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42-53 minutes

(*b*. Naples, Italy, January 1608; *d*. Rome, Italy, 31 December 1679)

astronomy, epidemiology, mathematics, physiology (*iatromechanics*)

physics, volcanology.

Borelli is not as widely known or appreciated as perhaps he should be. What reputation he has is based upon his mechanics, including celestial mechanics, and his physiology or iatromechanics. The former, unfortunately, was quickly and completely overshadowed by the work of Isaac Newton; and his iatromechanics, although important and influential, was too much informed by what proved to be a relatively sterile systematic bias to bear much immediate fruit. Accordingly historians have undervalued his place in the development of the sciences in the seventeenth century, and they have paid little attention to his career or his personality. (There has been no lengthy treatment of his life since the eighteenth century, and important and elementary biographical information is still hard to come by.) But he was highly respected by his contemporaries. He read widely, and he drew his scientific inspiration from a broad spectrum of the heroes and near-heroes of the early seventeenth century: such men as Galileo Galilei, William Harvey, Johannes Kepler, and Santorio Santorio. He worked on many problems, contributed significantly to all the topics he touched, and in fact played an important part in establishing and extending the new experimental-mathematical philosophy. He was brilliant enough scientifically to be very much ahead of his time, even if he was not quite brilliant enough nor free enough from other commitments to produce general synthetic solutions in his fields of interest which would be either successful or entirely convincing.

During the century prior to Borelli's birth, Italians had been in the forefront of the late Renaissance effort to translate and master the Alexandrian astronomers, mathematicians, and physiologists. By the end of that century many had learned all they could from the past and had begun to strike out on their own. Galileo's telescopic discoveries only dramatically underscored the fact that major innovations were underway in all fields of natural philosophy. And they also indicated that the Italians could be expected to continue playing a leading role in these new enterprises. But during Borelli's lifetime the world saw Galileo condemned for his innovations, the Lincei persecuted, the Cimento disbanded, and the Investiganti of Naples suspended, It also saw the death, in the decade of the I640's of many of Galileo's most talented disciples: Benedetto Castelli, Bonaventura Cavalieri, Vincenzo Renieri, and Evangelista Torricelli. Borelli's Italy rejoiced over the conversion of Queen Christina of Sweden and perhaps was as much interested in the fact of Nicholas Steno's conversion as in his scientific accomplishments. Moreover, it was a politically fragmented Italy, portions of which were absorbed in struggles to throw off oppressive foreign domination. And later on its best investigators, for example, Marcello Malpighi and Gian Domenico Cassini, had to find recognition and support north of the Alps. In sum, the new philosophy faced distracting competition and even open hostility from several quarters, and in the long run the Italians could find neither the wherewithal nor the enthusiasm to support science in the ways it was beginning to be supported elsewhere. Borelli's career, then, is an illuminating record of an original scientist who was also politically active in Counter-Reformation Italy. Borelli himself ended his life in political exile in Rome—poverty stricken, teaching elementary mathematics.

Borelli's birth was not auspicious. As part of their rule of southern Italy at the turn of the century, the Spanish maintained military garrisons in the three principal fortresses of Naples. On 28 January 1608, a Spanish infantryman, Miguel Alonso, stationed at Castel Nuovo, witnessed the baptism of his first son, Giovanni Francesco Antonio. The mother was a local woman by the name of Laura Porrello (variously spelled in the records as *porrello, porrella, borrella, borriello, borrelli*). The couple went on to have one daughter and four more sons, including a Filippo baptized 9 March 1614. In later years both Giovanni and Filippo used Borelli as a family name; Giovanni dropped two of his baptismal names but retained an Italianized version of his father's name in their place. Why they did this perhaps can be guessed from the circumstances of their early years.

In November 1614 Tommaso Campanella was returned to Castel St. Elmo, where he had previously been confined. Meanwhile Miguel Alonso had been ordered to Castel St. Elmo. Just after Campanella's return, Miguel became implicated in some serious offense and was arrested along with several other persons. Although it is not known for certain what the alleged crime was, responsible sources suggest that there may have been a conspiracy to free Campanella. In any case the interrogations and trial took place in secret, and during the summer of 1615 Miguel was found guilty and sentenced to the galleys. Upon his certification that he was unable to serve in the galleys the sentence was commuted to exile. Miguel seems to have gone to Rome, and it has usually been supposed that this was the occasion for young Borelli's presence there and eventual contact with Benedetto Castelli. But now we know that Miguel did not remain in exile. He appealed his case and was exonerated. In April 1617 he returned to duty at Castel St. Elmo, where he stayed until he died in 1624. Laura Porrello possibly remained attached

to Castel St. Elmo in some capacity, for at her death in 1640 she was buried, as Miguel had been, at the church serving the fortress.

We can guess that sometime before 1626 young Borelli came to the attention of Campanella; there was no lack of opportunity. In 1616 the latter was given a few months of at-large detention in Castel Nuovo (he may have written his *Defense of Galileo* at this time), but he was back in the dungeon of Castel St. Elmo when Miguel returned from exile. In May 1618 he was again sent to Castel Nuovo, where he had a relatively easy imprisonment; he was able to write, see friends, and even have students. It is possible that Borelli was among these, and it is also possible that Borelli received some medical training at the University of Naples in this period, although we have no published records to that effect. In 1626 Campanella was taken to Rome, where he was fully liberated in 1628. Five years later a disciple, under duress, implicated Campanella in a plot to assassinate the Spanish viceroy in Naples. Under great pressures Campanella fled Italy for Paris, in 1634, taking Filippo Borelli with him. There Filippo helped to edit and publish various of Campanella's works, and in at least one he appears as *nipote ed amanuense dello autore*. What happened to Filippo later is not known, but a letter of another of Campanella's disciples in 1657 connects Giovanni Alfonso with information concerning several hundred copies of Campanella's books left at the Dominican convent of Santa Maria Sopra Minerva and also indicates that Giovanni had a brother, a "P. Tomaso filosofo." It has been suggested that on Campanella's death, in 1639, Filippo entered ordres and took the name Tommaso.

We do not know when Borelli himself went to Rome. Anytime after 1628 he could have resumed whatever relationship he had established in Naples with Campanella; and it is quite possible that Campanella in turn introduced him to Castelli. In any case he became a student of Castelli along with Torricelli. He must have been in Rome through the period of the publication of Galileo's *Dialogo* and the subsequent trial. Although he did not meet Galileo, he probably had access to all the ins and outs of the affair through both his mentors. And possibly it was during this period that he acquired a copy of calculations or tables made by Galileo concerning the Medici planets (the moons of Jupiter), calculations which were not among the papers inherited by Vincenzo Viviani at Galileo's death and which Viviani requested a copy of in 1643. After Campanella left Rome, Borelli continued for a while with Castelli. In 1635, or shortly thereafter, Castelli's recommendation obtained for Borelli the public lectureship in mathematics in Messina, Sicily. And Castelli continued to look after Borelli's welfare. In 1640, when the mathematics chair at the University of Pisa became vacant, he wrote two letters to Galileo praising Borelli very highly, calling him in one *huomo di grandissimo ingegno e sapere, versatissimo nelle dottrine di V.S. Molto III.re e tutto tutto*nostri ordinis. Galileo's choice, however, was Vincenzo Renieri who then held the position until his death in 1647. Borelli would eventually obtain the post, but not until 1656.

Meanwhile Borelli made his way in Messina. The city had had little to boast of since the death of Francesco Maurolico in 1575. In the 1630's, however, there was an effort toward a political and intellectual revival which included an attempt to improve substantially the city's university. The people backing these moves were among the same who formed the Accademia della Fucina in 1639, a group of the young, enlightened nobility and merchant class, jealous of its political rights and beginning to grow restless under the restrictions of Spanish rule. The Fucina itself became a forum for both political and intellectual discussion, and in 1642 it came under the direct protection of the Messinese senate. It is not clear when Borelli became a member, but his talents as a public lecturer of mathematics were already highly appreciated. In 1642 the senate provided him with ample funds and sent him on a mission to leading universities to hire away good teachers, especially in law and medicine. We can guess that on this trip Borelli stopped in Naples to see Marco Aurelio Severino, perhaps renewing an old association. He must have visited Castelli in Rome. We know that he visited Tuscany, but unfortunately too late to see Galileo. But he did spend some time in Florence, and while there he met both Viviani and Prince Leopold, the youngest brother of the grand duke. After Florence he went on to Bologna where he very favorably impressed Bonaventura Cavalieri. Then he was off to Padua and eventually Venice where he planned to catch a ship back to Messina. Among the topics of discussion in Florence must have been the work of Santorio, for in Venice he bought a copy of *De statica medicina* and mailed it back to Viviani along with other items of scientific interest. By 1643, then, even though he had not yet published, he was beginning to be known in Italy, and what evidence we have indicates that he had already exposed himself to the studies that were to concern him for the rest of his life: mathematics, physiology, and planetary astronomy.

From 1643 to 1656 Borelli remained in Sicily, so far as we know; he published two works and possibly had a hand in a third. The first developed out of a dispute that may have had some polemic roots in the political and intellectual rivalry between Messina and Palermo. In 1644 a Pietro Emmanuele of Palermo published a *Lettera intorno alla soluzione di un problema geometrico*. This was attacked, so he followed it a year later with a *Lettera in difesa di un problema geometrico*. In the second, at least, Borelli's reputation was impugned, and Borelli replied in the *Discorso del Signor Gio: Alfonso Borelli, accademico della Fucina e professore delle scienze matematiche nello Studio della nobile città di Messina, nel quale si manifestano le falsità, e gli errori, contenuti nella difesa del Problema Geometrico, risoluto dal R. D. Pietro Emmanuele* (Messina, 1646). The Fucina also reacted to protect both itself and Borelli by encouraging the publication of several pamphlets. In one of them, Daniele Spinola's *Il Crivello* (Macerata, 1647), the resolution of the original problem was provided by Giovanni Ventimiglia, a student and a friend of Borelli.

As this controversy died down, Sicily was invaded by an epidemic of fevers. Messina was especially hard hit and the senate encouraged its local *dotti* to try to discern its causes. One study that resulted was Borelli's *On the causes of the malignant fevers of Sicily in the years 1647 and 1648…*; to which he added a section entitled *And at the end the digestion of food is treated by a new method* (Cosenza, 1649). During his investigation of the epidemic Borelli had visited other cities, observed autopsies, and noted in detail the circumstances under which the disease was prevalent. He concluded that in no way were the fevers caused by meteorological conditions or astrological influences, but were probably caused by something getting into the

body from the outside. Since this thing seemed to be chemical, Borelli prescribed a chemical remedy, sulfur, and for this recommendation he acknowledged the counsel of his friend and colleague Pietro Castelli (*d*. 1661). In the addendum he again disclosed a chemical approach; he characterized digestion as the action of a *succo acido corrosivo* turning food into a liquid form. Borelli would repeat and expand this particular inquiry during his stay in Pisa.

In 1650 Borelli was considered for the chair of mathematics at Bologna. Cavalieri had died in 1647 and the authorities there wished to fill the post with someone equally able. Accordingly they made inquiries concerning Borelli and received strong endorsements for him as the best mathematician in Italy after Cavalieri. They also learned that Borelli was a trifle capricious and had a leaning toward the "moderns," Copernicus and Galileo (*il Gubernico et il Galileo*). Whether or not this latter was a factor, Borelli was passed over and the chair went to Gian Domenico Cassini. So Borelli remained in Messina and was there when Maurolico's *Emendatio et restitutio conicorum Apollonii Pergaei* was finally published in 1654. The original of the *Conics* of Apollonius had contained eight books, but the sixteenth century possessed only the texts of the first four. Maurolico had attempted to reconstruct Books V and VI. The extent of Borelli's connection with this project is not certain. We do know that he had composed a digest of the first four books before he left Messina. On this account alone he would have been prepared for an opportunity that presented itself when he later arrived in Pisa. Sometime previously the Medici had acquired an Arabic manuscript which seemed to contain all the original eight books. As early as 1645 Michelangelo Ricci had corresponded with Torricelli about the possibility of translating and publishing it, but with no results. Somehow Borelli had learned of it, however, for just a month after his inaugural lecture at Pisa, in the spring of 1656, he wrote to Leopold suggesting that with the aid of someone who knew Arabic he could edit these "most eagerly awaited" last four books. This led, in 1658, to a long summer's collaboration in Rome with the Maronite scholar Abraham Ecchellensis during which the two substantially completed an edition of Books V, VI, and VII. (It turned out that Book VIII was missing from the manuscript.) After many frustrating delays the work finally saw print in 1661 along with an appended Archimedean *Liber assumptorum* taken from another manuscript.

We must presume that in the years before Borelli left Messina he was already in touch with what would become a very important group in Naples. Tommaso Cornelio and Leonardo Di Capoa had both studied with Marco Aurelio Severino. On Severino's urging Cornelio had traveled for several years and had studied with such leading innovators of northern Italy as Ricci, Torricelli, and Cavalieri. When he came back to Naples in 1649 he brought with him the works of Galileo, Descartes, Gassendi, Bacon, Harvey, and Boyle, among others; and he and a lawyer named Francesco d'Andrea started an informal gathering which met to hear the results of its members' investigations. As it gained notoriety, the group faced various pressures, among them political, and in 1663 expediency compelled it to organize formally as the Accademia degli Investiganti under the protection of Andrea Concublet, the marchese d'Arena. All the while it pursued its physical, chemical, and physiological inquiries; corresponded with individuals and groups in other cities; and from time to time received distinguished visitors. Marcello Malpighi, for instance, had been at Pisa from 1656 to 1659 and then went to Bologna. In 1662 Borelli recommended him for the chair that had become vacant with the death of Pietro Castelli in Messina, and on his way south in the fall of that year Malpighi was warmly entertained by Cornelio and Di Capoa. From at least the time of his return to Naples, Cornelio had devoted himself to physiological experimentation in the new mathematical-mechanical manner. He became a professor of mathematics at the University of Naples in 1653. By 1656 his old teacher Severino had persuaded Cornelio to publish his investigations and speculations; delays occurred, unfortunately, but when his *Progymnasmata physica* appeared in 1663 one section of it carried a dedication to Borelli. For Borelli's part, almost immediately upon his arrival in Pisa he established a flourishing anatomical laboratory in his own house. Here he collaborated with and taught many talented students of the various disciplines of anatomy from Marcello Malpighi, at the beginning of his stay, to Lorenzo Bellini and Carlo Fracassati, in his last few years. Here also he nurtured his great iatromechanical project, a work on the movements of animals. He probably had had such an endeavor in mind before he came; in 1659 he could already complain of having to put it aside because of the work on Apollonius. By 1659, of course, Borelli had become involved in many things, not the least of them the experimental investigations of the Accademia del Cimento.

One year after Borelli arrived in Tuscany the Accademia del Cimento held its first session; the year Borelli left, the Cimento quietly died. Indeed, Borelli seems to have been the principal animus of the academy, but lest he appear the sole mover, we should recall the documentation, especially for the extensive experimental work performed during this Galilean epoch, in Giovanni Targioni Tozzetti's *Atti e Mémoireinedite dell' Accademia del Cimento e notizie aneddote dei progresse delle scienze in Toscana*. In fact the Tuscan court had been thoroughly infected by Galileo's ideas and those of his pupils. Grand Duke Ferdinand II, from the time of his accession to power in 1628 until his death in 1670, maintained a personal laboratory as did Prince Leopold. From the time of the death of the Master, Galileo, informal gatherings met at the court and presented and discussed experiments. At first Torricelli was the most prominent figure; after his death in 1647 Viviani presided over the activities.

Then, possibly under the crystallizing influence of Borelli, Leopold asked for and received permission from Ferdinand to organize formally an academy for purely experimental research. Under Leopold's aegis it met for the first time in June of 1657. Among its more distinguished members, besides Borelli and Viviani, were Antonio Oliva (*d*. 1668), Carlo Rinaldini (*d* 1698), and Francesco Redi (*d*. 1697). Nicholas Steno arrived in Florence in 1666 and soon thereafter joined the group. Lorenzo Magalotti, after attending the University of Pisa as a student, was appointed secretary in 1660. The Cimento had adopted a policy of submerging the identities of its members and presenting itself as a group. Accordingly, when Magalotti brought out the *Saggi di naturali esperienzi fatte nell'Accademia del Cimento* in 1666–1667, it appeared anonymously and refrained from identifying the individual contributions of the members. Actually the *Saggi* presented only part of the work performed; it tended to emphasize the identification and description of physical phenomena and the perfecting of measuring techniques. It

failed to present other interesting investigations, including some potentially controversial observations and discussions of comets.

During the life of the Cimento dissension appeared among the membership; Borelli may have originated some of it. He seems to have chafed under the requirement of anonymity, and by all accounts he was a touchy person to get along with under any circumstances. In any case, toward the end of 1666 and just after the publication of his important work on the theory of the motions of the moons of Jupiter, Borelli made his decision to leave Tuscany and return to Messina. In 1667 Leopold was created a cardinal and thus had some of his energies diverted. Rinaldini moved on to the University of Padua, and Antonio Oliva went to Rome where he came under the suspicion of the Inquisition and died by throwing himself from a window of one of its prisons. In December of 1667 Steno converted to Catholicism and shortly thereafter set out on a series of journeys. How or whether any of these events may have been connected is not known with any degree of certainty. But at this point the Cimento effectively ceased to function, even though it apparently was not formally dissolved, and even though Prince, now Cardinal, Leopold continued to direct some experimental work until he died in 1675. As far as Borelli was concerned, he had been, and afterward remained, on excellent terms with Leopold; and Leopold maintained his high regard for Borelli.

Besides his involvement with the Cimento and his own laboratory, Borelli had had other things to keep him busy during these years in Tuscany, among them his teaching duties. He was by no means the usual sort of professor. Nor did he bother to cultivate the finer graces of that calling. His first lectures at Pisa, for instance, were something of a disaster. He lacked any particular eloquence and was long-winded and dull. The students reacted with catcalls and agitation, once forcing him to stop before finishing his lesson. Very quickly, however, he demonstrated his capabilities, and his lack of Tuscan oratorical polish probably became less of a barrier. Then, in connection with his post, he prepared for publication of his *Euclides restitutus*. Not one to be overawed by canonical texts, he frankly stated that although Euclid had done an excellent job in compiling his *Elements*, these nevertheless could be repetitive and prolix, and it was time to put the material together in a clearer and more concise package. While he was about it, Borelli took the opportunity not only to reexamine the parallel postulate and propose his own version but also to try to establish the theory of proportions on firmer grounds. The Latin edition of this work appeared in 1658. Five years later his student Domenico Magni undertook the task of providing a "Euclid for the layman" by editing out most of Borelli's technical commentary and shortening and translating the remainder into Italian. Both works apparently were very well received. In subsequent editions of the Latin version, Borelli's short summary of Apollonius and other brief analyses appeared.

One of the more notable events during Borelli's stay in Pisa had been the appearance of a comet in late 1664. Borelli immediately took up the vigil and kept very close track of it throughout December and until the beginning of February 1665. Out of this came a small paper, which he published in the form of a letter addressed to Stefano degli Angeli, a mathematician at the University of Padua. Borelli showed that, no matter which interpretation one preferred, Ptolemaic, Tychonic, or Keplerian, one had to admit that the comet changed in its absolute distance from the earth. This fact raised obvious difficulties for the first two systems, and Borelli argued that it presented difficulties for the Keplerian also. He went on to show that his parallax measurements proved the comet to be above the moon, at least toward the end of the observations presented here. This was touchy material, and Borelli published under the pseudonym of Pier Maria Mutoli. His interest in comets continued into the spring. In early May he wrote Leopold that he believed that the true motion of a comet *then* visible could in no ways be accounted for by means of a straight line but rather by a curve very similar to a parabola. And he proposed to demonstrate it, not only by calculation, but also with some kind of mechanical device. Borelli apparently built this instrument; unfortunately, neither it nor any description of it remains.

During the summer of 1665 Borelli established an astronomical observatory in the fortress of San Miniato, a pleasant site on a hill a short distance from Florence. Here he used an excellent Campani telescope and some instruments of his own design to try to determine with extreme accuracy the motions of Jupiter's satellites. From this work came his *Theoricae mediceorum planetarum ex causis physicis is deductae* (1666), in which, among other things, he explained how the elliptical orbits of planetary bodies could be understood in terms of three types of action. In the first place, a planetary body has a tendency toward a central body and would move toward that central body if no other factors intervened. Then, a central body, such as the sun, sends out rays and as that body rotates the rays also rotate. The cumulative effect of the impacts of these seemingly corporeal rays is to impart to the planet a motion around the central body. This motion in revolution thus produces a centrifugal tendency which balances the original centripetal one and thereby establishes the planet in a given mean orbit. Small self-correcting fluctuations account qualitatively for the observed ellipses. There are some obvious difficulties in accommodating these proposals to the satellites of the major planets, and it is clear that Borelli had much more in mind than just explaining the motions of the moons of Jupiter. The Copernican implications of his scheme, however, could be masked by seeming to focus attention on Jupiter.

Meanwhile, as time allowed. Borelli continued his anatomical research. He collaborated with Lorenzo Bellini in an investigation of the structure of the kidney, and in 1664 this resulted in a short piece entitled *De renum usu judicum*. And he also produced two major studies which were not only exercises in pure mechanics but also, in the eyes of Borelli himself, necessary introductions to what he would consider to be his most important work, the *De motu animalium*. Respectively, these were *De vi percussionis* (1667) and *De motionibus naturalibus a gravitate pendentibus* (1670). Both cover considerably more subject matter than their titles indicate. In the first, for instance, Borelli discusses percussion in detail, some general problems of motion, gravity, magnetism, the motion of fluids, the vibrations of bodies, and pendular motion, to cite just a few items. Likewise, in the second, he argues against positive levity, discusses the Torricellian experiment, takes up siphons, pumps, and the nature of fluidity, tries to understand the expansion of water while freezing, and deals with fermentation and other chemical

processes. When we consider that all this was the product of years of experimental and theoretical investigation, we should not wonder that he objected to giving it over to be brought out anonymously by the Cimento just because he happened to present a good deal of it before that society. To the apparent displeasure of Leopold, Borelli published *De vi percussionis* in Bologna. And in the early summer of 1667 he set out once more to Messina.

On the way he passed through Rome and stopped for the summer in Naples. While there he was the guest of the Investiganti for whom he repeated many of the experiments he had performed at the Cimento. And he also repeated for his own edification some work that the Investiganti had accomplished independently. As a result of this visit, Concublet provided for the publication of *De motionibus naturalibus*, for which Borelli reciprocated by writing a warm dedication to him. Back in Messina, Borelli resumed his chair in mathematics. Stefano degli Angeli had raised some objections to parts of *De vi percussionis*, so in 1668 Borelli wrote the short *Risposta*; one of the problems concerned the deviation toward the east of a body dropped from a tower. In 1669 there occurred a major eruption of Etna and Borelli took the occasion to observe it closely, making notes on the topography of the mountain, the locations of the flows, and the nature of the various materials ejected, and offering some reasoned speculations of the sources of the heat powering the display. These he published in the *Historia et meteorologia incendii Aetnaei anni 1669*. Meanwhile he tried to return to his long delayed *De motu animalium*.

Borelli did not confine himself only to the sciences. He had always taken a great interest in the public affairs of Messina. For example, while he was in Tuscany he helped to procure a copy of a manuscript the Messinese wished to publish. The work in question was the *Storia della guerra di Troja* by Guido Giudici delle Collone. A Latin version had been found among the papers of Maurolico, but it was known that the Accademia della Crusca had cited an Italian translation in Florence. At the request of the Messinese senate and with the aid of Boreili a copy was made in 1659. The Fucina published it in 1665 with a dedication to the senate. When Borelli returned from Pisa, then, he was coming home. And even though he was nearing sixty, he seems to have taken up an active political role. Agitation had been growing between the local citizens and their Spanish overlords. This led in 1674 to an open revolt. With some assistance from the French the struggle continued until 1678 when the French decided to leave the city, taking with them many of the city's leaders and (among other things) ensuring the closing of the Fucina. But trouble had brewed even before 1674. Borelli himself was thought to have provided the ideological inspiration for a party of republicans. In 1672 the Spanish Conservatore del Regno managed to stir up riots against the party, during which the home of Carlo Di Gregorio, which served as the meeting place for the Fucina, was burned. Borelli was declared a rebel and a price was placed on his head. He left very quickly and seems to have gone directly to Rome. One of his current projects also became a casualty. He had been into the papers of Maurolico and was publishing the latter's edition of the works of Archimedes when in 1672 the Spanish confiscated the nearly completed printing.

When Borelli arrived in Rome he was by no means unknown to that city. Besides his years of study there and several visits during the intervening period, he also knew and had corresponded frequently with Michelangelo Ricci and from its beginning the *Giornale de' Letterati* had published news of his scientific accomplishments: abstracts of his longer works and complete versions of a few shorter pieces. It is not surprising, then, that he would come to the attention of Queen Christina and come under her somewhat erratic patronage. Christina had been the only legal offspring of Gustavus Adolphus of Sweden. She had received an excellent education and undertook many projects, among them the creation of a learned academy in Stockholm. One of her first acts after her spectacular conversion to Catholicism was to attempt to start an academy in Rome, this in early 1656. Unfortunately, political and financial problems occupied her attention for many years. Finally, in 1674, she launched her Accademia Reale. Borelli appeared twice before it in 1675—in February when he spoke on the construction of the triremes of the ancients and again in April when he discussed Etna, this time including considerations resulting from a climb to the rim of the volcano in 1671. Christina also patronized another, more scientific group, known variously as the Accademia dell'Esperienza or the Accademia Fisica-matematica. It was organized in July of 1677 under the leadership of Giovanni Giustino Ciampini, who was also connected with the *Giornale de' Letterati*. Its membership included Borelli and an old friend and disciple, Lucantonio Porzio. But recognition apparently did not entail too much tangible support, and Borelli began to look farther afield for that. Cassini had been in Paris for several years and had become a member of the Royal Academy of Sciences. In 1676 Borelli wrote him complaining of the extreme circumstances to which he had been reduced by his enemies and the lack of quiet which was interfering with the completion of his works; he hinted that he too would like to serve the Most Christian King. By February 1677, negotiations were under way. A year later he had hopeful news, but he wrote that he was too old to travel to Paris. Instead he would send his work on the motion of animals to be printed there with a dedication to the king. In May of 1678 he still hoped for his election to the Royal Academy, but since he did not wish to trust his only copy of *De motu animalium* to the mails, he wrote that he needed time to have another made. Actually it is unlikely that he ever was elected to the Academy. A short time previously he had been robbed of all his possessions by a servant. Lacking adequate means, he had accepted the hospitality of the fathers of the Casa di S. Pantaleo and had entered their house on 13 September 1677. For the last two years of his life he taught mathematics at its Scuole Pie. Apparently he never sent a copy of his manuscript to Paris. Then in late 1679 Queen Christina agreed to bear the printing costs and Borelli dedicated the *De motu animalium* to her. He died in December, however, and his benefactor at the convent, P. Giovanni di Gesù, accepted the responsibility of seeing this last and most important work through the press. Volume I, treating of external motions, or the motions produced by the muscles, appeared in 1680. Volume II, dealing with internal motions, such as the movements of the muscles themselves, circulation, respiration, the secretion of fluids, and nervous activity, appeared in late 1681. A simple stone in the wall of the Church of S. Pantaleo recalls: *Joh. Alphonso Borellio, neapolitano, philosopho medico et matematico, clarissimo*, …

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Thomas B. Settle