days, William Gilbert. The following evening I dined in the company of another club of learned men, one of whom surprised me by asking the question:—'Who was the man Gilbert you scientists met to name a club after yesterday?' Do you not know? 'No, really not, we none of us know, or at most know little: tell us all about him.' To the best of my ability I ventured the task, a task I had also essayed some twenty-two years agone; and during the present month I undertook to tell the same story again to a larger audience at the London Institution. As it seems to be a bit of biographical history that is of general interest, I now propose to repeat it to the large class of readers who peruse the pages of LONGMAN'S MAGAZINE.

Beyond the mere matter of biography of a remarkable person there is something of special interest connected with the life of the man now under consideration. In studying his life and works we go back to the origin of one of the greatest natural revelations that the wit of man has ever unfolded. We go to the beginnings of electrical discovery, and in fact arrive at the very term by and through which it is known. Such knowledge is useful to men of science of all lands, but to Englishmen it is doubly precious because it conveys the fact that the great revelation of electrical science and art had its birth here in this land, and was the work originally of one of our own early school of scientific scholars.

GILBERT BY BIRTH AND EDUCATION.

William Gilbert was born at Colchester in a house which still stands near to the church of the Holy Trinity. The house was

originally called the Tymperley's or Tympernells, a goodly respectable house to this day, and at one time quite a commanding residence in the fine old town. Gilbert was born in the year 1540, as the eldest son of Jerome Gilbert, gentleman, a native of the little town of Hintlesham in Suffolk, afterwards a burgess of Colchester, his position as such bearing the date 1528, and at one time, according to Symonds, Recorder of the town. The name now invariably written Gilbert was in those days written by the family, according to the loose custom of the day, sometimes Gylberd, sometimes Gilberd. According to another custom equally curious to us, Jerome Gilberd had a younger son who was also named William, so that our William was marked by his family as William Gilberd, senior. Of the early school-days of William, senior, and of his early qualities of mind we have no details, but we find that from the grammar school at Colchester he went to the University, first to Oxford, then to Cambridge. At Cambridge he proceeded B.A. 1560, Fellow, St. John's, March 21st, 1560, and M.A. 1564. After this he seems to have left England for a time, in accordance with the current fashion, to make the grand tour on the continent of Europe, going, as a matter of course, to Italy, to become, so to say, 'Italianated' before returning to his native country. Whilst in Italy he took his degree of Doctor of Medicine, probably at Padua; but the learned librarian of the Royal College of Physicians, Dr. Munk, has shown from Mr. Cooper, the classical author of the 'Athenae Cantabriginensis,' that he graduated M.D. Cambridge in 1569, and became senior Fellow of his College, St. John's, on December 21st of the same year. This would be the date of the completion of his studies and would land him in the twenty-ninth year of his age.

Three years after the time just named he was in London and had commenced to practise as a physician. As a matter of rule he entered the Royal College of Physicians, then the only fully incorporated and select home of medicine. He soon became a Fellow of the College, and rose through all the offices until he reached the highest, the Presidency. He must also have become in a certain degree popular as a practitioner, for he was made physician to the queen—Queen Elizabeth—with whom he seems to have ingratiated himself not only as physician but as physicist.

The status of medical men in the period when Gilbert flourished was, socially, complex. There were at least six classes of healers, with more or less of reasons for being called by that name. There was the peripatetic healer who went about from town to town, set

up his tent or shop, doled out his remedies with the narratives of his cures to the people, and sometimes, as at Norwich—to take one instance—had allotted to him some corner of a market or other public place, where, for the time, he stood forth a duly qualified practitioner, quacksalver though he might really be. Above this representative of so-called physic stood the apothecary, the man who kept a store or shop where he sold potent drugs, and where, if a Shakesperian picture of him and his fate may be accepted as correct, the fate endured was hard enough for one possessing a certain respectable measure of knowledge, who might be a sort of ally of the better and superior members of the faculty, as one Sambroke was to the distinguished William Harvey. Next in order came the barber surgeon, who with his hands acted as chirurgien to the heads of physic, one of the class whom Harvey did not disdain to teach as well as direct. These barber surgeons all over Europe were men of some mark. They formed themselves into guilds or companies, one of which remains in London, splendidly housed, up to this present hour. A few of these chirurgiens, like Ambrose Paré, became illustrious. The barber surgeon acted as barber really and truly, but he also operated more deeply and sharply. He bled, he dressed wounds, he cut off limbs, and he quenched blood. Sometimes, as in the case of Paré just named, he rose to such eminence that kings and nobles courted him and subjected themselves to his professional will. But more frequently the barber surgeon led a sorry life as a mechanic of the poorest sort, a kind of human-body carpenter and joiner, doing work as the assistant of a master who employed him and looked down upon him. Above these three grades there was presented at this same time a very different style of man; a man, generally, who had passed through University training and who had selected a part of that Aristotelian learning which dealt with life and its manifestations as the most choice of learned pursuits. This class of scholar had become an anatomist. He had commenced to explore the regions of the bodies of animals inferior to man, and even of man himself. A prince of this kind had arisen in Andrew Vesalius, who had given to the world, in a book of anatomy, a view of the fabric of the human frame, which all men of his kind copied, and which at the present day is copied to an extent little understood by the reading and student world at large. Licentiates and Fellows of a newly-constituted College of Physicians, of which Gilbert was one, were beginning to take up this line of work, and amongst the chirurgiens there was an

ambition of a similar order. These anatomists were laying down, in fact, the foundations of modern medicine in its most solid form, and sometimes from amongst them scientists might be found who were veritable practitioners as well as teachers of the science and art of healing. In another and almost entirely distinct order came the real physicians, the illustrious of the newly-formed college, the men who in London, at all events, held the power of practical medicine in their hands, and were the favoured of the court and of the ruling masters of their time. These were chiefly engaged in practice only. Yet certain of them, filled with a broader spirit, were intent to follow in pursuits a little aside from the beaten track. One would wander into anatomy, another into paths of literature, and even of drama. A third would play a part in the new philosophy, and in hours free from attendance upon the sick would devote time for enquiries into the mystery of the earth and in the cultivation of knowledge of nature, by trying nature by herself—that is to say, by studying natural phenomena, by and through the experimental method of research.

William Gilbert attached himself to this last-named school of medicine and philosophy. A man of vigorous and poetic mind he desired to look into the causes of natural things, and how should he look except by questioning such things from nature? Nature is a book of experiment herself; let her be read by her own devices. It was clearly in this spirit that Gilbert set forth in his work. It was not, strictly speaking, an original type of labour, for some of his contemporaries were following it. Sir Francis Bacon was following it, and, according to himself, was making a system of it which was to bear his name as the virtual founder of the method. But Gilbert was ahead of Bacon, for Gilbert was, in very fact, doing what Bacon later on described as the thing that ought to be done. Gilbert was experimenting and proving, Bacon was thinking out, and suggesting experiment.

GILBERT THE EXPERIMENTALIST.

The experimental labour which Gilbert undertook as the immortal bye-work of his life was something in strict accord with the work and progress of discovery belonging to his country and his age. Our England was becoming the mother of navigation and mother-mistress of the sea. She, through her brave sons, was ready to go anywhere. Another Gilbert had thundered forth in

the council chamber of the Queen anathema on him who should shun his country's glory, for fear or terror of death; and he, brave Sir Humphrey Gilbert, perished in the northern sea with the undying words on his lips, 'We are as near to heaven by sea as by land.' But Englishmen, cautious as brave, desired to be guided in their wanderings over the mighty deep, and had begun to use, as the mysterious self-directing guide to the courses of their explorations, the mystical magnet—'Lapis est cognomine Magnes' which Claudian had poetised and many had brought into use—as an index needle that should, in correctness, beat the stars themselves. What, therefore, finer study than the magnet for him, William Gilbert? 'Plato divinam virtutem putat.' Why should not he follow out experimentally so divine an object?

So William Gilbert began to work originally at the magnet, which work, dealing with the phenomenon of magnetic attraction, led him, naturally enough, to another phenomenon, which afterwards, by his influence, came to be known as electric attraction, and which has made him the father of electrical science, as Priestley designates him. But I must not anticipate.

It was for a period of years extending over the best and most active part of his life that Gilbert laid out and carried out his experimental labours. We have evidence that he practised medicine in London for thirty years, and it is clear from the number of particular experiments which he gathered together that a considerable section of that space of time must have been expended on his favourite pursuit. He could have taken very little leisure, for his professional cares must have been considerable, and as he was obliged to carry out his experiments largely with his own hands, making his own instruments as well as devising them, every spare minute must have been occupied. The result was that just towards the close of his life the fruits of his labours were revealed in a volume called *De Magnete*, a volume to which we must now turn as to the reflex of the man himself and the impress of him on the world. The work *De Magnete* is divided into six books, and is preceded by a preface which, in some respects, is amongst the most remarkable of all the chapters presented to 'the candid reader' and student of magnetic philosophy. It is worth a moment's contemplation this preface, which, like the rest of the work, is written in Latin, requiring some patience for the proper understanding of it.[1] He opens boldly with the declaration

[1] For much valuable aid in studying *De Magnete*, I am greatly indebted to my learned friend James Menzies, M.A.

that the earth on which we live is a great magnet, and, that the conspicuous forces of the globe may be the better understood, he proposes to begin from the common magnetic, earthy, and iron bodies; those substances which we can grasp with our hands and perceive with our senses, and then proceed to demonstrable magnetic experiments, and so penetrate, for the first time, into the innermost parts of the earth. For after many of the things which have been obtained from the heights of mountains, the depths of seas, the profoundest caverns, and buried mines, have been seen and understood, then, at last, we shall have learned the true substance of the earth. He tells us that to the investigation of magnetic force he has given a great and prolonged attention, nor did he find the labour idle, since during its progress new and unexpected properties have revealed themselves, so that he has essayed to show forth the very interior of the terrene globe, and its true substance on magnetic principles: to reveal unto men the earth, our common mother, and to point out, as with the finger, true demonstrations and experiments to the senses. He next compares the studies of terrestrial with those connected with celestial phenomena, observing that as geometry ascends from sundry very simple to very high and difficult conceptions, by which the wit of man climbs above the firmament, so the teaching of magnetic science sets forth, in convenient order, certain obvious facts out of which more remarkable ones come to light, and at last indicate order, and reveal the concealed and greatest secrets of our globe. But almost the whole of this department of natural science is new and unheard of, except what a few writers have delivered concerning certain familiar properties of the magnet. He but little approves of the aid obtained from the ancient Greek writers, because neither the poor Greek arguments nor the Greek words avail to demonstrate or cast any light upon the truth. Nor does he bring to his work any craft of eloquence or adornment of words, but aims so to explain that things difficult and unknown may be so handled by him, and so set forth, in words absolutely necessary, that they may be clearly understood. Sometimes he uses new and unusual words, not that, by means of a childish veil of words, shadows and darkness should be cast upon facts, as the alchemists are wont to proceed, but that hidden things which have no name and have never before been understood may be plainly delivered.

Such is an outline of the preface to the work, a preface to be followed by the six books which make up the volume. In the first

of these books he deals with the history of his subject, and towards the close of it he treats of the globe of the earth as magnetic, and on the magnetic stone as showing all the primary forces of the earth. He tells also how the earth by the same force maintains its fixed position in the universe. Gilbert's opinion, as thus shadowed out, is that the earth, with its masses of rocks and of waters, and all its parts whether seen or hidden from human sight, is a magnet and is possessed of all the properties known as magnetic. He considers the earth to be firmly cohering in its primary form which maintains its position and fixed polarity, and that it revolves with a determinate motion from an implanted power of movement, even as the magnet, beyond all bodies seen by us, possesses a true and genuine character little injured and deformed by external injuries. Such is our earth in its interior parts, a body possessing a homogeneous magnetic nature, as in all the magnetic metals of the earth, in veins of iron, in all kinds of clay, and in most varieties of earth and stone. By the side of this magnetic force the 'pure element' and the vain terrestrial phantasm of the peripatetic philosophers is rude, inert, cold, dry, dead, and vigourless; a something that has been seen only in dreams, and has no effect in the nature of things. But every fragment of the earth shows, by true experiments, all the force of the magnetic nature, and obeys the universal principle of the earth throughout its various motions. All is clear to Gilbert. The earth being a magnet, a first moving terrestrial cause is at work for movement of all kinds; nay, for life itself, on the earth.

It is in the second chapter of the second book of *De Magnete* that our great interest settles on the subject of electricity. The study of the attractive powers of the magnet led Gilbert to a wider contemplation of the phenomena of attractions as they are presented in nature in bodies that are neither magnetic nor magnetised. Nothing could be more probable than that his mind should be turned in the direction named. It had been known for many ages that there were certain substances which would, under particular circumstances, attract like the magnet. The one substance of this nature which has been most noted was the substance called *amber*. The story had come down from classical days of little children picking up amber, of rubbing it, and then making it, while in the state excited by friction, draw to itself light bodies to which it was brought near—bodies, for instance, like straws and feathers. To this substance *amber*, so called from the word, derived from the Persian, *anabar*, or from the Arabic *anbaron*,

the Greeks gave the name *electron* and the Latins *succinum*; and had Gilbert wished, he might have adopted the Latin word, whereby he would have given us a name for electricity entirely different from that which is now in daily and constant use. Fortunately, for all mankind perchance, he went to the Greek original, and applied to the phenomena induced by the excitation of the fossil resin, on which the story originally rests, the word 'electrical,' from which we take the word 'electricity.' Priestley called Gilbert 'the father of electrical science,' and we may add that he not only named the science, as was his bounden duty, but that he chose for it as good a name as could have possibly been chosen.

There is something quite poetical in the manner in which Gilbert refers to amber. Amber holds flies, ants, and other small creatures 'shining in eternal sepulchres,' '*æternis sepulchris relucentes.*' Amber attracts certain light substances, but it is not alone in regard to this property, therefore bodies having similar properties may correctly be called electrics. There was a new field for enquiry as to substances that were electrical. He does not attempt to enumerate them all, but after due investigation he enumerates several. Jet is an electric, so is the diamond, sapphire, and other precious stones, together with glass, sulphur, sealing-wax, and resin. He does not, however, confine electrics to those which he himself might know—a wise precaution, and one worthy so wise a man; for electrics are still discoverable, and a bit of a New Zealand gum called Kaurie gum, which came into my hands but a few months ago looking like a bit of amber, acted like it too, proving when excited to be a good electric.

For his experiments with electrical bodies Gilbert made plans as simple as they were effectual. He balanced strips of metal from their centres so that they could swing easily, and then he presented them to the excited electric. The attraction was the sign of the electrical affinity. He studied what were electrics, and he likewise studied the nature of bodies that would come under the attractive influence exerted by an electric in the active or excited state. In this line of observation he found that metals of various kinds, and various light substances, such as paper and straws, came

[1] *Succinum* seems to have been the classical word in the era of Gilbert. Thus John Louis Vives speaks of it and of its attractive powers in the line—

'Ut paleam succinum sic formam amor trahit,'

which might be freely translated—

'As amber draws the straw,
So love doth beauty draw.'

under the electric influence and held it for a certain period; but I cannot discover, as a fact or even as an inference, that he was acquainted with the phenomena of conduction or of insulation. His research after substances that could be attracted by the excited electric must have been very extensive, for it passed from solid bodies to others which, though known to be solid in our time, were considered to be spirituous or vaporous in his day. For example, he produced dense fumes from burning materials which emitted, whilst burning, a dense smoke, and then presenting to the fumes an excited electric rod he recorded the fact that the dense smoke was drawn towards the electric; but lighter vapours were not, he thought, so attracted, and he believed that the air was never attracted or moved.

The conditions of an external character which modify electrical action did not escape the attention of this early explorer. He made himself conversant with the fact that the states of the winds have an effect on the production of the phenomena. He explained that when the wind is north or north-easterly then the electric attractions are most easily manifested, while southerly winds reduce the action. Bearing on this same topic he connected dryness and moisture of the atmosphere as contributing their influence for or against electrical activity. If the air be dry and cold the activity will be increased; if the air be moist, the activity will be diminished or even nullified altogether. So effective is moisture as a reducer or destroyer of electrical phenomena that even the vapour given off by the breath of those who are near whilst experiments are in progress, may be sufficient to render the effects imperfect. In this observation he anticipated one of the greatest difficulties which beset the labours of the many electricians who long afterwards followed him, and which to this day is recognised by practical workers in electrical science.

In his simple way Gilbert essayed the experiment of electrifying water. He presented an excited electric body to a drop of water, and noticed that the drop was seen, thereupon, to assume a conical shape and form. Nearly two hundred years after his time this same experiment, conducted by the electricians on a more elaborate scale, was adduced as an illustration, in miniature, of the waterspout. Tiberius Cavallo, a prince of electricians in the latter half of the eighteenth century, expanded the simple Gilbertian experiment into one of the most beautiful of the experimental series, an experiment which became a favourite when afterwards performed with the frictional machine and Leyden

jar. Two small boards were put about two inches from each other; a drop of water was placed on the middle of the lowest of the boards, and a metallic ball fixed in the upper board was brought to the distance of an inch from the surface of the water. In this situation the upper board was electrified, whilst the lower one was connected with the earth. And now, the lower board representing the earth, the water the sea or lake, and the metal globe on the upper board a cloud, the water was drawn up into a conical shape towards the cloud; and, to compare small things with great, it represented a waterspout.

A most important study by our great pioneer is contained in a page of his mind relating to the nature of electrical action and electrical activity. With him the passage, or as we say the current, of electricity was of an effluvium which moved from one body to another, resting, as it were, by preference on certain bodies for which it had an affinity. What the nature of it might be he did not pretend to explain, nor indeed did he define the meaning of the word 'effluvium' in anything like an analytical sense. We can only assume that he meant an unctuous body of real material essence which had sufficient lightness to pass from one substance to another, with sufficient tenacity to hold to certain substances for which it had a special affinity, and to cling to them until they were charged to saturation; but which would, in course of time, be carried away by currents of air and moisture, from the substance which temporarily retained it; much in the same way as an odour, say of musk, may for a time be retained, and after a time be disseminated. The view was exceedingly natural at the first start into the investigation of the strange results that had been observed, and it held good for many a long day afterwards; held good, as Cavallo truly remarks, as long as the mere effects of electrical attraction were observed. It began to die out 'when the light, the burning quality, and the phosphoreal smell was perceived to be produced by excited electrics, and when it was suggested that the electric fluid was of the same nature as fire'—a view that has been doomed itself to go out in its turn, to glide into a theory of vibration, and then to sweep into another theory which would make the electrical fluid one with the hypothetical ether of Sir Isaac Newton, and in some measure bring back the original conception of an emanation or effluvium.

We may leave Gilbert in doubt, modestly enough expressed by him, as to the nature of electricity, but we are bound to follow him with admiration in his discourse on the relationship between

electrical and magnetical phenomena. It is a perfect marvel, one of the leading electricians who was present at the first public meeting of the Gilbert Club observed, how accurately he, Gilbert, had arrived at some of the views now considered as novel in reference to the relationships of magnetism and electricity. William Gilbert, separated from the meeting held in his honour by a gap of three hundred years, might, indeed, literally have sat down on the benches in the rooms of the Society of Arts and have discoursed there with his brethren on many points, with the facility of a modern electrician. A few of his ideas on this part of our study may here be fitly introduced.

Respecting electric and magnetic force he contended tha magnetic bodies attract by their mutual strength—a refined definition which a modern scholar might envy, and which some in much longer phrases have endeavoured to present, with less clearness and less adherence to the simplicity of truth. Then follows the distinction that while magnetic bodies attract by their mutual strength, an electrical body, when it is excited, so as to attract things to itself, alone attracts. The electric alone attracts, but the body attracted, unchanged in its natural force, is drawn spontaneously by the nature of the material of which it is composed. That is to say, it is not an electric attracting another electric, or a substance alone capable of becoming electric; but it is attractive towards the electric spontaneously. The inclination of his thoughts appears to have been to the effect that in the consideration of magnetic attraction we can only deal with bodies, ferruginous, that can take the specific properties of the loadstone and confer the same properties themselves, but to none other kind or species of bodies: in other words, that magnetic bodies become magnets by being magnetised, and afterwards act mutually towards each other; but that electrical bodies, while they will draw other bodies towards themselves, and exhibit their powers of attraction in a wide degree, irrespective of quality of substance attracted, will not by contact render any substance permanently electric, or confer the virtue of attraction to other electrics after contact is broken. He drew also a distinction in regard to the lines of attraction, magnetic and electrical. The magnet attracts at its poles directly, at other points obliquely and transversely, but electric bodies attract in a straight line towards the centre of the electric.

Again, touching the motions electrical and magnetic, he teaches that magnetism is the motion of arrangement and order,

whilst electrical motion is that of accumulation of matter. The globe of the earth is directed and moved by magnetism, and at the same time it coheres as a mass and is welded together, so that it is solid in form.

To excite an electrical body friction was, he taught, required: yet he did not consider this rule to be universal; for he had, he believed, one piece of amber which would act without being excited by friction. On this point he must surely have been in some measure deceived; for although an excited piece of amber left in a dry atmosphere will retain its power of attraction for a considerable time, there is no modern evidence to indicate that amber is capable of being made a permanent electric, ready at any time to attract without friction.

To some extent Gilbert may be considered as having foreseen what has been called in modern times the attraction of cohesion. When two drops of water run into one they cohere as one drop; and in like manner he inferred that electrical combination takes place by cohesion, and so the electric effluvium brought into contact with substances with which it can combine accumulates. Moreover, although he conveys the idea of a distinction between the electrical and magnetic states, it is as if he differentiated only as to differences of phenomena, and as if he had a foresight of the connection which exists between terrestrial magnetism and electricity.

Altogether this part of the work of William Gilbert must be accepted as one of the most curious in the whole range of science. A man of true genius, he was in his way a poet of science; but his was not the poetry of bare inspiration. He sought before he spoke, and played no hazard without experiment. A true student of nature, he knew nature as Walter Savage Landor has described her, as one who would not declare herself to the crowd nor by sound of trumpet, but whom he must question with the simplicity of a child and look earnestly in her face for a reply.

If I have dwelt long on the portions of the work *De Magnete* which treat on the subject of electrical philosophy in its birth and early days of growth, it is not because there is less important matter in other parts of the work. In the six books there are many more lessons of far-reaching character. In these the magnetic motions are described: the direction of the magnetic needle; the variation of the needle; the declination of the needle; and numerous arguments and speculations having reference to the one grand theme that the earth is a mighty

magnet. He explains to us how out of magnetic material he made a terrella or little earth, and gave to it form, so that, like the earth, it had its poles, its equator, and its terrestrial lines. He demonstrates on this minute globe the directions of the magnetic needle. He divides his artificially constructed globe and points out how the polarities are produced and how a divided magnet makes its own poles. He interposes a globe of iron between a terrella and a magnetic needle, and shows a continued polarity through the interposing medium. Here and there throughout the volume we meet with passages of quite poetic beauty, of which the following is a specimen. He is dealing with the subject of the magnet and the magnetic force, and is comparing the magnetic force with the vital, in the twelfth chapter of the fifth book; and, as if taking a visionary sight from a tower of experiment, he communes with himself and the future. Magnetic force he imagines resembles vital or living force, and is even something that surpasses the vital; since the vital is confined to the organic animal body. It is, as it were, the vital force set free and displaying itself, unconfined, as a living phenomenon. This is the one remarkable virtue which the ancient philosophers considered to be life, in the heavens, in globes, in stars, in the sun and the moon, which could not be maintained except by a divine and living force, for without such a force how could vast bodies revolve in fixed terms, or how could such wonderful powers be infused into other bodies through the primary forms of the globes themselves? The ancients, the whole Platonic school, the Egyptians, the Chaldeans, affirm that the universe is endowed with life; a view far superior to that derived from Aristotle which would endow the stars with the animate principle, and would deny the same to the elements. For his own part he, Gilbert, believes that the whole creation, all globes, all stars, and the glorious earth itself, are governed, from the beginning, by a proper and determinate life and have their own movements of self-preservation. There are not, it is true, either in the stars, the sun, or the planets, any organs which we are able to recognise as such; yet they live. If there be anything of which man can boast, assuredly it is life. God Himself, by whose will all things are ruled, is intelligence, is mind. And who will demand organs in the Divine Mind, which overpasses all the framework of organs and is not restrained by material organs? But in the stars, the force implanted in them acts differently from that which exists in those divine attributes which are beyond the ordinary nature;

and in the stars also the force acts differently than it does in animals, and in animals differently than it does in plants. But miserable were the condition of the stars, wretched the condition of the earth, if the stars and the earth were denied that glorious dignity of life which is granted to the worm, the ant, the moth, the plant, and the toadstool.

From such readings as the above it might be assumed that Gilbert grasped, by an accidental foresight, the idea now current that there is in nature but one kind of primary influence or force, and that the same is universally distributive and active throughout all the universe. The argument is not wanting in plausibility, for, although he seems to have considered electric phenomena as distinct from magnetic, yet this distinction merely relates to action under differing conditions and states as apart from principle of action; and, in regard to what is called vital action, he certainly goes exceedingly near to an affirmation that vital force is one and the same with what would now be denominated physical force. The title of the chapter just commented on can convey no other impression—*Vis magnetica animata est.*

As the work *De Magnete* professed, rightly, to be experimental, so it was befitting that it should be freely illustrated. It is full of illustrations, so full that there is not one important experimental demonstration that is not made plain by a diagram or a figure. There is a diagram of the balanced needle, a needle of three fingers length, resting on a point, with which he made tests of attraction, repulsion, and the like. There is a drawing of another needle floating in a vase of water, and supported by means of a cork, so as to show variation and declination. There are drawings of terrellæ and of what is called the '*orbis virtutis*,' showing positions of magnets at various angles on the globe. There are sketches of magnetic rods and terrellæ indicating laws of polarity. There is a rough but striking picture of a blacksmith's shop in the Elizabethan days, with the smith at work hammering a piece of iron for the purpose of an experiment; and, in the first chapter of the fifth book, on the subject of declination, there is a drawing of a compass which indicates excellent artistic skill and workmanship. In due course the Council of the new Gilbert Club will give the public all these illustrations in combination with the complete text in the English tongue. The brief summary I have ventured to produce in this place will then be filled up, and, for the first time, a book which cost Gilbert eighteen years of labour and research will be accessible to all readers.

Gilbert, the Physician.

The character of William Gilbert, as a man and as a practising physician, can only be inferred, contemporary biography having left poor traces of him. That he was esteemed as a practitioner of medicine is certain, since he became Physician to the Queen, a position in his day meaning a great deal and carrying with it a widely spread acceptance of scientific learning and skill. Further, in the Royal College of Physicians he took, from the first, a leading place. He was one of the Censors of the College from 1581 to 1590; he was Treasurer from 1587 to 1594, and from 1597 to 1599; he was Consiliarius 1597–99, Elect 1596–97, and President 1600. The facts give to him a commanding position, sustained by the further fact, that on the death of the Queen he was appointed Physician in Chief to her successor, James the First.

An engraving lies before me done by Clamp, in which the likeness of Gilbert is delineated. It represents him as a man who had passed the middle age, but who was of firm and thoughtful countenance; and yet, if I mistake not, a man of cheerful and even playful humour. A sort of subdued smile sits on his face, as if the painter had told him to assume, for the moment, his most serious expression, and as if the effort were rather perplexing. The forehead is bold and finely shaped, the eyes keen and penetrating, the nose well formed and strong, the lips compressed, the chin less firm than the lips, but not retreating; the cheeks rounded, and the lobe of the ear large, a sign—according to *Laycock*—of a good cerebral circulation. He wears a moustache in this picture and a short beard, minus whiskers, and is topped by a tall hat with a somewhat narrow turned-up brim. Around his neck is the linen plaited abundant frill, borrowed in design, I believe, from Muscovy, in regard to fashion; and his body is enveloped in a dark robe, possibly the collegiate or doctorial robe of his day. In front the robe presents a row of fourteen starlike buttons with quilted vest surface and with large sleeves, from which a comely shaped pair of hands project, the left hand resting on a terrestrial globe. The picture is stated to have been painted by Harding, but I can find no painter of that name connected with the time, and inasmuch as the plate says the likeness was 'from an original picture in the Bodleian Library at Oxford,' and that it was published as a plate by S. S. E. Harding of Pall Mall, in the year 1796, it may be that

it was a copy, from the Oxford original, now lost, by one of the Hardings, probably the father of the water-colour painter James Duffield Harding, who was the son of an artist living at the latter part of last century.

The reflection we gather of Gilbert from the portrait suggests the idea of a close student and a retiring man. He was nevertheless so well appreciated that the Queen, sending for him to the Court, not only made him her physician, but allowed him an annual pension to enable him to pursue his studies, and to him alone of all others bequeathed a legacy. A bachelor to the end of his days, and obviously one who saved his means as well as his time, he died wealthy, leaving by his last will his library, consisting of books, globes, instruments, and a cabinet of minerals, to the Royal College of Physicians. After the death of the donor these treasures were safely deposited with the College by his executors, his brothers Ambrose and William; but in course of misadventure they have, unfortunately, all been lost.

I should imagine that in his later days Gilbert returned to his native place, Colchester, where he had become, according to Wood, the chief person, and where he died eight months after the death of the Queen, whose junior he was by seven years. He was buried at Colchester, in the Church of the Holy Trinity, hard by his birth-place and death-place; and over his tomb, in the chancel, his brothers raised a handsome monument with a Latin inscription, which still remains and which I herewith reproduce in translation.

AMBROSE AND WILLIAM GILBERD HAVE PLACED THIS TOMB,
IN MEMORY OF BROTHERLY PIETY
TO WILLIAM GILBERD, SENIOR, GENTLEMAN, AND DOCTOR OF MEDICINE.
THIS THE ELDEST SON OF JEROME GILBERD, GENTLEMAN,
WAS BORN IN THE TOWN OF COLCHESTER,
STUDIED THE ART OF MEDICINE AT CAMBRIDGE,
PRACTISED THE SAME FOR MORE THAN THIRTY YEARS AT LONDON
WITH SINGULAR CREDIT AND SUCCESS,
HENCE, CALLED TO COURT, HE WAS RECEIVED WITH HIGHEST FAVOUR
BY QUEEN ELIZABETH,
TO WHOM, AND TO HER SUCCESSOR JAMES, HE SERVED AS CHIEF PHYSICIAN.
HE COMPOSED A BOOK CELEBRATED AMONGST FOREIGNERS CONCERNING
THE MAGNET, FOR NAUTICAL SCIENCE.
HE DIED IN THE YEAR OF HUMAN REDEMPTION 1603, THE LAST DAY OF
NOVEMBER,
IN THE 63RD YEAR OF HIS AGE.

A Summary.

The inscription which the brothers Gilbert composed in memory of their illustrious relative savours naturally of affection as well as of pride, for the brothers of Gilbert, like those of his contemporary and fellow immortal, William Harvey, were right loyal admirers and lovers of the light of their family circle. But others beyond them, others whom no family endearment influenced, have borne such independent testimony to his genius and his industry that it becomes a wonder how in this age of electrical miracles he should have failed to have become a household word, a word as familiar to us as that which he originally suggested—electricity. Near his own time men of the highest position in science and learning gave to him the fullest approbation. Galileo pronounced him great to a degree that might be envied, and Dr. Munk repeats a statement that it was by a perusal of *De Magnete* that Galileo was induced to turn his mind to magnetism. Sir Francis Bacon admitted that *De Magnete* was a painful and experimental work, which observation, cold as it is, serves to convey that it was a work the value of which, founded on labour, could never lose its true place in history. Nicolas Pieresc, the Attorney-General of the Republic of Letters, as Bayle has designated him, often lamented that when he was in England he did not become acquainted with so great a man. Carpenter, in his work 'Geography Delineated,' expresses the opinion that Gilbert had trodden out a new path to philosophy. Sir Kenelm Digby compared him with Harvey, the discoverer of the circulation of the blood, a comparison certainly very happy, for in almost all essential particulars, as experimentalist, as expositor, as professor, and as learner by sound induction, Gilbert and Harvey are alike to the letter—as much alike as they were in being Royal Physicians and most devoted Fellows of the Royal College of Physicians. Barrow places Gilbert side by side in fame with Galileo and Descartes; and good old Fuller, always happy at similes, says, that as Mahomet's coffin at Mecca is said to hang up attached by one invisible loadstone, so the memory of this Doctor, William Gilbert, will never fall to the ground. His incomparable work, *De Magnete*, will support it to eternity.

During last century Gilbert passed largely out of memory, a fact which at first carries with it some surprise, considering that in last century the study of electrical phenomena first began

seriously to attract the attention of men of science, and through them the world at large. The surprise decreases, however, when we discover the sudden flood of new light which broke in and illumined the subject after the marvellous and original researches of Stephen Grey; the invention of the frictional machine; the singular discovery of the Leyden jar; and, to the world at large, the still more singular discovery of the identification of electricity with lightning and the practical application of the lightning conductor. These overwhelming disclosures, far more wonderful, really, than any that have been made in our own time, put out of recognition the little beginnings with which the name of Gilbert is connected. Still he had his admirers even in the midst of the most brilliant triumphs of later discoverers. The just and watchful Priestley accorded to him the first place, reviving also many of the facts that have been collated in these pages, and, although thinking that in some things he was fanciful, as in regard to the permanent electricity of a certain piece of amber, and in other things whimsical, as when he infers that electrical bodies only attract whilst magnetical bodies attract and repel, concludes his criticism with the statement—

'Such were the discoveries of our countryman Gilbert, who may justly be called the father of modern electricity, though it be true that he left his child in its very infancy.'

In our own time one man of true fame and honour, the historian of historians, Hallam, has rescued William Gilbert from obscurity and has presented him in a position of honour and light which none but such a brilliant historian could have depicted. The year 1600, he tells us, 'was the first in which England produced a remarkable work in physical science, but this was one sufficient to raise a lasting reputation to its author, Gilbert, a physician, who in his Latin treatise on the magnet not only collected all the knowledge which others had possessed on that subject, but became at once the father of experimental philosophy in this island, and, by a singular felicity and acuteness of genius, the founder of theories which have been revived after the lapse of ages and are almost universally received into the creed of science. The magnetism of the earth itself, his own original hypothesis, could not be confirmed by all the experimental and analogical proof which has rendered that doctrine acceptable in recent philosophy; but it was by no means one of those vague conjectures which are sometimes unduly applauded when they receive a confirmation by the favour of fortune. He relied on the analogy of

terrestrial phenomena to those exhibited by what he terms a terrella or artificial spherical magnet, and it was evidently by the torch of experiment that he was guided.' 'Gilbert,' adds Hallam, 'was one of our earliest Copernicans, at least as to the rotation of the earth, and, with his usual sagacity, he inferred, before the invention of the telescope, that there are a multitude of fixed stars beyond the reach of our vision.' This is a view of Gilbert above almost all others the most appreciative; it places him in the highest rank of men of science, even of to-day, and it leaves us in marvel as to what he would have achieved had he had the good fortune to be one with us. It supports, moreover, with strict accuracy, the opinion of another critic, the historian of the Royal Society, Thomson, that *De Magnete* is 'one of the finest examples of inductive philosophy that has ever been presented to the world.'

A Posthumous Work.

The great work *De Magnete* was published in the year 1600, but it was not the only work which its author had prepared. He left behind him a volume entitled *De Mundi Sublunari Philosophia Nova*. This volume remained in manuscript in the library of Sir William Boswell Knight, and after nearly fifty years of seclusion was published by William Gilbert, junior, then a proctor in the Court of Arches, the same brother of William, senior, who took part in raising the monument in the Church of the Holy Trinity at Colchester. The book appeared with a dedication, by the editor, to the unhappy Henry, Prince of Wales, the friend of Sir Walter Raleigh, and one of the truest lovers of science. There was also another book written soon after *De Magnete* by Thomas Blondeville, descriptive of two ingenious instruments which Gilbert invented for the use of seafaring men, by which they were to be able to find out the latitude of a place without the aid of sun, moon, or stars. These works have not received such favour and attention as *De Magnete*, but now that a Gilbert Club has been established, they too, I doubt not, will appear in an English dress, and will take their proper place in the record of the life-work of the first master in experimental science of this mother-land of the practical sciences; a master still shining in his eternal sepulchre.

Benjamin Ward Richardson.