The examination of the viscera of healthy cats.—In order to institute contemporaneous comparisons between the intestinal contents of the Delhi cats and the contents of similar animals in health, we kept two cats without food for twelve hours, and then placed them under the influence of chloroform until they died. The contents of the first intestine examined were of firmer consistence than similar material from the Delhi specimens, and not so white, but the reaction was acid, just as it was in preparations from Delhi. The contents of the second intestine, however, were quite fluid, and contained masses of flocculent, granular matter, which, allowing for the action of the spirit, was in no way distinguishable from the material described in connexion with the Delhi specimen. Portions of this gut were ligatured, and set aside in spirit for some days, and subjected to careful examination. It would have been extremely difficult, if not impossible, to have distinguished them from the Delhi specimens, either by the unaided senses or by microscopic examination. Neither of these two cats harboured the particular round worms found in the preparations from Delhi.

The specimens sent from Delhi showed no anatomical or microscopical appearances indicating that the animals from which they were obtained had been affected by cholera or any similar disease.

CARLO MATTEUCCI:

HIS MERITS IN PHYSIOLOGICAL AND MEDICAL PHYSICS.

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Translated by J. P. STEELE, B.A., M.D. EDIN.

(Concluded from p. 118.)

WE have already said that Matteucci in the field of animal electricity, properly so-called, appears to have taken as a starting-point anterior studies on electrical irritation. In fact, we already find in 1830 a first work of our author, which treats of the "Contraction experienced by Animals on the Opening of the Electric Circle in which they are found." It was published at Forli. Whether it is an accident, or a sign that the same theme occupied his mind all his life, his latest scientific works also treat of the cause of the contraction observed on opening the electric circle, which cause he had finally found in the polarisation of the nerve. It was, above all, that long and strong tetanic contraction which occurs at the opening of an ascending current of the nerve which for years had riveted his attention, and of which he explored the cause until, at the close of his career, he succeeded, by means of an ingenious combination, in shedding a ray on this point, the intelligent appreciation of which was possible only after new studies on the secondary polarisation of the animal tissues.

The interest awakened throughout all Europe by Faraday's work could not but find a response in the mind of Matteucci. Already, at the beginning of his career, he had sought to apply the new facts to the study of organic processes. His researches on the electrolytic decomposition of some organic fluids are interesting attempts which will have to be resumed one day when the advanced state of organic chemistry will admit of a better determination of the results obtained. It was an ingenious undertaking, which belongs originally to Thomas Young and to Wollaston (*Philosoph. Mag.*, 1809, vol. xxxiii., p. 489), and which Matteucci revived to explain the different actions of the secretions by attributing them to electric tensions between the surface of the animal parts; but even this undertaking (*Annales de Chimie et de Physique*, 1830-34) had to be suspended because, after the existence of this current was experimentally proved, it became impossible to decide which of the two factors—i. e., current or chemical difference—is the cause, and which the effect.

Experiments on the electric irritation of the nerves, and on the law of electric contraction, furnished ample food to the zeal of Matteucci. These experiments, which are of great importance in the scientific point of view, are yet

more so in the practical, because, in Matteucci's hands, they have become the basis of ELECTRO-THERAPEUTICS.

Matteucci, in this field, and as to the general results yielded by it, has not to any notable extent detached himself from Marianini and Nobili, his method of experimenting having been essentially that of his Italian predecessors. Nevertheless, we find in his memoirs on this subject, besides some methodic indications of high utility, a more precise appreciation of the results which could be obtained by this improved method, and new experiments demonstrate that the electric irritation of the sensory nerves offers in its results the greatest analogy with the irritation of motor nerves. This analogy, already surmised by Bellingeri and Marianini, becomes identity (always through the currents then in use), if the sensory nerve be considered as a motor nerve which runs in an inverse direction, and of which the action is expressed by a reflex movement. In our own day, the experiments of Pflüger have amply confirmed these provisions of Matteucci.

It is a merit of Matteucci's to have recognised that the centripetal (ascending) current, if it has run for a considerable time along a motor nerve, augments, after its opening, not only the excitation (this was already known to Ritter, with whose works Matteucci was unacquainted), but also the excitability. By this means was prepared an induction which has become almost a new revelation for the medical application of electricity. True it is that Matteucci has had to leave lacunæ in the proofs which he has given in favour of his thesis—lacunæ which he might in part have filled up, if he had cared to avail himself of the results already obtained in this field about the beginning of the century (1798) by Ritter and Pfaff. Suffice it to say that more than fifteen years after Matteucci's publication, an extended experimental research conducted by Haidenbain has completely justified its provisions as to the restorative action of the ascending current.

The most important discoveries of Matteucci relate to the physiological production of electricity in connexion with biological processes. In this field his services are so well and widely known that we can afford to be brief. For a long time a production of electricity was recognised almost as a miraculous exception to physiological law in electric fishes. The proofs which Galvani sought to give in favour of an electricity developed in the animal are, in part, of great value, but in the form in which Galvani presented them they have broken down under the criticism of Volta. Other suppositions, which are not un plentiful in the history of man and of electric animals, lack every trace of proof. Nobili in 1827 made the important discovery that a frog, either alive or sometimes after death, two points of whose length are in communication with a galvanometer, makes it deviate in the sense of a current, which in general goes from the hind feet to the head. This current is strong enough to irritate the nerves of another frog. Nobili calls this the "current proper" of the frog, without meaning to make out that it is inherent in the tissues of the animal. On the contrary, he employed all the acumen of his genius to uphold the supposition that the current proceeds from external causes and combinations, and that it is probably of a thermo-electric nature.

Much of Matteucci's research is occupied with this "current proper" of the frog. Its essential fruit has been the important conclusion that the current cannot depend either on a thermal or on a chemical difference in the primary sense of Volta; that it is, therefore, inherent in the animal body. This demonstration of a physiological current so struck the mind of the experimenter that every trace of animal electricity which, in the numerous researches this discovery prompted, was indicated by the galvanometer or the galvanoscopic frog, he regarded as proceeding from a current analogous to the "current proper" of the frog. A similar current came in this way to be attributed to all animals—to the frog mutilated and the frog excoriated, even to little fragments of animals. But after the first enthusiasm had given place to a more detailed analysis, Matteucci alighted on (in 1840) another important fact. He found in the muscles of warm-blooded as of cold-blooded animals that all the muscular groups manifest a current if a point of the interior of the muscle is connected by means of a conducting arch with a point of the surface.

This formula differs, however, from the general law of the muscular current which Du Bois had found in 1842 and

published in 1843. Du Bois speaks of "transverse cut, natural or artificial," instead of internal surface — of "longitudinal cut" instead of external surface; and so, according to his experiments, he very happily generalises the expressions of Matteucci, confirming at the same time the immediate results of his researches.

After the discovery of the muscular current Matteucci had to acknowledge that very many of the phenomena he had hitherto derived from the "current proper" belong to the muscular current. Analysis of facts showed him that, conformably with the views of Du Bois, in nearly all animals the muscular current suffices to explain all the phenomena he had observed, and that, strictly speaking, the frog alone evinces phenomena which seem to require for their explanation a "current proper" besides the muscular current.

It was not without hesitation that Matteucci brought himself to attribute all the phenomena to the muscular current. Up to 1845 he had resolved to save the "current proper" of the frog at least for the frog itself, and the subsequent history of animal electricity has shown that Matteucci was not badly guided by his instinct. It is now proved that in reality the current which Nobili and Matteucci had primarily called "proper" to the frog is, in fact, proper to that and to some other animals—that it does not proceed from the muscles, but that it is produced in the skin. In this view the frog really possesses at least two kinds of currents, as Matteucci had for a long time maintained: the current of the skin and the current of the muscles.

If it has not been given to Matteucci to discover the alteration of the muscular current which accompanies the contraction of the muscle, he has alighted on a curious and interesting phenomenon which stands in close relation with the oscillations of the current in the contraction—the "contraction," I mean, which he has called "induced." The fact consists in this: that if a frog's nerve is extended upon the length of the muscle of another frog, every time that this muscle contracts the nerve becomes irritated in such a manner as to induce secondary contraction of the muscles which stand in relation with this nerve. A third nerve may be extended over the muscle of the second frog, and in this way induce tertiary contraction or quaternary, &c. This singular phenomenon has all the appearance of an electric irritation, but some experiments undertaken to test the hypothesis of an electric origin of the contraction in question did not give Matteucci all the certainty which appeared to him necessary to affirm decisively that the phenomenon is the effect of an electric variation in the muscle. To-day it is no longer doubted that a rapid diminution in the muscular current of the "inducement" frog—a diminution which exists during the contraction—is the cause of the so-called induced contraction of Matteucci.

No one can occupy himself with the production of electricity in the animal body without taking into consideration the electric fishes, in which the electro-motor power is found developed to a high degree. With these Matteucci often and deeply busied himself, examining the discharge of the torpedo with all the means then available of physics. Linari, with the aid of Matteucci, has succeeded in drawing the electric spark from the torpedo. Savi, at Matteucci's instance, has given us a magnificent anatomical description of the nervous centres and of the electric organ of this fish, and Matteucci was thus enabled to win appreciation of the analogy which exists between this organ and the muscle—an analogy already vaguely surmised in past ages, according to which these electric organs were *musculi falcati* (scythe-shaped muscles). Matteucci hoped that a more minute microscopic analysis of the electric organ might yield still stronger support to this analogy; and this analysis, made but recently by Wagner, Valentin, and the other day by Boll and Ciaccio, has not falsified his expectation—at least in all that relates to the distribution of the nerves.

We have still to speak of the last works of Matteucci which treat of the polarisation of the nerves. In the second part of the third series of the "Memorie della Società dei XL," 1863, p. 93, we find a memoir of his "Sulla teoria fisica dell'elettrotone dei Nervi," which contains, not all indeed, but the principal part of these researches. They give a very ingenious explanation of the phenomenon which, discovered by Du Bois, and described under the name of

electrotone, was for some time regarded as a mysterious product of the particular structure of the nerves.

It is true, as Du Bois has already observed, that, among all the known organic tissues, the nerve alone shows the phenomenon described as electrotone, but it is an exaggeration to believe that these phenomena do not yield to physical analysis. Matteucci has proved that the electrotone, far from being uselessly connected with the functional property of the nerve, may be considered as a secondary current produced by the electrolyses which are deposited at various points when a constant current runs along it—on condition of that being admitted which had long been probable—viz., that the axis-cylinder of the nerve is a much more perfect conductor of electricity than its surrounding medulla, which has all the appearance of an oily liquid. Not content with theory, Matteucci demonstrated by experiment that every cylinder composed of a central nucleus, which is a good conductor of electricity, and of an electrolyte of great resistance, as a peripheral stratum shows all the characteristic phenomena of the electrotone if the central conductor is polarisable in the electrolytic solution.

In other works on the same theme, Matteucci has developed yet further results, which were the fruit of these researches on the secondary polarisation.

It cannot be said that these latest works of Matteucci were received with much applause on their first publication. Too pronounced was the antagonism in which he placed himself with generally accredited opinion, and too simple appeared the explanation proposed by him; because, if true, it would have had to remain concealed for so long a time, in spite of the interest which the electrotone had awakened among the cultivators of electro-physiology, the ranks of whom were every year increasing. But Matteucci could still see the triumph of his doctrine. His experiments were repeated, his findings confirmed, new observations poured in to substantiate his own, and to-day we can class these latest works of Matteucci on the secondary polarity as among the most meritorious which exist in the field of electro-physiology.

ON THE EQUALISATION OF LIGHT IN HOSPITALS AND ROOMS.

By ROBERT MALLETT, Esq., C.E.

THE temperature of inhabited rooms has been rendered equable by means of the thermostat in connexion with a source of artificial heat and by other means, but no attempt that I am aware of has ever been made to devise apparatus by means of which the light which enters apartments, and more especially the wards of ophthalmic hospitals, might be rendered nearly uniform, whatever were the variations occurring in the amount of light at any moment coming from the sun. This varies not only with the period of the day or year, and with the serenity or obscurity of the sky, but also with every passing cloud; and in London, in the spring of the year especially, the constant transit over a sunlit sky of huge masses of opaque cumulous clouds, whose production is perhaps due to the wind setting over the hilly country which more or less surrounds the metropolis, produces a constant and rapid fluctuation of light, distressing to a healthy eye, and injurious to one diseased or overworked. This fluctuating light, which penetrates every apartment, is not, I believe, guarded against in the ophthalmic wards of any hospital in London, by any but the ineffectual provision of two sets of window-blinds, one set being quite opaque, the other of the ordinary white calico, sunlight filtered through which is, like the light passed through ground glass, distressing to all eyes. Though the production of a photostat, or apparatus for equalising the admission of daylight, is a much more delicate problem than that of the thermostat, it seems to me that in the present state of physical science the means may be devised for effecting the object sufficiently nearly for practical purposes, and I venture to recommend its consideration more especially to our electrical engineers or physicists. The problem can only be solved experimentally, and not without