

TRANSLATORS' PREFACE.

The present volume of the series of English translations of M. Arago's works consists of his own autobiography and a selection of some of his memoirs of eminent scientific men, both continental and British.

It does not distinctly appear at what period of his life Arago composed the autobiography, but it bears throughout the characteristic stamp of his ardent and energetic disposition. The reader will, perhaps, hardly suppress a smile at the indications of self-satisfaction with which several of the incidents are brought forward, while the air of romance which invests some of the adventures may possibly give rise to some suspicion of occasional embellishment; on these points, however, we leave each reader to judge for himself. In relation to the history of science, this memoir gives some interesting particulars, which disclose to us much of the interior spirit of the Academy of Sciences, not always of a kind the most creditable to some of Arago's former contemporaries.

But a far higher interest will be found to belong to those eloquent memoirs, or éloges of eminent departed men of science, who had attained the distinction of being members of the Academy.

In these the reader will find a luminous, eminently simple, and popular account of the discoveries of each of those distinguished individuals, of a kind constituting in fact a brief history of the particular branch of science to which he was devoted. And in the selection included in the present volume, which constitutes but a portion of the entire series, we have comprised the accounts of men of such varied pursuits as to convey no inadequate impression of the progress of discovery throughout a considerable range of the whole field of the physical sciences within the last half century.

The account given by the author, of the principal discoveries made by the illustrious subjects of his memoirs, is in general very luminous, but at the same time presupposes a familiarity with some parts of science which may not really be possessed by all readers. For the sake of a considerable class, then, we have taken occasion, wherever the use of new technical terms or other like circumstances seemed to require it, to introduce original notes and commentaries,

sometimes of considerable extent, by the aid of which we trust the scientific principles adverted to in the text will be rendered easily intelligible to the general reader.

In some few instances also we have found ourselves called upon to adopt a more critical tone; where we were disposed to dissent from the view taken by the author on particular questions of a controversial kind, or when he is arguing in support, or in refutation, of opposing theories on some points of science not yet satisfactorily cleared up.

We could have wished that our duty as translators and editors had not extended beyond such mere occasional scientific or literary criticism. But there unfortunately seemed to be one or two points where, in pronouncing on the claims of distinguished individuals, or criticizing their inventions, a doubt could not but be felt as to the perfect *fairness* of Arago's judgment, and in which we were constrained to express an unfavourable opinion on the manner in which the relative pretensions of men of the highest eminence seemed to be decided, involving what might sometimes be fairly regarded as undue prejudice, or possibly a feeling of personal or even national jealousy. Much as we should deprecate the excitement of any feeling of hostility of this kind, yet we could not, in our editorial capacity, shrink from the plain duty of endeavouring to advocate what appeared to us right and true; and we trust that whatever opinion may be entertained as to the *conclusions* to which we have come on such points, we shall not have given ground for any complaint that we have violated any due courtesy or propriety in our *mode* of expressing those conclusions, or the reasons on which they are founded.

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LIVES
OF
DISTINGUISHED SCIENTIFIC MEN.
THE HISTORY OF MY YOUTH:
AN AUTOBIOGRAPHY OF FRANCIS
ARAGO.

I have not the foolish vanity to imagine that any one, even a short time hence, will have the curiosity to find out how my first education was given, and how my mind was developed; but some biographers, writing off hand and without authority, having given details on this subject utterly incorrect, and of a nature to imply negligence on the part of my parents, I consider myself bound to put them right.

I was born on the 26th of February, 1786, in the commune of Estagel, an ancient province of Roussillon (department of the Eastern Pyrenees). My father, a licentiate in law, had some little property in arable land, in vineyards, and in plantations of olive-trees, the income from which supported his numerous family.

I was thus three years old in 1789, four years old in 1790, five years in 1791, six years in 1792, and seven years old in 1793, &c.

The reader has now himself the means of judging whether, as has been said, and even stated in print, I had a hand in the excesses of our first revolution.

My parents sent me to the primary school in Estagel, where I learnt the rudiments of reading and writing. I received, besides, in my father's house, some private lessons in vocal music. I was not otherwise either more or less advanced than other children of my age. I enter into these details merely to show how much mistaken are those who have printed that at the age of fourteen or fifteen years I had not yet learnt to read.

Estagel was a halting-place for a portion of the troops who, coming from the interior, either went on to Perpignan, or repaired direct to the army of the Pyrenees. My parents' house was therefore constantly full of officers and soldiers. This, joined to the lively excitement which the Spanish invasion had produced within me, inspired me with such decided military tastes, that my family was obliged to have me narrowly watched to prevent my joining by stealth the soldiers who left Estagel. It often happened that they caught me at a league's distance from the village, already on my way with the troops.

On one occasion these warlike tastes had nearly cost me dear. It was the night of the battle of Peires-Tortes. The Spanish troops in their retreat had partly mistaken their road. I was in the square of the village before daybreak; I saw a brigadier and five troopers come up, who, at the sight of the tree of liberty, called out, "*Somos perdidos!*" I ran immediately to the house to arm myself with a lance which had been left there by a soldier of the *levée en masse*, and placing myself in ambush at the corner of a street, I struck with a blow of this weapon the brigadier placed at the head of the party. The wound was not dangerous; a cut of the sabre, however, was descending to punish my hardihood, when some countrymen came to my aid, and, armed with forks, overturned the five cavaliers from their saddles, and made them prisoners. I was then seven years old.

[1]

My father having gone to reside at Perpignan, as treasurer of the mint, all the family quitted Estagel to follow him there. I was then placed as an out-door pupil at the municipal college of the town, where I occupied myself almost exclusively with my literary studies. Our classic authors had become the objects of my favourite reading. But the direction of my ideas became changed all at once by a singular circumstance which I will relate.

Walking one day on the ramparts of the town, I saw an officer of engineers who was directing the execution of the repairs. This officer, M. Cressac, was very young; I had the hardihood to approach him, and to ask him how he had succeeded in so soon wearing an epaulette. "I come from the Polytechnic School," he answered. "What school is that?" "It is a school which one enters by an exami-

nation." "Is much expected of the candidates?" "You will see it in the programme which the Government sends every year to the departmental administration; you will find it moreover in the numbers of the journal of the school, which are in the library of the central school."

I ran at once to the library, and there, for the first time, I read the programme of the knowledge required in the candidates.

From this moment I abandoned the classes of the central school, where I was taught to admire Corneille, Racine, La Fontaine, Molière, and attended only the mathematical course. This course was entrusted to a retired ecclesiastic, the Abbé Verdier, a very respectable man, but whose knowledge went no further than the elementary course of La Caille. I saw at a glance that M. Verdier's lessons would not be sufficient to secure my admission to the Polytechnic School; I therefore decided on studying by myself the newest works, which I sent for from Paris. These were those of Legendre, Lacroix, and Garnier. In going through these works I often met with difficulties which exceeded my powers; happily, strange though it be, and perhaps without example in all the rest of France, there was a proprietor at Estagel, M. Raynal, who made the study of the higher mathematics his recreation. It was in his kitchen, whilst giving orders to numerous domestics for the labours of the next day, that M. Raynal read with advantage the "Hydraulic Architecture" of Prony, the "Mécanique Analytique," and the "Mécanique Céleste." This excellent man often gave me useful advice; but I must say that I found my real master in the cover of M. Garnier's "Treatise on Algebra." This cover consisted of a printed leaf, on the outside of which blue paper was pasted. The reading of the page not covered made me desirous to know what the blue paper hid from me. I took off this paper carefully, having first damped it, and was able to read underneath it the advice given by d'Alembert to a young man who communicated to him the difficulties which he met with in his studies: "Go on, sir, go on, and conviction will come to you."

This gave me a gleam of light; instead of persisting in attempts to comprehend at first sight the propositions before me, I admitted their truth provisionally; I went on further, and was quite surprised,

on the morrow, that I comprehended perfectly what overnight appeared to me to be encompassed with thick clouds.

I thus made myself master, in a year and a half, of all the subjects contained in the programme for admission, and I went to Montpellier to undergo the examination. I was then sixteen years of age. M. Monge, junior, the examiner, was detained at Toulouse by indisposition, and wrote to the candidates assembled at Montpellier that he would examine them in Paris. I was myself too unwell to undertake so long a journey, and I returned to Perpignan.

There I listened for a moment to the solicitations of my family, who pressed me to renounce the prospects which the Polytechnic School opened. But my taste for mathematical studies soon carried the day; I increased my library with Euler's "Introduction à l'Analyse Infinitésimale," with the "Résolution des Equations Numériques," with Lagrange's "Théorie des Fonctions Analytiques," and "Mécanique Analytique," and finally with Laplace's "Mécanique Céleste." I gave myself up with great ardour to the study of these books. From the journal of the Polytechnic School containing such investigations as those of M. Poisson on Elimination, I imagined that all the pupils were as much advanced as this geometer, and that it would be necessary to rise to this height to succeed.

From this moment, I prepared myself for the artillery service,—the aim of my ambition; and as I had heard that an officer ought to understand music, fencing, and dancing, I devoted the first hours of each day to the cultivation of these accomplishments.

The rest of the time I was seen walking in the moats of the citadel of Perpignan, seeking by more or less forced transitions to pass from one question to another, so as to be sure of being able to show the examiner how far my studies had been carried. [2]

At last the moment of examination arrived, and I went to Toulouse in company with a candidate who had studied at the public college. It was the first time that pupils from Perpignan had appeared at the competition. My intimidated comrade was completely discomfited. When I repaired after him to the board, a very singular conversation took place between M. Monge (the examiner) and me.

"If you are going to answer like your comrade, it is useless for me to question you."

"Sir, my comrade knows much more than he has shown; I hope I shall be more fortunate than he; but what you have just said to me might well intimidate me and deprive me of all my powers."

"Timidity is always the excuse of the ignorant; it is to save you from the shame of a defeat that I make you the proposal of not examining you."

"I know of no greater shame than that which you now inflict upon me. Will you be so good as to question me? It is your duty."

"You carry yourself very high, sir! We shall see presently whether this be a legitimate pride."

"Proceed, sir; I wait for you."

M. Monge then put to me a geometrical question, which I answered in such a way as to diminish his prejudices. From this he passed on to a question in algebra, then the resolution of a numerical equation. I had the work of Lagrange at my fingers' ends; I analyzed all the known methods, pointing out their advantages and effects; Newton's method, the method of recurring series, the method of depression, the method of continued fractions,—all were passed in review; the answer had lasted an entire hour. Monge, brought over now to feelings of great kindness, said to me, "I could, from this moment, consider the examination at an end. I will, however, for my own pleasure, ask you two more questions. What are the relations of a curved line to the straight line that is a tangent to it?" I looked upon this question as a particular case of the theory of osculations which I had studied in Lefschütz's "Fonctions Analytiques." "Finally," said the examiner to me, "how do you determine the tension of the various cords of which a funicular machine is composed?" I treated this problem according to the method expounded in the "Mécanique Analytique." It was clear that Lagrange had supplied all the resources of my examination.

I had been two hours and a quarter at the board. M. Monge, going from one extreme to the other, got up, came and embraced me, and solemnly declared that I should occupy the first place on his list. Shall I confess it? During the examination of my comrade I had

heard the Toulousian candidates uttering not very favourable sarcasms on the pupils from Perpignan; and it was principally for the sake of reparation to my native town that M. Monge's behaviour and declaration transported me with joy.

Having entered the Polytechnic School, at the end of 1803, I was placed in the excessively boisterous brigade of the Gascons and Britons. I should have much liked to study thoroughly physics and chemistry, of which I did not even know the first rudiments; but the behaviour of my companions rarely left me any time for it. As for analysis, I had already, before entering the Polytechnic School, learnt much more than was required for leaving it.

I have just related the strange words which M. Monge, junior, addressed to me at Toulouse in commencing my examination for admission. Something analogous occurred at the opening of my examination in mathematics for passing from one division of the school to another. The examiner, this time, was the illustrious geometer Legendre, of whom, a few years after, I had the honour of becoming the colleague and the friend.

I entered his study at the moment when M. T—, who was to undergo his examination before me, having fainted away, was being carried out in the arms of two servants. I thought that this circumstance would have moved and softened M. Legendre; but it had no such effect "What is your name," he said to me sharply. "Arago," I answered. "You are not French then?" "If I was not French I should not be before you; for I have never heard of any one being admitted into the school unless his nationality had been proved." "I maintain that he is not French whose name is Arago." "I maintain, on my side, that I am French, and a very good Frenchman too, however strange my name may appear to you." "Very well; we will not discuss the point farther; go to the board."

I had scarcely taken up the chalk, when M. Legendre, returning to the first subject of his preoccupations, said to me: "You were born in one of the departments recently united to France?" "No, sir; I was born in the department of the Eastern Pyrenees, at the foot of the Pyrenees." "Oh! why did you not tell me that at once? all is now explained. You are of Spanish origin, are you not?" "Possibly; but in my humble family there are no authentic documents preserved

which could enable me to trace back the civil position of my ancestors; each one there is the child of his own deeds. I declare to you again that I am French, and that ought to be sufficient for you."

The vivacity of this last answer had not disposed M. Legendre in my favour. I saw this very soon; for, having put a question to me which required the use of double integrals, he stopped me, saying: "The method which you are following was not given to you by the professor. Whence did you get it?" "From one of your papers." "Why did you choose it? was it to bribe me?" "No; nothing was farther from my thoughts. I only adopted it because it appeared to me preferable." "If you are unable to explain to me the reasons for your preference, I declare to you that you shall receive a bad mark, at least as to character."

I then entered upon the details which established, as I thought, that the method of double integrals was in all points more clear and more rational than that which Lacroix had expounded to us in the amphitheatre. From this moment Legendre appeared to me to be satisfied, and to relent.

Afterwards, he asked me to determine the centre of gravity of a spherical sector. "The question is easy," I said to him. "Very well; since you find it easy, I will complicate it: instead of supposing the density constant, I will suppose that it varies from the centre to the surface according to a determined function." I got through this calculation very happily; and from this moment I had entirely gained the favour of the examiner. Indeed, on my retiring, he addressed to me these words, which, coming from him, appeared to my comrades as a very favourable augury for my chance of promotion: "I see that you have employed your time well; go on in the same way the second year, and we shall part very good friends."

In the mode of examination adopted at the Polytechnic School in 1804, which is always cited as being better than the present organization, room was allowed for the exercise of some unjustifiable caprices. Would it be believed, for example, that the old M. Barruel examined two pupils at a time in physics, and gave them, it is said, the same mark, which was the mean between the actual merits of the two? For my part, I was associated with a comrade full of intelligence, but who had not studied this branch of the course. We

agreed that he should leave the answering to me, and we found the arrangement advantageous to both.

As I have been led to speak of the school as it was in 1804, I will say that its faults were less those of organization than those of personal management; for many of the professors were much below their office, a fact which gave rise to somewhat ridiculous scenes. The pupils, for instance, having observed the insufficiency of M. Hassenfratz, made a demonstration of the dimensions of the rainbow, full of errors of calculation, but in which the one compensated the other so that the final result was true. The professor, who had only this result whereby to judge of the goodness of the answer, when he saw it appear on the board, did not hesitate to call out, "Good, good, perfectly good!" which excited shouts of laughter on all the benches of the amphitheatre.

When a professor has lost consideration, without which it is impossible for him to do well, they allow themselves to insult him to an incredible extent. Of this I will cite a single specimen.

A pupil, M. Leboullenger, met one evening in company this same M. Hassenfratz, and had a discussion with him. When he reëntered the school in the morning, he mentioned this circumstance to us. "Be on your guard," said one of our comrades to him; "you will be interrogated this evening. Play with caution, for the professor has certainly prepared some great difficulties so as to cause laughter at your expense."

Our anticipations were not mistaken. Scarcely had the pupils arrived in the amphitheatre, when M. Hassenfratz called to M. Leboullenger, who came to the board.

"M. Leboullenger," said the professor to him, "you have seen the moon?" "No, sir." "How, sir! you say that you have never seen the moon?" "I can only, repeat my answer — no, sir." Beside himself, and seeing his prey escape him, by means of this unexpected answer, M. Hassenfratz addressed himself to the inspector charged with the observance of order that day, and said to him, "Sir, there is M. Leboullenger, who pretends never to have seen the moon." "What would you wish me to do?" stoically replied M. Le Brun. Repulsed on this side, the professor turned once more towards M. Leboullenger, who remained calm and earnest in the midst of the un-

speaking amusement of the whole amphitheatre, and cried out with undisguised anger, "You persist in maintaining that you have never seen the moon?" "Sir," returned the pupil, "I should deceive you if I told you that I had not heard it spoken of, but I have never seen it." "Sir, return to your place."

After this scene, M. Hassenfratz was but a professor in name; his teaching could no longer be of any use.

At the commencement of the second year, I was appointed "*chef de brigade*." Hatchette had been professor of hydrography at Collioure; his friends from Roussillon recommended me to him. He received me with great kindness, and even gave me a room in his lodgings. It was there that I had the pleasure of making Poisson's acquaintance, who lived next to us. Every evening the great geometer entered my room, and we passed entire hours in conversing on politics and mathematics, which is certainly not quite the same thing.

In the course of 1804, the school was a prey to political passions, and that through the fault of the government.

They wished forthwith to oblige the pupils to sign an address of congratulation on the discovery of the conspiracy in which Moreau was implicated. They refused to do so on the ground that it was not for them to pronounce on a cause which had been in the hands of justice. It must, however, be remarked, that Moreau had not yet dishonoured himself by taking service in the Russian army, which had come to attack the French under the walls of Dresden.

The pupils were invited to make a manifestation in favour of the institution of the Legion of Honour. This again they refused. They knew well that the cross, given without inquiry and without control, would be, in most cases, the recompense of charlatanism, and not of true merit.

The transformation of the Consular into the Imperial Government gave rise to very animated discussions in the interior of the school.

Many pupils refused to add their felicitations to the mean adulations of the constituted bodies.

General Lacuée, who was appointed governor of the school, reported this opposition to the Emperor.

"M. Lacuée," cried Napoleon, in the midst of a group of courtiers, who applauded with speech and gesture, "you cannot retain at the school those pupils who have shown such ardent Republicanism; you will send them away." Then, collecting himself, he added, "I will first know their names and their stages of promotion." Seeing the list the next day, he did not proceed further than the first name, which was the first in the artillery. "I will not drive away the first men in advancement," said he. "Ah! if they had been at the bottom of the list! M. Lacuée, leave them alone."

Nothing was more curious than the *séance* to which General Lacuée came to receive the oath of obedience from the pupils. In the vast amphitheatre which contained them, one could not discern a trace of the gravity which such a ceremony should inspire. The greater part, instead of answering, at the call of their names, "I swear it," cried out, "Present."

All at once the monotony of this scene was interrupted by a pupil, son of the Conventionalist Brissot, who called out in a stentorian voice, "I will not take the oath of obedience to the Emperor." Lacuée, pale and with little presence of mind, ordered a detachment of armed pupils placed behind him to go and arrest the recusant. The detachment, of which I was at the head, refused to obey. Brissot, addressing himself to the General, with the greatest calmness said to him, "Point out the place to which you wish me to go; do not force the pupils to dishonour themselves by laying hands on a comrade who has no desire to resist."

The next morning Brissot was expelled.

About this time, M. Méchain, who had been sent to Spain to prolong the meridional line as far as Formentera, died at Castellon de la Plana. His son, Secretary at the Observatory, immediately gave in his resignation. Poisson offered me the situation. I declined his first proposal. I did not wish to renounce the military career,—the object of all my predilections, and in which, moreover, I was assured of the protection of Marshal Lannes,—a friend of my father's. Nevertheless I accepted, on trial, the position offered me in the Observatory, after a visit which I made to M. de Laplace in company with M.