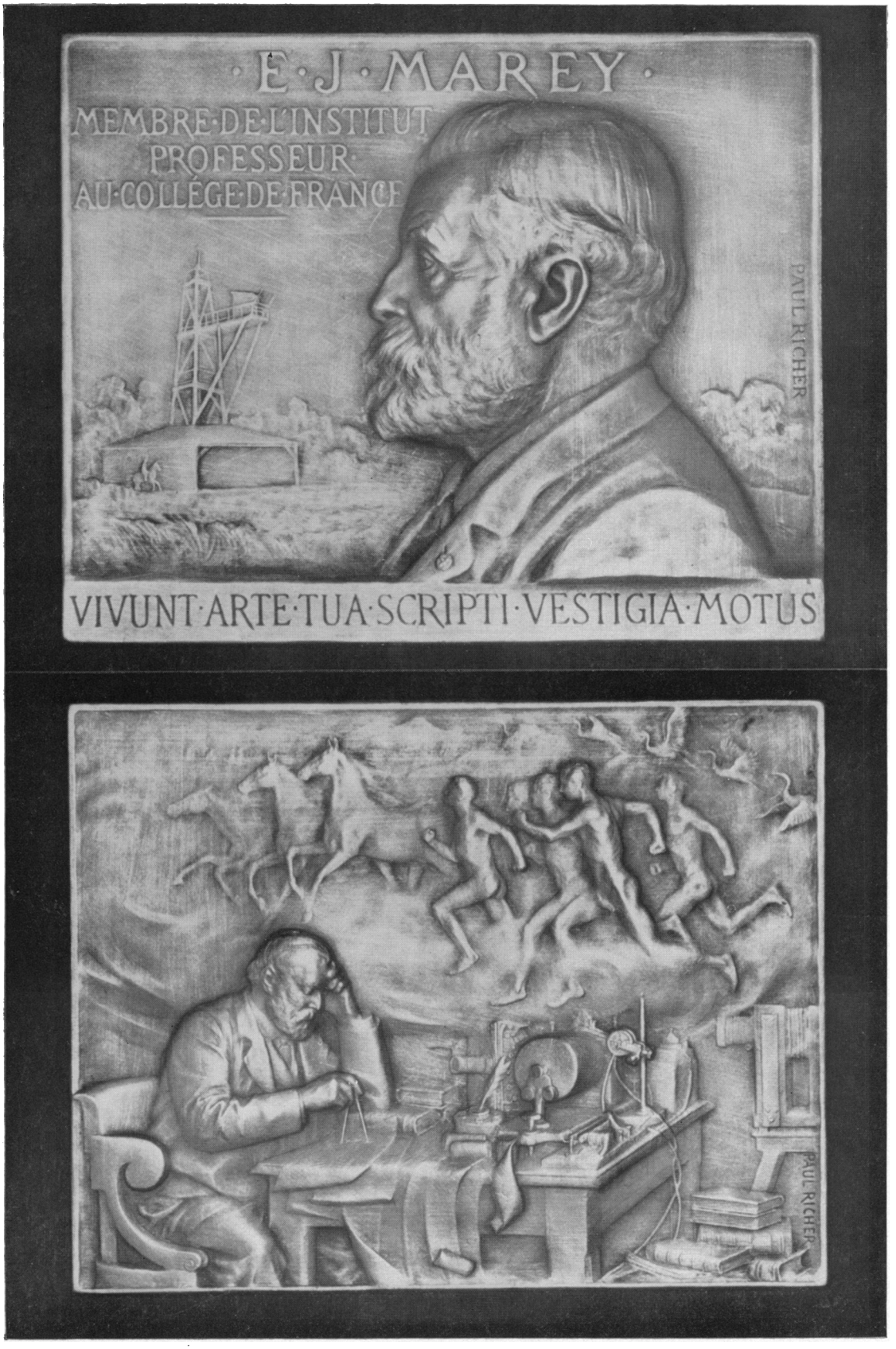

Fig. 1 (see p. 203)

News, Notes and Queries

E. J. MAREY—PHYSIOLOGIST AND FIRST CINEMATOGRAPHER*

by

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ASTRONOMERS, physicists and engineers invent with ease their own yardsticks to measure the distance of the stars, the temperature of a super-cooled liquid or the power of a machine. Not so the biologist, psychologist and medical research worker, to whom Life presents an infinite variety of different motions, most of which can be described, but few measured with accuracy. Marey—a great French physiologist of the last century—constructed the first modern cine-camera in 1887 and used it widely as his measuring rod for all kinds of animal and human movements; thus he laid the foundations of scientific cinematography. His life, his scientific work, and the widespread imitation of his methods are here briefly reviewed.

Marey was born in Beaune in 1830, his father being a wine merchant, his mother a school teacher. Already at his local college he showed himself a bright and industrious lad whose everlasting interest in animals remained with him to the end of his life. He was equally fascinated by mechanics and the other exact sciences, and when his college career was finished, he went to Paris to study medicine, such curriculum offering then the best possible combination of his two vocations. However, after taking his medical degree, he soon became dissatisfied with the inexactness of the diagnostic methods then in vogue, and he installed a private laboratory in an old theatrical dressing room near the famous Comédie Française. There his first research project was the construction of an accurate pulse-counting device, which inscribed on a rotating smoked drum the pulse-beat of the patient, to whose wrist the apparatus could easily be strapped. This sphygmograph was the subject of his first scientific paper in 1860, the forerunner of many others published in the *Comptes rendues* of the Académie des Sciences, whose president he became 35 years later.

This first research project of Marey's was typical of the many others which followed: in all of them he was anxious to register and to record, in the most accurate possible manner, the diverse movements of the animal kingdom. In this early work he used the rotating smoked drum, the well-known kymograph, and on it he recorded the frequency of the bee's wing movements, the various paces of the horse, the leg movements of a running and jumping man, and even the wingbeat of a pigeon in free flight. A tuning fork was always recorded simultaneously and thus he had a time base against which to measure the animal's movements, both as an absolute quantity and for comparative research.

*A paper read to the Osler Club of London on 12 October 1965. By kind permission of the Science Museum, Marey's original *chambre chronophotographique* was on display at the meeting, and Dr. D. B. Thomas, of the Department of Photography at the Science Museum, was a guest.

Recognition for such pioneering work came soon; he was elected to the Academies of Science and Medicine and appointed professor at the Collège de France where better laboratories were placed at his disposal; soon a band of devoted assistants were ready to carry out his innumerable experiments. But like the great scientist he was, he was never satisfied with his work. The inertia of the inscribing lever on the drum, and the transmitting system itself between the animal and the lever—often replaced by the still universally used 'Marey's *tambours*'—were a great disadvantage. He had only to look at the famous photographs which Muybridge sent to him from San Francisco and personally showed to him in Paris in 1881, to realise that photographic methods would give him at last that instantaneous and inertia-free method of recording movement for which he had searched so long. But instead of using Muybridge's method of twenty-four photographic cameras in one row, he followed Janssen's astronomical revolver of 1874, in which a single daguerrotype glass plate was rotated by clockwork behind a single shutter and one sole lens. This first cinematographic camera of Marey's, the *fusil photographique*, was described by him in 1882 and allowed him to take twelve consecutive frames of the flight of birds, to which subject he applied it above all others. The use of this camera, incidentally, earned him the name of 'Fool of Posillipo' after the village on the Bay of Naples where he had his new private laboratories; none of his neighbours could understand why this strange gun, on which he lavished so much care and attention, never killed a bird.

But the gun was also unsatisfactory from a photographic point of view as the images were very small, only a few could be obtained, and again the inertia of the glass plate prevented any higher frequency of exposure than 12 frames per second. Marey therefore chose for his next camera ribbons of paper 9 cm wide and 4 m long covered with a silver bromide emulsion, such as were available in 1887 and made by Eastman and by Balagny. In the next year, 29 October 1888, he could proudly present to the Académie des Sciences the first results achieved with this camera. These were indeed the first modern motion pictures, obtained on one single tape of light-sensitive emulsion, intermittently brought to rest behind a lens, and obscured by a rotating shutter while moved forward for the next exposure. By 1890 he was able to carry out with this camera high-speed cinematography at 60 frames per second, and the flight of a pigeon, thus recorded, was published in his classical book: *Le Vol des Oiseaux:* it was there reproduced by phototypography, and Marey viewed these images in his 'wheel-of-life' six times as slowly as he had recorded them. For the next ten years, this type of camera was in continuous use by Marey, Bull, and their colleagues to record innumerable aspects of animal and human movements; all research films were quantitatively evaluated and the results have remained to this day the classical contributions on the flights of birds, the crawling of insects, the swimming of fishes, and the running of man. Such was the first use of cinematography, before Friese-Greene, Lumière, or Edison had set out to entertain mankind with their new toys.

As a scientist Marey was not interested in the use of cinematography for entertainment purposes and the heated discussions about the original invention of the cine-camera and motion picture film left him quite undisturbed. In his many books and scientific papers he paid generous tribute to his two predecessors, Muybridge

and Janssen; his own results, and descriptions of his equipment, he published in the *Comptes rendues*, where they are today available to anyone who might care to read them. Marey in turn inspired Edison in 1889, when the latter was on a visit to Paris, and where he showed him a magic disk on which extracts from Marey's films were mounted and illuminated by electric flashes. Marey's contributions to the projection of motion-picture film were spasmodic and not very successful, as for his scientific research work the analysis of individual pictures—frame-analysis—was far more important and yielded all the required information. At his physiological research station at the Parc du Prince, donated by the City of Paris, and at the Institut Marey, founded in 1903, much of this work was carried out; Marey's death in 1904 did not bring it to an end, and it still goes forward today under the direction of L. Bull, Marey's devoted chief assistant.

Marey's undying fame will forever be remembered in the many scientific laboratories in which cinematography has been used as a research instrument. To its quantitative use he led the way by including a clock in the field of view of his lens, and by the frame-analysis of the resulting motion pictures. To name here all the applications would be impossible, and many of them are discussed in the present author's book: *Research Films* (Academic Press, New York, and Academic Books, London, 1956). In bacteriology, cytology, botany, animal behaviour, psychology, anthropology, and especially medicine, many hundreds of research films have been made, often using cinematography through the microscope, another invention of Marey's. Men like A. Gesell, F. B. Gilbreth, R. W. G. Wyckoff, J. Comandon, A. F. W. Hughes, R. G. Canti, W. Kuhl have all carried on Marey's tradition of scientific cinematography in the fields of animal and human biology; R. R. McMath and B. Lyot in astronomical cinematography, J. Y. Cousteau and the United States and British Navies in underwater cinematography. In physics and chemistry, in mechanical, civil, electrical, chemical and aeronautical engineering—in all these fields of pure and applied research—the cine-camera has found its rightful place as a research instrument.

Marey would indeed have been pleased to see how his methods have so greatly contributed to our increase in knowledge. It is not given to many scientists to make a fundamental discovery which finds application in more than one field of research, quite apart from being the first scientific cinematographer. As long as scientists make use of cinematography in their research, under the oceans, on Mount Everest, over the North or South Pole, from rockets and satellites, or in the innermost recesses of the human body, they will owe an immense debt to Marey, the maker of the first cine-camera and the first to demonstrate it as the quantitative yardstick of all movement.

Fig. 1 shows a silver-plated bronze medal, reproduced at twice actual size, by the artist, Paul Richer. The obverse shows a bas-relief of Marey, wearing the rosette of the Commandeur de la Légion d'Honneur. In the background is a representation of his Physiological Research Station at the Parc-des-Princes, Paris. Here a rider on horseback is filmed in three dimensions, from above, from the front and from the side. The reverse of the medal sums up the whole of Marey's life-work. On the back of his working table stands the cylindrical drum of a kymograph with his *tambours*. To the right of the table appears the front part of the *chambre chronophotographique;* an earlier model of it also protrudes from behind the kymograph. Marey himself can be seen to analyse the displacement between individual phases of a movement, recorded on one of his paper bands. Above him are seen the main subjects of his researches, birds, men, and horses. (The medal is in the author's collection.)
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