

## The Genesis of the Royal Society.

By Dr. IRVINE MASSON.

THE origin of the Royal Society is frequently traced to the meetings of virtuosos in Oxford before the Restoration. In point of fact, these meetings represent the second of four stages which mark the evolutionary process, of which the following brief account is derived chiefly from contemporary works and manuscripts.

We may pass over the several abortive attempts to found educational colleges on a Baconian plan, which were made in the years following 1640; few were conceived in the real spirit of the new philosophy, most were in any case unpractical, whilst the only one which seemed likely to win government sanction—that of Hartlib and Comenius, in 1641—was frustrated by the outbreak of civil troubles.

Of the actual beginning, there is in the British Museum a very definite account from the hand of the Rev. John Wallis, the mathematician, who was himself one of the leaders throughout all four stages of the Society. This account occurs as a side-issue in an otherwise uninteresting polemical tract which he published in 1678; and in 1697 he repeated the main substance of it in a private letter which, by a series of curious chances, found its way into print in 1725. References in the early letters of Boyle, Hartlib, and Petty, and statements by Hooke, corroborate the story at essential points. It is best to quote from Wallis's actual words; and passages from his letter of 1697 are interpolated in square brackets.

"I do acknowledge . . . that those meetings<sup>1</sup> might be somewhat conducing to that of the Royal Society which now is. But (without disparagement to Bishop Wilkins) not, that 'the first Ground and Foundation of the Royal Society'<sup>2</sup> was there laid. Which I take to be much earlier than those meetings there.

I take its first ground and foundation to have been in London [at a time when, by our civil wars, academical studies were much interrupted in both our Universities] about the year 1645 (if not sooner), when the same Dr. Wilkins . . ., Dr. Jonathan Goddard, Dr. Ent, Dr. Glisson, Dr. Scarbrough . . ., Dr. Merrit, with myself and some others, met weekly . . . at a certain day and hour, under a certain penalty, and a weekly contribution for the charge of experiments, with certain rules agreed upon amongst us."

The scope of the inquiries of the "Philosophical College," as they called themselves, or "Invisible College," to use Boyle's term, is next given. Debaring matters of theology and State affairs, they confined themselves to—

"Philosophical enquiries, and such as related thereunto; as physick, anatomy, geometry, astronomy, navigation, staticks [magneticks, chymicks], mechanicks, and natural experiments. We there discoursed of the circulation of the blood, the valves in the veins [the venæ lactæ, the lymphatic vessels]"—thus far the medical sciences—"the Copernican hypothesis, the nature of comets and new stars, the attendants on Jupiter, the oval shape of Saturn [the spots on the Sun, and its turning on its own axis], the inequalities and selenography of the Moon, the several phases of Venus and Mercury; the improvement of

telescopes, and grinding of glasses for that purpose (wherein Dr. Goddard was particularly engaged, and did maintain an operator in his house for that purpose)."

In addition to these astronomical studies, they dealt with—

"the weight of the air, the possibility, or impossibility, of vacuities, and Nature's abhorrence thereof, the Torricellian experiment in quicksilver, the descent of heavy bodies, and the degrees of acceleration therein, with other things of like nature. Some of which were then but new discoveries, and others not so generally known and embraced as now they are [with other things appertaining to what hath been called the New Philosophy, which from the times of Galileo at Florence and Sir Francis Bacon (Lord Verulam) in England, hath been much cultivated in Italy, France, Germany, and other parts abroad, as well as with us in England].

Wallis mentions, in his second account, that the convening of these meetings was, he thought, suggested by Haak, a Palatine German who had settled in England and is otherwise known as a writer on behalf of the Council of State.

The meetings were, says Wallis, held at Goddard's house and at the Mitre Tavern near by in Wood Street. Within a short time, however, they removed to the Bull Head Tavern and, in Term time, to Gresham College. Here they used to attend the weekly astronomical lecture given by Samuel Foster (one of their number), and immediately afterwards they met, either in his rooms in the College, or at some other convenient place; and their numbers increased.

Of the members named, scarcely any were more than thirty years of age. Wilkins, a leading spirit, had been trained at Oxford; Wallis and several of the others were Cambridge men. It is quite clear, from statements made elsewhere by Wallis, that it had been at the University that the seeds of Bacon's principles had been sown in these men, who, born at nearly the same time as the "Novum Organum," became the first agents of its real propagation when they came together in London.

Within a year of the foundation of the club, Robert Boyle, newly returned to England, became their youngest member, and was given an appreciative welcome. Later, his visits from his Dorset manor necessarily became intermittent; but we may note that it was these meetings which first drew him to be "Innited among the Spagiriks." At about the same time, Hartlib introduced William Petty, then at the outset of the remarkable career in which he founded on one hand a science—statistical economics—and on the other, the fortunes of his line: both of which account for the way in which his great-grandson, Lord Shelburne, befriended Joseph Priestley and Jeremy Bentham.

The Invisible College continued; but in 1648 and 1649 the parliamentary "Purgation" of the Universities transferred to Oxford the chief corner-stones of the society: one after the other, Wilkins, Wallis, Goddard, Petty, were appointed in the room of deposed

<sup>1</sup> At Wadham College, Oxford.

<sup>2</sup> Quoted from his antagonist, Dr. Holder.



academic heads. It seems that the Philosophical College still went on, but beyond this nothing is known of it for some years; the centre of gravity had shifted, and the second phase is at Oxford.

Wilkins and the others, together with Seth Ward, Bathurst, and Willis the physician, formed a new branch, and for some four years regular and successful meetings were held, while the membership grew. No minutes are known to survive,<sup>3</sup> but there is a set of rules of 1651 which recalls the customs of the parent society, already indicated. The meeting-place was the apothecary's shop under Petty's lodging, which served as the magazine on which they drew for their material.

After a time, when Petty departed to Ireland in 1652 as surgeon to the Forces, the gatherings became less popular; and it was now that they were transferred to Wadham College, where Wilkins kept his collection of curios and instruments. In 1654, Boyle settled in Oxford; and thenceforward there was no lack of experimental matter. Further impetus was added by the accession of that extraordinary pair, Christopher Wren and Robert Hooke—so similar in the trend of their scientific genius, so different in their natures—and in astronomy, physics, chemistry, physiology, the bases of experimental discovery were now being gradually laid or confirmed. Wren was a principal in the first injection of fluids into the veins, together with his senior, Willis; Boyle was amassing that knowledge of chemistry which enabled him to write the Old Testament of the science, "The Sceptical Chymist"; Hooke was developing instruments which in their eventual forms are used to-day.

Hooke in his recollections says that no collective records were kept during this period: and since, in a letter of February 1657, Petty expresses his pleasure at hearing that "the club is revived at Oxford," it appears that for some time formal meetings had been in abeyance. Wallis expressly confirms this; he says that the "set meetings" were in 1659-1660 "disused, and had been for a good while"; and he adds "what was of this nature at Oxford (about experimental philosophy) in these days, was rather at Mr. Boyl's lodgings, than at Wadham College." London, according to Wallis, became the venue, where Rooke's lecture, like Foster's ten years before, attracted them weekly; and it is certain that after 1657, when Wren succeeded to the chair of astronomy at Gresham College, his weekly lecture was the occasion of regular discussions, and it became increasingly the practice of the Oxford virtuosos to come to London to partake in these. This represents the third stage, and it continued, with interruptions, up to the Restoration.

At Gresham College, after Wren's two o'clock lecture on November 28, 1660, twelve being present (Wilkins, Goddard, Boyle, Petty, Rooke, Wren, Lord Brouncker, Ball, Hill, Sir P. Neile, Sir R. Moray, Bruce), they decided to put their gatherings on a formal basis. Wilkins was elected chairman, Ball as treasurer, and Croone as registrar; a provisional set of rules was framed, and a list of forty-one eligible for membership was made. Next week the King's approval was notified, and Moray was elected president; and with the request that Mr. Wren prepare against the next meeting for the

pendulum experiment, the concerted work of the new society was inaugurated.

A year and a half later (July 15, 1662) the charter was sealed which formally incorporated "The Royal Society for the Improvement of Natural Knowledge." Lord Brouncker was first president of the Royal Society, Wilkins and Oldenburg (actually the latter only) were the secretaries. The motto "Nullius in verba" was John Evelyn's choice.

It should be understood that the papers communicated were not read with the view of publication; for, during the first ninety years of the Society's existence, no official journal was issued. The Philosophical Transactions, which first appeared in 1665, were, until 1750, a private enterprise of the secretary, published at his own expense and sold to fellows and to the public for his own profit; the Council merely kept a watchful eye upon them, and in some measure acted as guarantor. Frequently a paper which had been delivered to the Society would be copied into the Phil. Trans., appearing there among other scientific news from home and abroad, book-reviews, and articles; but the important researches were usually published by their authors in books, sometimes under the imprimatur of the president. At the same time, the Phil. Trans., in Oldenburg's hands, did valuable propagandist work for science, and, in conjunction with the foreign correspondence which the Society maintained officially, lent a powerful aid to the founders of the scientific societies of Europe, which were largely formed on the London model. The early Phil. Trans. can be fairly described as the NATURE of the seventeenth century.

At Gresham College the Royal Society maintained a research laboratory, and in 1663 it obtained from Boyle the invaluable services of Robert Hooke, who was made its salaried curator of experiments. The subjects for investigation were usually chosen by discussion at the meetings; and the curator or individual fellows were asked to carry out the necessary work at the College or in their own laboratories. The reports on these, and the directions of the Society as to the further course of the work, were recorded by the secretary in the books. Here were also registered the reports of the sub-committees, appointed to investigate industrial processes at home and to organise scientific observations in remote places.

The following notes, selected from the years 1660-1661, give some indication of the varied activities of the Society at this time:—

"The experiment of the compression of water was directed to be tried by Dr. Wilkins and Dr. Petty.

Experiments were made at the Tower of London on the weight of bodies increased in the fire.

Dr. Clarke was intreated to bring in the experiment of injection into the veins.

Sir Kenelme Digby related that the calcined powder of toades reverberated, applyed in bagges upon the stomach of a pestiferate body, cures it by severall applications. "But the truth is, Sir Kenelme was an errant mountebank" (Evelyn).

Mr. Boyle brought in an account . . . of the experiment hee made of the compression of aire with quicksilver in a crooked glasse tube. . . .

Dr. Goddard was desired to give an account of his dissection of the chameleon.

That the Society write to Mr. Wren, and charge

<sup>3</sup> Except these which begin in 1683 and continue to 1690, when the Oxford Society appears to have ceased.



him . . . to make a globe of the moon, and likewise to continue the description of severall insects.

A report was made of the trial of the diving engine at Deptford on Friday preceding, by the amanuensis, who stayed in it eight and twenty minutes under water.

Mr. Henshaw read his History of the Making of Saltpetre.

Mr. Boyle to try the velocity of sounds."

Space does not permit the description here of the great number of tests, measurements, and reports which were brought forth; the names alone must suffice to recall the fundamental character of many of the researches produced. Boyle, Hooke, Wallis, Petty, Wren, Willis, Glisson, of the original fellows; Newton, and Mayow, among those who followed soon, are all household names in their sciences to-day; and the records speak of many others, less familiar now, but still valuable contributors to learning who were rightly honoured in their day.

It is evident from Pepys' and Evelyn's diaries, as well as from surviving correspondence, that the activities and the aims of the Society made a wide appeal among educated people; and there is in the British Museum a long and amusing doggerel poem which shows how strong and affectionate a respect was inspired among its lay supporters of the early 'sixties. Hostile critics were, naturally, not lacking, and it was to answer these that Sprat was egged on by Wilkins and others to write his well-known "History of the Royal Society," and

that Joseph Glanvill produced his delightfully vigorous "Plus Ultra."

The fundamental principle upon which the Society was based, as is clear from many documents both official and private, was the Baconian doctrine. Croone writes in 1661—

" . . . you may please to understand that this Company do's not take upon it selfe to assert any one hypothesis, but every man is left at present to his Freedom; for they believe that to make any Hypothesis, and publickly owne it, must bee after the triall of so many exp'ments as cannot be made but in a long tract of time."

In the draft of a minute, probably written by Hooke about 1663, and now in the British Museum, we find—

" This Society will not own any Hypothesis, Systeme, or Doctrine of the principles of Naturall Philosophy, proposed or maintained by any philosopher Auncient or Moderne, nor the explication of any phaenomenon, where recourse may be had to originall causes. . . . Nor dogmatically define, nor fix Axioms of Scientificall things, but will question and canvas all opinions, adopting nor adhering to none, till by mature debate and clear arguments, chiefly such as are deduced from legitimate experiments, the truth of such positions . . . be demonstrated invincibly."

Boyle's "Sceptical Chymist" is, of course, an outstanding exposition of the same theme, upon which the whole existence of the Royal Society rested, and rests.

## The Natural History of the Common Eel.

By J. T. CUNNINGHAM.

THE propagation of the eel was a mystery not only to ordinary people, but also to naturalists, from the time of Aristotle to the end of the nineteenth century, and continued to be a mystery for years after the breeding and development of many other fishes, both marine and fresh-water, had been successfully studied and investigated. At present our knowledge of the development of the eel is almost but not quite complete, and the extraordinary facts of the matter have been brought to light chiefly by the adventurous and persevering efforts of the Danish naturalist, Dr. Johannes Schmidt, of Copenhagen, who has published a memoir on his researches in the Philosophical Transactions of the Royal Society of London and has described them in articles in NATURE (August 22, 1912, and January 13, 1923).

The gradual elucidation of the history of the eel started from our knowledge of a very curious group of fishes named Leptocephali, which means "Small-heads." They were so named from the fact that the head is very small in proportion to the body, which is like a narrow ribbon  $\frac{1}{2}$  to  $\frac{3}{4}$  in. in breadth and from 3 to 6 in. in length. The surfaces of the ribbon are the right and left sides of the fish, so that the breadth is vertical in the natural position, and the whole creature is perfectly transparent. The newly hatched young of many fishes are transparent, but they are usually of minute size, while the Leptocephali are much larger. These remarkable creatures had been collected from time to time, some at the surface of the ocean in various parts of the world, some cast on the shore in England

or other parts of Europe. Various species of them were distinguished, but for a long time there was nothing to show what relation they bore to other fishes. It was evident that they were not mature, and some naturalists suggested that they were monstrosities, that they were the young of some ordinary fishes which from time to time were accidentally carried into mid-ocean by currents, and there went on growing in size without advancing in structure, that they were in fact overgrown fish-larvæ which were unable to complete their normal development because they had been removed from their normal conditions of life. Gradually, however, evidence presented itself that these Leptocephali were connected with the eel family.

Although there is only one fresh-water eel in Europe and another very similar in North America, there are many species of the same family in the sea, some living at moderate depths and some in the deep abysses of the ocean. On the Atlantic coasts of Europe there is only one marine species, the well-known conger, which reaches 7 or even 8 ft. in length, but there are several species in the Mediterranean, one of which, the *Muræna*, was a favourite article of food to the ancient Romans. The species of the eel family are similar in certain important features of structure to the herring family, the salmon family, the carp family, and others, but they are distinguished by the entire absence of the hinder pair of fins. In this and other details of structure, such as the number of the vertebræ, the Leptocephali agree with the eels. In particular the *Leptocephalus morrisii*, several specimens of which form had been captured