

F. C. Donders : in memoriam / W. B.

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Publication/Creation

[London] : [Harrison and Sons], [1891?]

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In Memoriam

F. C. Donders

AMICO AMICUS
COMMUNIS AMICI (M. F.*) MANDATO,
LIBENTER OBEDIENS,

W. Bowman.

Holland has produced more, perhaps, than its share of men whose names are likely to be held in lasting honour by mankind, and among them hardly one greater or nobler as a hero of science than FRANS CORNELIS DONDERS. In him rare gifts of nature were so happily blended, and turned to such good account for the advantage of his fellow men, as to make him an illustrious example of how much may be accomplished for our race in those quiet paths of life in which he was well content to pass his days. He was, indeed, doubly fortunate, for, while he bore a conspicuous part in the extension of knowledge and its beneficent applications, in fields which he found already ripening for the discoveries with which his fame will be ever associated, he lived long enough to see the rich results of his labours universally and gratefully acknowledged by his contemporaries.

He was born the 27th May, 1818, at Tilburg, a manufacturing town of North Brabant, in the Kingdom of the Netherlands, in a community almost exclusively Roman Catholic. His father was a simple burgher, kindly and studious, who, though he seems to have left the cares of business very much to his more practical wife, while he occupied himself apart with chemistry, music, and literature, was still full of active sympathy with the less studious life around him. Eight daughters had been born to them, but, as yet, no son, when the unexpected fulfilment of a long deferred hope induced, it was thought, a congestion of the brain, under which the poor father rather suddenly succumbed. The child was tenderly reared by the mother and elder sisters, in narrow circumstances, and was probably spoiled, for he became unruly,

* Michael Foster, Sec. R.S.

and had to be sent at seven to the village school of Duizel, in the vicinity. Here he rapidly acquired all that the humble master, Mr. Panken, could impart, and showed such precocity, especially in arithmetic, that the rustics would mount him on the table of the village inn, and give him sums to solve for half-pence. It was thus, perhaps, discovered that he might be safely entrusted with the payment of the weekly wages by an employer, who rewarded him by a little pocket money. "Imagine the little boy with the dark eyes peeping out of the black locks"—the fond mother would say—"sitting behind the desk to give the coins to the big workmen!" He was also made responsible for the steady going of the village clock. They used to call him "Master's Frans." In after years, when Donders, the great Professor, was secretly requiting, by substantial benefits to afflicted relatives, the love bestowed upon him in childhood, such trifling incidents as these were recalled and treasured up by loving hearts, and they are, therefore, deemed not unworthy of a passing record here.

As he grew to be eleven years old he became so useful in the school that his mother was asked to allow him to remain there as a tutor for two years more at a salary. Thus early did the clever lad begin to exercise that innate aptitude for teaching which he afterwards cultivated to such perfection. He was subsequently moved on to other seminaries at Tilburg and Boxmeer, learned easily to converse in Latin and French, and less fluently in Greek. English he acquired from schoolfellows, since become London merchants, and friends of after life. In music, too, he was an adept, taking the 2nd violin in quartetts.

His religious instruction he first received from a sister of charity (*béguine*), who prepared the children for the priest's teaching. His sister Thérèse seems to have been a remarkable woman. He would relate of her that she was chosen abbess over a pauper establishment by the bishop, although the youngest of the community, and therefore in her own eyes unworthy. A photograph of her shows her to have been very like Donders in features. It is not surprising, perhaps, that his early reveries were of the priesthood; and some interesting traits have been preserved, witnessing to his boyish fervour in this direction; but, with opening manhood, the current of his aspirations, from whatever cause, entirely changed, and he never afterwards for a moment regretted his resolve to embrace a medical career. Having this in view, he would have proceeded to Liège, where his eldest sister was settled, having married M. Grandmont, subsequently head of the eminent firm of publishers in that city. But the revolution was about to break out, which was to end in the severance of Belgium from Holland, so he turned aside to the University of Utrecht, entering it as a medical student at the age of seventeen, and becoming at the same time a pupil in the Military Hospital.

"Indescribable" he says, on the occasion of his jubilee, after a lapse of fifty years, "was the impression made upon me here by the chemical lectures and experiments of Nicholaas de Fremery. When, for the first time, I mastered the notion that all that exists, in its infinite variety, is composed of a relatively small number of elements, which in certain proportions unite and reunite, it seemed to me as if, with the creation of the elements, the whole of nature had been given, and my imagination worked this out in its own way. Later on I became especially interested in Physiology, as taught by Schroeder van der Kolk."

The term prescribed for admission to his examination for his degree at Utrecht not having yet arrived, he anticipated it by at once proceeding to Leyden, where his unusual proficiency in Latin and his many accomplishments secured for him a brilliant reception from the academical body.* Thus accredited, he went immediately to Flushing as a military surgeon and health officer, and shortly afterwards was promoted to headquarters at the Hague. Here he worked intensely in the hospital wards, made autopsies, contributed papers to the medical journals, and was favourably noticed by the Director-General; who, being about to reorganise the Military Medical School at Utrecht, flatteringly invited him, then only in his twenty-fourth year, to give the courses on Anatomy, Histology, and Physiology. This was no light enterprise, for it included 18 lectures in the week for the 46 weeks which made up the scholastic year; but he undertook it joyfully, "feeling teaching to be his true vocation." Thus he came back already distinguished to his own University city, his home from that time onward. There he was soon to become famous.

G. J. Mulder, then recently appointed Professor of Chemistry in the University, was already powerfully contributing to give form to the new science of Physiological Chemistry, and his genius at once attracted and was attracted by that of Donders. The two soon became close friends and fellow workers, Donders occupying himself in every spare moment with microscopical researches in connexion with the chemistry of the elementary tissues, and publishing many original papers.† With Jac. Moleschott also, then very young, he established a lasting friendship, as well as with Opzoomer and others who, in their several ways, became eminent. In those days of opening manhood, Donders plunged eagerly and discursively into every avenue of spiritual and intellectual activity. Men of science, lawyers, divines, were alike his intimates, while, in general society, his

* His inaugural dissertation, based on original researches, was entitled "*Dissertatio inauguralis sistens observationes anatomico-pathologicas de centro nervoso*," 1840.

† *Vide, e.g., "Proofs of a General Physiological Chemistry,"* 1843-50, pp. 539 *et seq.*

musical and artistic temperament, responsive to every refined emotion, his quick perception and ready memory, his geniality and conversational powers, made his handsome presence everywhere acceptable.*

Donders was then," writes Moleschott with fervid admiration, "a swelling rose-bud, whose calix leaves signified nothing but pure science, the flower leaves hidden glory. In one word, he was a man complete—perfect for his time of life." His bright intelligence, indeed, was able to assimilate without apparent effort all that it saw and read of in the active world around—a world then agitated by novel questions, of absorbing interest, regarding the Constitution of the Universe and the true import of Man's place and being in it.

In those days very recent advances in the methods and aims of exact research, as applied to various branches of science, had made it possible to penetrate more deeply than ever before into many of the profounder mysteries of nature, and some grand enlightenment seemed near at hand. During the years following 1840, one conception in particular, that of the *Conservation of Energy in Nature*, long foreshadowed, was rapidly assuming definite shape under the ordeal of exact experiment pursued on many converging lines. It could hardly, however, have been said to have become yet established, even in the minds of the most advanced physicists, ere Donders had clearly recognised its far-reaching importance in its special application to the Science of Life, the foundations of which his keen gaze was then freshly exploring. In the winter of 1844, when but twenty-six, in "only a lecture, not pretending," he modestly says, "to any high scientific worth," he casts a glance on the change of matter as the source of animal heat.† Here we already find him embracing in his view all nature, and looking confidently to her most general and all-pervading laws for the explanation of the enigma of life. "Animal heat is chemical heat;" but the final and irreversible proof of this, he shows in detail, "can only be given when science shall have proved that the *quantity* of heat in the animal body answers absolutely to the chemical change which takes place there." "All working in nature, all life on earth, rests on the change of the elements from which it is formed, but side by side with this change of matter stands a change of forces. Both are inseparably bound up together. As the change of matter is the condition without which no life exists, so the change of forces is the condition without which no life gives evidence of itself. An idea arises gradually in science, which finds confirmation everywhere, absolute contradiction nowhere, an idea

* His stature was 6 feet 1 inch; circumference of head, 24 inches, English.

† "A Glance on the Change of Matter of Epitellurian Life as the Source of Proper Heat of Plants and Animals," by Dr. Donders, Military Doctor, 2nd Class, at the Military School of Medicine, delivered in the Society of Sciences, Utrecht; Van der Post, Feb. 1845. [In Dutch, never translated.]

great and all-encompassing, fertile for the future development of science, it is the Permanence of Forces. No one molecule of matter can be destroyed, but neither can a minimum of Energy. Thus runs the important hypothesis which may come to be the soul of natural science. The forces change and join, they appear under different forms, but no force is annihilated. Determinate quantities of movement, heat, light, electricity, magnetism, and nervous force respond to each other, and can pass from one into the other." "There is therefore a sum of energy, just as much as there is a sum of matter; both are proportionate to each other, both remain always the same."

And Donders was hardly less prescient as he stood on the threshold of that other great achievement of our era, the doctrine of the *Evolution of Organisms on our planet*. The knowledge of the elements and of the elemental forces, then rapidly extending, was being more and more applied to the elucidation of certain vital problems, on which the greatest minds had long speculated in vain. Standing as we now do in the fuller light of those crowning disclosures of the progression of living nature through past ages which we owe chiefly to the genius of Darwin and of Wallace, dealing with an opulence of new materials for thought, it is very interesting to notice how Donders, in that nascent period, regarded this momentous subject. Already, in 1846,* he had briefly contested the then all but universally accepted teleological notion of the origination of organic forms by separate creative interpositions, accounting it to be arbitrary and unscientific; and soon after, on being called to the Professoriate of the University, he deemed the topic "weighty enough for a wider treatment, and because of its general bearing, well suited to an inaugural discourse."† Herein, after passing in review the grander features of the material universe and of the earth, as then known, he strives to show that the harmony everywhere pervading living nature, then usually explained by the principle of design (conformity to an end), is simply a necessary result of the conditions under which all organisms have come to be what they have been, or are. Though by no means denying the existence of a purpose in the phenomena of nature, he insists that a doctrine of the purpose can never become science, and can indeed only tend to obstruct the progress of science by lulling to sleep the spirit of enquiry into the laws governing the phenomena. These remain open to investigation in the field of life, just as in that of inanimate matter.

It is remarkable how firmly Donders here grasps the certainty that all life has been ever in process of being moulded into its specific forms by the continuous operation, through long ages, of laws

* *Vide* Gids, 1846, pp. 893 *et seq.*

† "The Harmony of Animal Life, a Manifestation of Laws." By F. C. Donders, 28th Jan., 1848. [Also in Dutch, never translated.]

implanted in matter and the forces of matter; and that these laws have gradually but necessarily at every stage been operative on the plastic organisation, adapting it continuously to the new conditions which it was ever encountering; in default of which adaptation and renovation of the disturbed harmony, the organisation itself could not have survived. The laws must be studied in the phenomena; and he particularly discusses and illustrates the operation of three laws, which for shortness' sake he calls those of *habit*, of *exercise*, of *inheritance*. But it is not enough, he adds, to deduce the necessity of the harmony from these laws; we must endeavour to fathom these laws themselves more deeply. The two former, those of habit and of exercise, mutually interacting, continually tend towards a restoration of the harmony between the organism as a whole and its surroundings, and between the several component parts of the same organism, as the harmony becomes by little and little disturbed in lapse of time by the intercurrent of altered conditions. The last law, that of inheritance, carries over into the future the accumulated modifications of the past, so far as they have survived in the latest offspring, thus preserving the continuity of life through successive generations, but only by essential changes in its forms. "Already some light dawns in science on the causes of the phenomena we referred to, the laws of habit and of exercise; and thus, ascending from cause to cause, without ever losing ourselves in dreams about the purpose, we approach, slowly it is true, but with firm step, the ideal point of view, according to which all the phenomena of nature will be seen proceeding from the attributes of the elements and elementary forces. And if once by an All-wise Omnipotence these elements and forces have been created for a predetermined purpose, and if the conditions of the whole future have been enshrined in their attributes, then also not a single drop of blood flows without purpose through our veins, but it is a purpose which lies outside the science of nature."

As Donders had originally approached physiology from the side of medicine, so now he had evidently come to meditate deeply on this great theme of the procession of organic forms down the tracts of time on independent grounds of his own, and rather as a physiologist than as a naturalist. As other matters were engrossing his attention, he did not pursue this one to further conclusions; but he welcomed with delight the publication, in 1859, of Charles Darwin's book, 'The Origin of Species;' became, subsequently, the friend and correspondent of its illustrious author; and visited him at Down. He also, some years later, undertook, at his request, more than one elaborate investigation,* designed to elucidate obscure questions relating chiefly to

* *E.g.*, "On the Action of the Eyelids in Determination of Blood from Expiratory Effort," by F. C. Donders, translated in Beale's 'Archives,' 1870. See also

his work, 'On Expression of the Emotions in Man and Animals,' then under preparation.

Almost casually, in one of his letters to Darwin (14th March, 1871), thanking him for a copy of 'The Descent of Man,' Donders thus summarises in our language his own views of 1847: "I always took a great interest in the question of the origin of organised beings. Even in 1847 I wrote and published an essay (*oratio inauguralis*) on the subject 'Harmony of Animal Life, a Manifestation of Laws,' containing, from the physiological *point de vue*, a further development of the doctrine which had been indicated by Lamarck, although the communications on this subject of Lamarck were as unknown to me as almost to every one, in that period. Fully excluding final causes from scientific research and theory, I tried to show how the infinite harmonical relations, on the one hand, between animals and surrounding nature, on the other hand, between the different parts and organs of every organism, are to be deduced from the laws of adaptation by habitude and by exercise, and from the laws of transmission. I applied the same on the psychical actions. I admitted the gradual evolution of the highest orders of plants and animals from more simple forms of spontaneous origin, and the origin of different species from the same source. I indicated the changes which are obtained by artificial selection, found the cause of continual progress in the circumstance that every not well adapted form necessarily is condemned to perish, but still was not aware of the influence of natural selection, your great and immortal discovery, the mighty factor, which alone allowed to give a full and special demonstration of the theory of descent. As I began to write, I had not the intention to mention to you my little book, but, telling about my special interest in the subject, I rather involuntarily inclined to explain it. And now, although it is written in Dutch, I could not resist my wish to send you a copy, in the hope that you will benevolently accept it. . . ." Darwin replies (18th March, 1871), ". . . I have been interested in what you tell me about your views, published in 1848, and I wish I could read your essay. It is clear to me that you were as near as possible in preceding me on the subject of Natural Selection." And afterwards (June 19th, 1871), ". . . When reading over your several letters, the thought has often crossed my mind how incomparably better an essay on expression you could have written than that which I shall be able to produce. . . ."; (April 8th, 1872) ". . . I feel, every day, that to write on Expression, a man ought to have ten times as much physiological knowledge as I possess. . . ."; and (December 21st, 1872) ". . . My book on Expression, in writing which I was so deeply indebted to your kindness"—

'Life and Letters of Charles Darwin,' by Francis Darwin, vol. 3, and C. Darwin 'On Expression, &c.,' 1872, p. 160.

sentences, honourable alike to each of these eminent men, exhibiting true modesty, transparent candour, and in all simplicity a most generous appreciation of merit in the other.*

But to resume the tenour of Donders' life. In 1847, that his services might the better be secured to his University, he was named Professor Extraordinary, there being no vacancy among the ordinary chairs; and such was the confidence inspired by his character that he was asked to select his own subjects for lecture. He chose four, viz., Forensic Medicine, Anthropology (especially for students in theology and law), General Biology, Ophthalmology. To this last he had been drawn, not only by its own intrinsic charm, but from his having, in the preceding year, in order to eke out his slender resources (for he had now wife† and child), undertaken a Dutch translation of the great German treatise of Ruete on that subject, and from having thereupon thrown himself, as was his wont, heart and soul into whatever lines of original research this work, as it proceeded, had suggested to him. It is impossible here to particularise, but several of these were among the more subtle problems lying on the borderland of physiological optics, problems remaining to perplex even the most observant practitioner, until by their solution the path is made clear to all alike. Suffice it that Donders in this way became more and more attracted towards Ophthalmic Practice; for with readiness he gave all the help in his power to the physicians and patients who were eagerly approaching him, as they heard of his discoveries in the physiology of vision. And when it was proposed to him by some of our passing countrymen that he should acquaint himself with English methods of treatment, then much esteemed abroad, he came to London in 1851, on the occasion of our first "Great Exhibition," returning by way of Paris. Some of the incidents of this journey he himself soon after placed on record,‡ and he always spoke of it as having had a great influence in moulding his life. It was his first travel, and it brought him, at least, one thing for which he had great reason to be thankful—the personal friendship of Albrecht von Graefe, an association soon to be fraught with splendid results for the expanding science of Ophthalmology; for these two men, both of the first capacity, laboured ever afterwards to advance it as brothers in council, and alike fruitfully; freely communicating their ideas to each other, always in perfect harmony of aim. While von Graefe, a stranger in London, was able to tell Donders of the European hospitals he had been visiting, and of the new clinical ideas he was

* *Vide* Chas. Darwin 'On Expression, &c.,' Nov. 1872, p. 160, &c. The writer is indebted to Mr. Francis Darwin for the opportunity of perusing these letters.

† His first wife was Ernestine J. A. Zimmerman, daughter of a Lutheran pastor. (She died Sept., 1887.)

‡ Notes on London and Paris, 'Nederlandsch Lancet,' 1852.

maturing, as well as of the construction in that year, by Helmholtz, at Königsberg, of a dioptric apparatus for rendering visible the fundus of the eye, Donders, a stranger there too, could, on his side, explain many discoveries of his own in the physiological field, and, among other things, declare the true nature of the act of accommodation, quite recently disclosed with certainty by his countryman Cramer, under, it may be added, his own inspiration and in his own laboratory. It was somewhat later, though independently, that Helmholtz arrived at the same conclusion.

It is not wonderful that Donders, on his return to Utrecht, should have already decided on adding to the abounding work of his four-fold lectureship, including the theoretical side of Ophthalmology, the onerous responsibility of its daily practice. He had, in fact, been gradually led to recognise more and more that this department of the healing art, from the very nature of its subject-matter, affords an ampler scope and a firmer ground than any other for the application and exemplification of those scientific principles which must eventually bear sway in all its departments, if vagueness and uncertainty are to disappear under the slow but certain advances of exact knowledge.* But in addition he was then swayed by a special impulse hard to be resisted. It had long been known that in animals having a *tapetum lucidum* the rays of light entering the eye through the pupil are in part reflected outwards by that shining surface along the lines of entrance; and in 1846 our countryman Cumming, too early lost to us, had shown that in man also such a reflex was in a certain way demonstrable. But, in 1851, Helmholtz discerned that it must surely be possible, by an optical contrivance, to render visible the reflecting fundus itself by bringing these emergent rays to a focus upon the retina of an observer; and, as just mentioned, such means he had devised. The *Ophthalmoscope* was thus given to mankind, a discovery rather than an invention, as Helmholtz has himself remarked—a revelation transforming ophthalmology, and of itself entitling that great man to our ever grateful remembrance. In the words of Donders, “the whole world spoke of it; every one wanted to see the ophthalmoscope, which revived long-lost hope.” But Donders felt that a sphere for its employment in Holland was still needed; and his fellow citizens, appealed to for this, and fired with some of his own enthusiasm, provided him with a temporary hospital; a few years later subscribing funds for a permanent one.† “That result,” he remarks, “was obtained through the influence of the discovery of the ophthalmoscope and the appearance of von Graefe at Berlin.” “In

* *Vide* Francisci Cornelii Donders, oratio de justa necessitudine scientiam inter et artem medicam, et de utriusque juribus et mutuis officiis, quam habuit die xxvi m. Martii a. MDCCCLIII, quum magistratum academicum deponeret.

† Opened February, 1859, with forty beds.

those days" (he proceeds) "—I may here tell what I have kept secret till now—I was invited by the medical faculty of Bonn to be the successor of Helmholtz [as professor of physiology]. It was the unanimous wish of all the members of the faculty, including Helmholtz himself, then about to leave Bonn. The offer might have been tempting. With a gift of 40,000 florins in my hand, for a purpose marked out by myself, it could not be thought of. The Ophthalmic Hospital thus founded was to be an institution for patients, but also for investigation and research in Ophthalmology in its widest range, in connexion with the University, by which both science and practice might be advanced; and not only did our students share its advantages, but foreign fellow practitioners made their appearance to witness our proceedings and to participate in our enquiries."

These last had reference to a variety of problems presented in the course of the practical work which Donders now entered upon, but chiefly to the "Refraction and Accommodation Anomalies," which were found to be greatly more common than had been supposed, and to admit in large measure of exact definition and correction. In 1858, there appeared the first of a long series of essays, in which, during six years, he was able to propound a complete doctrine, complete as it left his hands, both as to theory and practice, of the employment and prescription of corrective glasses, a subject never really mastered till then, and yet of the widest importance in everyday life, for the young, the middle-aged, and the old of all classes, and for all future time. His results, elaborated down to their minutest details, were then arranged and collected into a volume, which it was his wish to offer to the world first, in its entirety, in an English form, as a reminiscence perchance of the welcome he had experienced here in 1851. This volume, as translated from the Dutch MS. by Dr. Moore, of Dublin, and revised by himself, was accordingly published by the "New Sydenham Society" in 1864, and dedicated to an English friend.* It was soon out of print, passed into several languages, and must remain the permanent classic, both as to theory and practice, on the topics embraced by it. To attempt an analysis of it would be beyond the scope of the present notice. It constitutes the title on which its author takes rank above all his contemporaries as the main founder of a very large province of modern Ophthalmology.

But it must not be supposed that these results, memorable as they were, stood alone among the achievements of Donders in those fertile

* 'On the Anomalies of Accommodation and Refraction of the Eye, with a preliminary Essay on Physiological Dioptries.' By F. C. Donders, M.D., Professor of Physiology and Ophthalmology in the University of Utrecht. Translated from the author's MS. by Wm. Daniel Moore, M.D., Dublin. The New Sydenham Society, London, 1864.

years. He was also enriching Physiology in other directions, even though well-nigh exhausting his strength in doing so: for he had been also serving the University as Rector, an office which he relinquished in 1853.* In conjunction with Dr. Bauduin he undertook a Manual of Physiology, which, however, he could only carry as far as the first volume, 'Special Physiology' (1853)—for its time a work of authority, and still the best record of contemporary teaching. In 1857, he discovered that in each vowel sound the mouth is tuned to a definite pitch, alike in men, women, and children using a common speech, and differing only with difference of dialect; this was confirmed by Helmholtz. Again, in 1865, Donders took the first step in a new field of research, by determining the rapidity of perceptions of Thought and of the Will. Others had arrived at the physiological time, or that required for reacting by a movement on a nervous irritation. But in the next succeeding years he carried these exquisite investigations much further, analysing the time taken in simple, and also in many and various complex, psychical processes, by a most ingenious and refined method, which he explained in 1876, at one of the Conferences at South Kensington in connexion with the Loan Collection of Scientific Apparatus.† Others of his physiological papers deserving special mention, among a great number, were: "On the timbre of the Vowels," "Muscular Work and Development of Heat in relation to the necessary Elements of Food," "On the Tongue-instruments in the Organs of the Voice and Speech," "Influence of the Vagus Nerve on the Cardiac Movements," "On Associations, congenital and acquired" (the latter are the result of habit in the individual, the former represent habit in the species), "The Chemical Phenomena of Respiration are a Process of Dissociation;"—indeed, to the close of his life he remained indefatigable in the domain of Physiology, almost continuously winning new laurels in one or other of its departments.

In 1862 an event had occurred having an important influence in this direction. By the death of Schroeder van der Kolk the chair of Physiology fell vacant, and it was immediately pressed upon his acceptance, with the understanding that a new Physiological Laboratory should be erected for his use. This was an appeal he could not withstand, though aware that it would involve a partial, and, gradually, an almost complete, relinquishment of his ophthalmic practice. But Physiology in its widest range, with the ample field it presented for Research, had been his first love, and to this his inclination now gradually led him back. His esteemed pupil, Snellen, became his colleague at the Hospital, and eventually succeeded him there; while Thomas W. Engelmann, who was to be in course of

* *Vide* note *, *ante*, p. xv.

† *Vide* 'Science Conferences,' 1876, Section Biology, pp. 224—228.

time his much loved son-in-law, became his assistant in the Laboratory, and finally, his eminent successor. Donders continued in these new circumstances to display the same marvellous productiveness as heretofore, and to animate, by his influence and example, the younger men attracted to him, often from distant countries. He delighted, as he had ever done, to make them taste the joy of becoming themselves the authors of some original work of value, and to engage their interest and help in his own laborious and systematic inquiries into whatever promised to benefit mankind in the sphere of the sciences he was cultivating.

No better example of this generous ardour of pursuit could be adduced than his method of dealing with the subjects of the Colour Sense and of Colour Blindness, then more and more attracting attention in relation to the public safety. It exhibits very aptly his many-sided excellence. While acquainting himself with the ideas of his predecessors, he first statistically ascertained, with accuracy for himself, the broader facts, engaging for this the aid of his younger colleagues and pupils. The delicate instruments which he was from time to time contriving in the course of his researches bearing on the theory of the Colour Sense and its defects, as on other subjects,* were constructed in a special department of his laboratory by the mechanic Kagenaar, whom he had reared from a youth and made his friend. His theoretical conclusions, as they were reached, were published in papers of permanent value.† Meanwhile he was also calling the attention of the higher officials of the railway and sea services, of his own and other countries, by all the means within his power, to the responsibilities they lay under for the lives of the community, in the matter of Colour Blindness; was framing rules for their acceptance, which they might suitably enforce; and pressing his conclusions to their final consequences in practical life, with such directness, moderation, and good sense, as compelled the attention and assent of administrators and statesmen. And that he might not fail in his immediate object of effecting a present benefit, he further, for many years personally undertook, without remuneration, the very considerable labour of superintending the carrying out of this matter on the railways of Holland, examining scrupulously into the more doubtful instances of supposed defect, so as to prevent injustice to individuals, and in every way facilitating the adoption of the new rules which he had suggested. No wonder that his countrymen,

* Many of these instruments were exhibited at South Kensington in the Loan Collection of Scientific Apparatus, 1876.

† His views of that day "On Colours and Colour Blindness" were well summarised by himself in the theatre of the Lucasian Professor at Cambridge, August, 1880, Sir George G. Stokes being present. See 'Brit. Med. Journ.,' 13th November, 1880.

even the humblest, followed him with grateful recognition when he appeared at the stations or moved among them.

Indeed, his life was one of incessant labour and benevolent endeavour to turn to useful ends each new insight into nature which he and others were acquiring. Sympathising with all, seeming to understand the sentiments and interests of all, he was generous as well as just in his judgment of others, yet ever courageous and firm in the assertion of whatever he deemed to be right and true. Indefatigable in the pursuit of truth, he was as able in imparting it. Eloquence, the graces of style, and the mastery of several languages combined to make him a great teacher. Even in his youth he had become conscious that to teach was to learn, and that to learn was the purest of intellectual enjoyments.

"I was already in correspondence with Donders," says von Helmholtz, in a letter to the present writer, "before 1856, when I lived in Königsberg. He had sent me his physiological treatise on Animal Heat and his handbook on Physiology, and as I had then made the first experiments on the change of form of the crystalline lens in accommodation, he told me about the somewhat earlier experiments made by Cramer in his laboratory. As far as I know, I first made his personal acquaintance during my stay at Bonn, between 1856 and 1859. He used to go in summer, with his then already ailing wife, to Cleve, to breathe purer air in that hilly country, as was then the fashion in Holland. From thence he came over to Bonn. I have also paid him a visit of a few days, in Utrecht, at that time, and lived in his house. . . . The loveableness, openness, and honesty of his character you know—I need not portray them to you. We have then and afterwards discoursed very much on scientific questions, as we many times and independently had taken the same problems in hand. He had, in Ophthalmology, the greater experience of patients, and I have learnt much from him in that respect; but even where it seemed to me that I must maintain my own opinion, I never observed in him the least sign of sensitiveness, or of too great warmth in defending his position. In his way of talking he had then already, as a young man, something of stateliness; he loved choice expressions, reminding one somewhat of the antique eloquence of the French Academy. But he was never prolix, indeed, rather concentrated, in his conversation, and I have always loved to listen to him, though in Germany we are very little accustomed to attend much to the artistic oratorical element in speaking. He was clearly a warm-hearted man with great ideal views, and he thought it his duty to give utterance to these ideal views before the world, and to show them in their height and significance. Moreover, he was aware of his capacity of impressing this with great force upon his auditory. Very beautiful in this respect was his last speech in handing over the Graefe Medal at

Heidelberg."* . . . "Our friendship has remained unclouded to the last."

Donders took, from time to time, a very conspicuous part in the assemblies and congresses of Science. Here he shone as a star of the first lustre. By universal consent he was a most admirable President, particularly where men of many nationalities were met together; for his wide and accurate knowledge and accomplishments, his tact, the grandeur of his simple earnestness, and his magnificent personal bearing acted as a spell on all. If the occasion seemed to demand it he would give an address, sentence by sentence, in two or more languages, with perfect mastery. He presided over the fourth International Congress of Ophthalmologists in London, 1872, and again, for the last time, over the seventh meeting of the same at Heidelberg, in 1888; over the sixth International Medical Congress, at Amsterdam, 1879; and he was Vice-President, as well as a Royal Medallist, of the seventh International Medical Congress in London, 1881. In his own country, from 1865 onwards, he annually presided over the Physical Section of the Royal Academy of Sciences, and (alternately with the President of the Literary Section), was President *in pleno*.

But in 1883 he expressed the wish to withdraw from some of the more arduous of his many engagements. He was soon, alas! to cease from the service of the University for which he had done so much. By the law of the Netherlands a Professor must retire at seventy. He was approaching that age, apparently in full vigour, though indications of gouty congestions had more than once occasioned some disquietude to his friends. His Jubilee was celebrated at Utrecht, on the 27th and 28th May, 1888, amid the universal applause of his countrymen and of men of science everywhere. He was decorated by the King, and in his honour a commemorative medal was struck. Forty of his former pupils communicated each an original scientific paper to a memorial Festival volume, published by a committee.† The Royal Society of London, which had elected him a Foreign Member in 1866, asked three of its Fellows, Sir Joseph Lister, Mr. Jonathan Hutchinson, and Dr. Hughlings Jackson, to convey to him its congratulations; our Physiological and Ophthalmological Societies also sent deputations. Indeed, hardly one civilised country but was in some way represented. A large sum had been subscribed, and was placed at his disposal. He assigned it to the establishment of Travelling Fellowships in Physiology and Ophthalmology, to be attached to the Universities of the Netherlands, with Utrecht as a centre; not without a glance, perchance, at an early incident in his own fortunate career. That career he now passed in review

* Viz., to von Helmholtz himself, 9th August, 1886. *Vide* 'Festsitzung der Ophthalm. Gesellschaft, &c.,' Rostock, 1886.

† 'Feestbundel Donders-Jubiléum, &c.,' pp. 546, Plates xvii.

before his assembled friends and pupils in a speech of touching simplicity and eloquence—a lasting and truthful survey of the lifework he had been enabled to accomplish. “I may be thankful,” he concluded, “for the life granted me. I stand here comparatively strong, and also ready to do what may be given me to do. I stand here, having reviewed my life, and having seen how manifold were the advantages that have been allotted to me. All this makes me grateful, fervently grateful, especially to the Eternal Source of all that exists, of which it is not given to man—a speck in the infinite space, a breath in the infinite time—to form an idea; he can do no more than bow reverently in absolute submission. This submission has been asked of me more than once. I hope also to find the strength to submit to what may be required of me in the future.”

Some sorrowful bereavements had indeed befallen him: in the loss, in 1870, of his only child Marie, after giving birth to twins; and more recently, in 1886, of the beloved and admirable partner of many years, after a long and distressing illness, through which he had nursed her with the tenderest assiduity. But he remained steadfast and full of trust, and he had many compensations. The retrospect of his life was happy; his contemporaries loved and honoured him as few men have been loved and honoured, recognising in him in a rare degree the possession and harmonious, fruitful, and lifelong exercise of some of the greatest and best attributes that can adorn human nature.

The last illness of Donders was sudden, as his father's had been, and in him, too, it was the circulation of the brain that failed. That powerful organ of sweetest feeling, high aspiration, and self-restrained will, which had enabled him to accomplish so much, even measuring for us the velocity of thought, was now itself to give way. He had come on a visit to England in October, 1888, and seemed to be supremely happy in the renewal of his domestic life. Most interesting was it to listen to the themes he opened as to the work he might soon undertake in the studio of his refined home, tracing the springs of Art to their most secret source in the very constitution of man's bodily organisation, subject in all respects to the conditions and limitations imposed by physiological laws. The operations of these laws he had long delighted to track out to their remotest consequences, and to communicate his conclusions to masters in art of the quality of his friends Sir Fred. W. Burton and G. F. Watts. His studies had always inclined him in this direction, and he now hoped to execute a design he had long cherished, of illustrating his conceptions and views by reference to the life of Leonardo da Vinci, the great artist with a scientific turn of mind, to whose figure he had ever felt himself especially attracted. In such a field, had his days

been prolonged, it is probable that he would still have left behind him rich legacies of thought (for who so capable?), in which rigidly exact definitions of scientific truth would have been seen to be in truest harmony with the most exquisite sensibility to every form of beauty, natural or artistic.

But the joy of anticipation was a perilous joy, and could not be long supported. Pathetic were the circumstances of the last fatal seizure, for in the intervals of illness he knew and weighed as in a balance of the laboratory all its phases, with unimpassioned serenity and resignation, though not without sadness, while witnessing the grief of those who loved him, and recalling the scenes in which he had acted so conspicuous a part. He rallied sufficiently to be able to return home under the escort of his brother-in-law, who had been summoned to his bedside in England. But relapses recurred, with varying alternations and pauses. During these weeks of suspense, so agonizing to his friends, he often spoke of the insoluble riddle of existence, and of the hope of a future reunion. One afternoon he had walked with assistance in front of his house (it was his last walk), and he seemed refreshed. "We have had a nice walk, and you are better," said one. "Yes," he replied, "a beautiful walk—is it not a beautiful walk?—to *Eternity*!" He died on the 24th March, 1889, within a year of his jubilee.

The day of his burial was indeed one of gloom in Utrecht.

The second wife of Donders was Bramine, daughter of Mr. P. F. Hubrecht, Secretary of the Home Office at the Hague, sister of Professor Hubrecht, of Utrecht, a lady of noble disposition and of wide culture. We owe to her remarkable talent several fine portraits of him, for one of which, a three-quarter length, painted for his jubilee, she received the award of a gold medal at Munich in 1888. It is destined for the National Museum at Amsterdam. Others are, a half-length, with his decorations, in the Hall of the Professors at the University; one at the Ophthalmic Hospital, representing him as in 1864, soon after the foundation of the hospital; and a fourth, as seated in his study, with the bust of von Helmholtz at his side, in the last year of his life, painted for his twin grandchildren, Frans and Paula Engelmann. There are also two life-size heads by Mr. Watts, R.A., painted in 1873-75, during some of his brief visits to England. One of these, never completed, but remaining a grand sketch, forms one of Mr. Fred. Hollyer's series of Mr. Watts's portraits, and has been reproduced as the frontispiece to the present volume of the 'Proceedings of the Royal Society' by Mr. Dew-Smith, of the Cambridge Engraving Company. Both this and the jubilee portrait were exhibited at the Royal Society Conversazione,

18th June, 1890. There is, lastly, a life-size oil picture of Donders as he was in 1881, for which the writer is indebted to the kindness of his old friend E. U. Eddis, Esq.

Some Published Notices of FRANS CORNELIS DONDERS.

Some Earlier Ones.—(1.) A. Kölliker, Skizze einer wissenschaftlichen Reise nach Holland und England in Briefen an C. Th. v. Siebold. Zeitschrift f. Wissensch. Zoologie v. C. Th. v. Siebold und Kölliker, vol. 3, 1850, p. 86. (2.) F. C. Donders, Notes on London and Paris. Nederlandsch Lancet, 1852 (translated into English at the time). (3.) Photographs of Eminent Men of all Countries, with Brief Analytical Notices of their Works. By T. Herbert Barker, M.D., and Ernest Edwards, M.A., 4to, London, 1867–8, vol. 3, pp. 93–104. *Later.*—(4.) F. C. Donders, Discours d'Ouverture, Congrès International des Sciences Médicales, Amsterdam, 1879. Edition corrigée. (5.) Festsitzung der Ophthalmologischen Gesellschaft in der Aula der Heidelberger Universität am 9 Aug., 1886.—Ueberreichung der Graefe-Medaille an Hermann von Helmholtz, Rostock, 1886. (6.) Het Jubileum van Professor F. C. Donders gevierd te Utrecht op 27 en 28 Mei, 1888.—Gedenkboek uitgegeven door de Commissie, Utrecht, P. W. Van de Weijer, 8vo, pp. 210, 1889. (7.) Franciscus Cornelis Donders. Festgruss zum 27 Mai, 1888. Dargeboten von Jac. Moleschott, 8vo, pp. 51, Giessen, 1888. *Some Obituary and other Notices.*—(8.) Mort de Donders. Annales d'Oculistique, publiées par le Dr. Warlomont, 8vo, pp. 141–144, Mars-Avril, 1889. (9.) Franz Cornelius Donders, M.D. Brit. Med. Journ., 30th March, 1889 (by W. A. Brailey). (10.) F. C. Donders, par le Dr. E. Landolt, Extrait des Archives d'Ophtalmologie, Mai-Juin, 1889 (a just and eloquent tribute, translated in 'The Illustrated Medical News,' 14th September, 1889, with a portrait). (11.) Die Ophthalmologische Gesellschaft während der ersten fünfundzwanzig Jahre ihres Bestehens, von 1863 bis 1888. Im Auftrage des Ausschusses zusammengestellt und herausgegeben von Wilhelm von Zehender, 8vo, pp. 111, Rostock, 1888. (12.) Commemorazione dell' Accademico onorario Francesco Cornelio Donders, &c. Letta dal Prof. G. Colasanti nella seduta della R. Accademia Medica di Roma il 28 Aprile, 1889, 8vo, pp. 16. (13.) F. C. Donders, Klinische Monatsblätter für Augenheilkunde, herausgegeben von Dr. von Zehender, Mai, 1889, 8vo, pp. 163–168. (14.) Prof. Snellen (notice of Donders) 'Het Nederlandsch Gasthuis voor Behoeftige en Minvermogene Ooglijders gevestigd te Utrecht,' 29 Juli, 1889. (15.) F. C. Donders et son Œuvre, par Prof. J. P. Nuel (Liège), 'Ann. d'Oculistique,' 8vo, pp. 1–107, 1889 (with an analysis of 208 of Donders' papers and treatises, and a portrait—a full and admirable

account). (16.) F. C. Donders, Gedenkrede gehalten in der feierlichen Jahressitzung der Budapester Kön. Gesellschaft der Aertze am 14 Oct., 1889, von Dr. W. Goldzieher, 8vo, pp. 28. (17.) Bericht über die Zwanzigste Versammlung der Ophthalmologischen Gesellschaft, Heidelberg, 1889; redigirt durch W. Hess und W. Zehender, Rostock, 14 Dec., 1889. (18.) Mannen van Beteekenis in onze Dagen, Redactie: Dr. E. D. Pijzel.—Prof. Donders, door Dr. B. J. Stokvis, Haarlem, 1889. (19.) F. C. Donders,—von Horstmann, 'Deuts. Med. Wochenschrift,' 1889, No. 14. (20.) F. C. Donders, by Wenckebach, in 'Students Almanach' of Utrecht, Jan., 1890. (21.) Franciscus Cornelius Donders, by Henry Williams, M.D., Prof. of Ophthalmology in Harvard University, in Proc. Amer. Acad. Arts and Sciences, vol. 24, pp. 465-470. (22.) Franciscus Cornelis Donders, in 'Onderzoekingen gedaan in het Physiologisch Laboratorium der Utrechtsche Hoogeschool.' Uitgegeven door Th. W. Engelmann en C. A. Pekelharing. Veerde Reeks, I. 1., Utrecht, C. H. E. Breijer, 1890 (a true and deeply interesting tribute to Donders' work and character, by his son-in-law, signed "E.").

W. B.

Joldwynds, Dorking, 24th March, 1891.



