

## THE PUBLIC FACE OF SCIENCE: FRANÇOIS ARAGO

**Mathias Dörries**

Deutsches Museum, Múnic

*Summary: The French (Catalan born) scientist François Arago took on the role of a mediator between science and the public, government and Academy, scientists and industrialists, poor and rich, between those scientists who focused on research and those who were first and foremost excellent teachers. He was driven in his actions by the strong belief in the necessity of a gradual solution to social conflicts after long and tumultuous debates.*

*Key words: vulgarization, Académie des Sciences, science and society.*

In the late 19th century Amédée Mouchez, director of the Paris Observatory, called François Arago «the most powerful scientific promoter of the century, the most important *vulgarisateur*»<sup>1</sup>. Indeed, François Arago's life is the story of a man who rose from modest origins to the highest scientific and political responsibilities achieving a considerable if not decisive influence on the development of science and its position in French society during the 1830s and 1840s. For Arago *vulgarisation* was crucial to his relentless promotion of science: it meant more than the simple transmission of scientific knowledge, and always embedded a political message as well<sup>2</sup>. Arago's scientific and political aims were closely linked: scientific education furthered political emancipation of the people and therefore the democratization of the French society, and vice-versa, democratization of French society would bring about favourable conditions for the penetration of society by science and technology. One of Arago's first priorities was to create a free climate for discussion, which would teach people to articulate their opinions and convictions. Arago made it his task to initiate this educational process.

The reasons for Arago's strong emphasis on *vulgarisation* lie in the circumstance that he himself had profited from the radical political reforms promulgated in the aftermath of the French revolution. He wished to see his own successful career as the prototype for every member of the French society, and strongly supported change in French social and political conditions so that everybody would be able to find an appropriate place in society. In short, he advocated a meritocracy and the abolition of traditional aristocratic privileges.

<sup>1</sup> MOUCHEZ, Ernest (1879), «Discours», in: *Inauguration de la statue de François Arago*. Perpignan, 60-72, p. 61.

<sup>2</sup> For the history of *vulgarisation* and further references see: BENSAUDE-VINCENT, Bernadette; RASMUSSEN, Anne (eds.) (1997), *La science populaire dans la presse et l'édition: XIXe et XXe siècles*. Paris.

## 1. The new meritocracy

François Arago, born a few years before the French revolution, grew up in the village of Estagel, near Perpignan in southern France. The family were rather well-to-do peasants, the so-called *pagès*; they had enough to cover living expenses but not enough to provide an extensive education for their children<sup>3</sup>. Arago's mother, Marie Roig (1755-1845) had a strong influence on the education of her children. The daughter of a peasant, she had taught herself to write and read, and had strongly encouraged her children to study<sup>4</sup>. His father, François-Bonaventure (1754-1814) cultivated land, on which he grew olives and wine. He had studied law at the university of Perpignan, and he later profited from this education when he became a candidate for mayor of his village, and for other governmental positions after the French revolution. As the head of the *garde nationale* in Estagel he defended the department against Spanish troops. In 1797 the family left Estagel and moved to Perpignan where Arago's father worked in the mint<sup>5</sup>.

François Arago was the fifth child of eight. His own career appears to be less remarkable in view of his brothers and sisters, who all chose careers that led them out of the world of rural Roussillon. Three brothers went into the military, another brother who had traveled the world became a painter, writer and editor; another worked briefly in a chemical laboratory in Paris before becoming a writer and the head of a theatre and engaging in politics that forced him into exile in 1848. His sister married an astronomer in Paris (in fact Arago's colleague); his other sister also moved with her five children to Paris after the death of her husband<sup>6</sup>.

Arago's youth was marked by the tension between Catalan tradition and the outcome of the French revolution. Catalan was Arago's native language<sup>7</sup>, but French became

<sup>3</sup> See BIREMBAUT, Arthur (1981), «Les ancêtres attestés de François Arago», *106e Congrès national des Sociétés savantes*, Perpignan, vol. 4, 135-143. For an overview of the secondary literature see DAUMAS, Maurice (1943), *Arago; la jeunesse de la science*, Paris (re-edited: Paris, 1987). The latest edition discusses the literature up to 1987, see pp. 298-300. More recent articles are ROSMORDUC, Jean (1988), «Arago et la naissance de la polarimétrie», *Revue d'histoire des sciences*, 41, 25-38; GRISON, Emmanuel (1989), «François Arago et l'École Polytechnique», *Bulletin de la société des amis de la bibliothèque de l'École polytechnique*, 4, 1-28; GAUDANT, Jean (1991), «Les puits artésien de Grenelle fête ses 150 ans», *Travaux du comité français d'histoire de la géologie*, 5, 9-15. See also the biography of Arago's brother Étienne: TOULOTTE, Muriel (1993), *Etienne Arago (1802-1892): une vie, un siècle*. Perpignan.

<sup>4</sup> Toulotte (1993), 24-28; *Le Moniteur* 25 July 1845.

<sup>5</sup> FRENAY, Étienne (1987), «François Arago, enfant des lumières», in: François Arago, *Actes du colloque national des 20, 21 & 22 octobre 1986*, *Cahiers de l'Université de Perpignan*, 2, 101-107, p. 102. See also FRENAY, Étienne (1986) *Arago et Estagel, son ville natale*. Estagel.

<sup>6</sup> See Toulotte (1993) and LAUREILHE, Marie-Thérèse (1960), «Jacques Arago, auteur de lithographies politiques», *Bulletin de la Société de l'histoire de l'art français*, 61-68; (1952) «Jacques Arago, illustrateur du voyage autour du monde de la corvette 'L'Uranie'», *Bulletin de la Société de l'histoire de l'art français*, 96-102.

<sup>7</sup> It is interesting to note that Arago never defined himself as a Catalan and that historians have never dis-

obligatory after the reforms during the French revolution. One result of these reforms was the creation of secondary schools in Perpignan, an *École centrale* as well as a *Collège*. Arago who had attended the primary school in his village, then went on to study in these secondary schools, where he received a classical education in French and Latin; physics and natural history were absent from the curriculum.

The most decisive reform for Arago, however, was the creation of the *École Polytechnique* in 1794, whose task was to guarantee a sufficient supply of military and civil engineers. The School stood for enlightened ideas, for education as a means to ensure democratic ideas, and aimed at the application of science and technology with respect to the arts. It represented the new values of the French republic, with access no longer restricted to a privileged class, but theoretically open to anybody. There was a yearly competition in mathematics that took place all over France and only the best ones were chosen. In preparation for the competition Arago started studying mathematics as an autodidact, and he qualified in 1803 in sixth position<sup>8</sup>. New political conditions increased the permeability of French society and played a considerable, if not decisive influence to bring promising young students, like Arago, to Paris. The usual alternative would have been a military career.

When Arago came to Paris he had talent but no training in the natural sciences. While studying at the *École Polytechnique*, he by chance obtained a position as *secrétaire-bibliothécaire* in the Paris Observatory which allowed him to participate in astronomical and geodetic measurements<sup>9</sup>, at a time that he was still intending a career in the military. Arago thought he would work only provisionally in the realm of science, since there was little hope to earn money in the area<sup>10</sup>.

A decisive turn came when while working at the observatory he came in contact with the physicist Jean-Baptiste Biot, who in 1805 suggested to undertake a common project to finish triangulation measurements south of Barcelona. The origins of this project lay once again with the French revolution, with the decision of the Convention to standardize lengths and weights. The meter had been defined as the 10millionth part of the distance between the pole and the equator, and Delambre and Méchain had undertaken measurements between Dunkerque in the north of France and Barcelona, but had been unable to finish the project. Under quite difficult circumstances, Arago and Biot started their work. But the war that erupted in March 1808 cut short the project and the measurements in Majorca could no longer be taken. Arago was taken prisoner, went through all kinds of adventures, finally es-

---

cussed his origins; rather he has always presented himself as coming from the French southwest. This is in part a result of Arago's self-representation as a nationalist Frenchman, who welcomed centralisation, and had no interest to strengthen provincial values and traditions.

<sup>8</sup> See BELHOSTE, Bruno (1994), «Un modèle à l'épreuve. L'École Polytechnique de 1794 au Second Empire», in BELHOSTE, Bruno; DALMEDICO, Amy Dahan ; PICON, Antoine (eds.) (1994), *La formation polytechnicienne 1794-1994*. Paris, 9-30. PINET, G. (1887), *Histoire de l'École polytechnique*. Paris.

<sup>9</sup> BERTHALOT, Raymonde (1987), «Arago et l'Observatoire de Paris», in: François Arago, Actes du colloque national des 20, 21 & 22 octobre 1986, *Cahiers de l'Université de Perpignan*, 2, 11-22.

<sup>10</sup> CROSLAND, Maurice (1967), *La société d'Arcueil*. London, p. 86.

caped to North Africa and came back to Paris only one and a half years later, this time as a hero<sup>11</sup>.

His return in 1809 was followed almost immediately by his election to the Académie des Sciences at the very young age of 23. At this period no scientific career per se yet existed; moreover, Arago had not even written a single scientific paper by himself, and only published papers in collaboration with others. At this time began criticism of Arago's scientific qualifications, which would follow him for the rest of his life. Already quite early in Arago's career it was obvious that his talents lay not in research, but in the organization of science, a fact of which he himself was quite aware. While his scientific work contained excellent ideas and opened promising lines of research, Arago did not follow his ideas through. There was no doubt that his talent was far above average, but he was no genius<sup>12</sup>. It is therefore even more extraordinary that throughout his life Arago had an acute sense for new theoretical ideas and approaches of others: for example his decisive influence in supporting the work in optics of Fresnel, whom Arago brought out of obscurity to Paris<sup>13</sup>. What had made his own rise possible was on the patronage of influential scientists, like Biot, Humboldt or Bouvard, with whom Arago had established close friendships<sup>14</sup>.

Once elected to the Académie des Sciences and enjoying favourable conditions for work, Arago turned into a forceful advocate of science, first within the community of scientists, but then more and more in public. He regarded it as his task to accelerate scientific progress by trying to create more favourable circumstances for the progress of science. His self-created role might best be described as a catalyst<sup>15</sup>. Though still young, he developed a paternalistic attitude towards younger colleagues and made himself the friend of those scientists from whom he expected the utmost scientific progress. Once convinced of their scientific potential he remained faithful to them and tried to help them with their scientific ideas and

<sup>11</sup> See for Arago's version of these adventures his autobiography *Histoire de ma jeunesse*, in: *Oeuvres*, vol. 1, p. 1-102; TEN, Antonio E (1987), «Arago, géodésien», in: François Arago, Actes du colloque national des 20,21& 22 octobre 1986, *Cahiers de l'Université de Perpignan*, 2, 67-89.

<sup>12</sup> See for example the severe judgement by the mathematician Joseph Bertrand: «L'influence d'Arago était due à ses qualités personnelles, beaucoup plus qu'à sa renommée scientifique. Une science très vaste, un grand talent, un brillant esprit, le don de persuader, de conduire et de soumettre les hommes, sont des qualités très différents du génie d'invention.» Joseph Bertrand, in: DAUMAS (1987), p. 144. Also JAMIN, Jules (1885), «Eloge historique de M. François Arago», *Mémoires de l'Académie des Sciences* 44, lxxix-cxxii.

<sup>13</sup> For Fresnel see BUCHWALD, Jed Z. (1989) *The rise of the wave theory of light*. Chicago. See also FOX, Robert (1974), «The rise and fall of Laplacian physics», *Historical Studies in the Physical Sciences* 4, 89-136.

<sup>14</sup> For the discussion around Arago's election, see HOME, R.W. (1983), «Poisson's memoirs on electricity: Academic politics and a new style in physics», *British Journal for the History of Science* 16, 239-258; TANTON, René (1987), «Arago et l'Académie des Sciences», in: François Arago, Actes du colloque national des 20,21& 22 octobre 1986, *Cahiers de l'Université de Perpignan*, 2, p. 26; CROSLAND (1967), 164-165.

<sup>15</sup> See also CAWOOD, John (1985), «François Arago, homme de science, homme politique», *La recherche* 16, 1.464-1.471, p. 1468.

their material well-being for the rest of his life. Thus he created a wide net of personal relationships and slowly acquired considerable power over events in Paris. His rising influence showed in the election of new members to the Académie des Sciences like Malus, Poisson, Fresnel and Navier; in the energetic influence and support of Ampère's research; in his editorship of the *Annales de chimie et physique* from 1816 on; and in institutions like the Observatory and the École Polytechnique, where he worked closely with the military<sup>16</sup>.

From 1813 he gave public lectures on astronomy that immediately made him famous. Mandated by the Convention, it was the task of one of the members of the Bureau des longitudes to give these lectures. Arago, a brilliant speaker who knew how to address the audience, turned these lectures into a social event of the first importance and attracted a wide range of the Parisian population, including women, children, and dignitaries<sup>17</sup>. Arago gave these lectures for more than 30 years until 1846.

From the 1830s Arago held highly responsible positions: he became *secrétaire perpétuel* of the Académie des Sciences, and from 1831 he was a deputy in the parliament, representing his district of Perpignan. Politically, Arago was a moderate republican (though he never fully embraced republicanism); he belonged to the left 'Radical Party', a name that was adopted after the term 'republican' was forbidden in 1835. Arago defended property and the family, objected to radical social transformation and the terror of the first French republic. His most radical political view he gave in a parliamentary speech—one of the most outstanding ones given in parliament during the July Monarchy—in 1840, when he demanded the «universal right to vote» and the «organization of work»<sup>18</sup>. Finally, for the very short period of several months in 1848, Arago was to take over high political responsibility in the government.

As one of the two *secrétaires perpétuels* of the Académie des Sciences, which was a position for life, Arago obtained a decisive and lasting influence on scientific events in France. The *secrétaires perpétuels* served as judges who separated important scientific work from unimportant one, and their judgments often decided the careers of young scientists. They represented the Académie des Sciences *vis-à-vis* the larger public, especially by holding public *éloges* for deceased members. And, finally, they were also the link between scientists and administration, ministry and government, giving advice to governmental commissions and being responsible for furnishing expertise, when asked by the government<sup>19</sup>.

<sup>16</sup> For an overview of the French scientific landscape see: FOX, Robert (1973), «Scientific enterprise and the patronage of research in France 1800-79», *Minerva*, 11, 442-473 and FOX, Robert; WEISZ, G. (Ed.) (1980), *The organization of science and technology in France, 1808-1914*. London.

<sup>17</sup> Mouchez speaks about the «grande sensation», caused by Arago's lectures. MOUCHEZ, Ernest (1879), «Discours», in: *Inauguration de la statue de François Arago*. Perpignan, 60-72, p. 66. For the history and the content of these lectures, see ARAGO, François (1854-1862), *Oeuvres*. Paris, vol. 17, XIV-XXXVIII.

<sup>18</sup> ARAGO (1854-1862), «Discours sur la réforme électorale», *Oeuvres*, vol. 12, 589-614, pp. 590-591.

<sup>19</sup> See CROSLAND, Maurice (1992), *Science under control. The French Academy of Sciences, 1795-1914*. Cambridge.

## 2. Opening the Académie des Sciences to the public

Once elected *secrétaire perpétuel*, Arago eagerly took on what he regarded to be the most urgent needs of his times: popularizing science to the public, and popularizing politics to scientists. Both were efforts to broaden the basis of science in France. Popularizing science to the public meant large-scale education; popularizing politics to scientists was a matter of showing to colleagues that science could actively be constructed and convincing them that they could take part in shaping their future. Arago introduced two major decisions: first, Arago chose to open the Académie des Sciences not only to journalists but also to the larger public. Arago fostered a new climate in the Académie des Sciences, drawing public attention to the sciences; second, Arago also imposed the publication of the *Comptes rendus* from 1835 on, a weekly publication of some 40 pages, useful for the quick circulation of scientific results. A success that made the Académie des Sciences the focus of public and political debate.

Why did the Académie des Sciences open its doors? To answer this question it is necessary to go back to the time before 1830. During the Restoration science was on the defensive, and the Académie des Sciences had to struggle for independence from political interference. One reliable strategy for strengthening scientists' status was to look for a new ally, the public, and to strengthen pressure on the government via the masses. This was something new: it meant engaging the public in the daily business of science. The hope was that transparency in the Academy's actions would lead to a more widespread support for science, and solidify political opposition. The first steps were taken in the 1820s under the *secrétaires perpétuels* Fourier and Cuvier, when some journalists were allowed to listen to the weekly sessions of the Academy.

The Academy's slow opening to the public ran parallel to a more general discourse within opposition forces about how to reformulate the interaction between government and the public. The issue lay at the heart of reflections of the *doctrinaires*, a group of political philosophers, which formed its ideas in the 1820s. Guizot, one of its leading members, aimed to overcome the traditional separation of public and government, and agitated for a new role of the press and public opinion<sup>20</sup>.

In the Académie des Sciences science was now open to new participants who—more or less—stood outside scientific research. In fact, science and scientists now risked exposure at an unknown scale. In what way science would develop under the eyes of new players? Scientists and politicians regarded the public with ambivalent feelings. The crowds of the French revolution revived bad memories, and any political philosophy of the time had to devise strategies to prevent any repetition of that kind of event. No doubt, Arago ruled the Academy with a firm hand and imposed his authority whenever the public tried to interfere with the Academy's task. Nevertheless, the public exercised pressure on the Academy in a more indirect manner tolerated by Arago: it transformed the communication among scientists inside the Academy by its mere presence, and it certainly had its preferred subjects to which it was more attentive (either in support or criticism). It was up to Arago to justify the new situation to which he had contributed so heavily. In fact, he wanted it to have both ways: an Academy that continued research as in former glorious days, and an Academy that was attentive to pub-

<sup>20</sup> ROSANVALLON, Pierre (1985), *Le moment Guizot*. Paris, pp. 67-68.

lic interests. For him it was important to keep the Academy in the centre of public concerns, as a stage for the transmission of knowledge. Arago reserved for himself the role of the great communicator between social groups, and he liked to play a leading role in propagating such decisive scientific and technological results as Fresnel's theory of light or the art of photography.

Arago's popular science encountered strong criticism from what Arago's close friend Alexander von Humboldt ironically called 'aristocratic science.' In March 1840 the mathematician Guglielmo Libri wrote three anonymous articles in the *Revue des Deux Mondes*<sup>21</sup>. A refugee from Italy, Libri was a gifted mathematician and had made –with Arago's help– an astonishing career in France, becoming one of the younger members of the Academy of Sciences in 1833 at the age of 30.

Libri's article sent out a warning signal that French science was about to lose its dominant status in Europe. This was not due to general scientific malaise, nor to lack of funding, rather to a disturbing new feature of scientific activity: its prominence and popularity for a larger public. Libri had mixed feelings about the public's strong attention towards science: the public tended to assimilate science to its own populist needs. With the end of the July Monarchy, Libri argued, there was no further need for political agitation, and public attention only deflected scientists from their real work. Public condemnation of scientists on purely political grounds was counter-productive and would threaten important work done by conservative or revisionist figures, like the mathematician Cauchy or the physicist Ampère. In the Academy's newly constructed meeting room, Libri lamented, the public dominated, the best places were assigned to journalists, and speakers, instead of addressing primarily their colleagues, rather faced the new audience. Libri regarded the Academy as engaged on an «offending» and «dangerous» course and feared for the «dignity» of science.

The quality of research was threatened by public taste. For Libri «science of minor quality» was about to replace abstract research and mathematical works. By science of minor quality Libri meant «little scientific games,» like Daguerre's discoveries, to which the Academy had paid considerable attention. Arago, he complained, focused on curious, isolated effects, and neglected long research, mathematics, theoretical astronomy, higher theories and broader conceptions. Arago –so Libri– preferred a narrative science to science that required mathematical demonstrations. Concessions of this kind had led the Academy on the wrong path, to the low grounds of public taste and preference. What was needed, was to reclaim a noble place for science, to lead it out of daily political business to new spiritual heights.

Libri's elitist view of science made him feel closer to colleagues in other countries. The Academy's primary orientation, Libri suggested, should be toward contact with foreign societies, and he pointed to the Academy's neglect of contact with other leading scientists (such as Gauss or Berzelius) who no longer cared to send their research work to the Academy. What Libri suggested was a horizontal international association, not a vertical national one, as intended by Arago. Libri saw the Academy as an institution whose future work was to control, register and further scientific achievements on a world-wide scale, not to continue its time-consuming function as a tribunal of industrial issues of minor importance.

<sup>21</sup> LIBRI, Guglielmo (1840), «Lettres à un Américain sur l'état des sciences en France», *Revue des Deux Mondes* 21, 789-818; 22, 532-544; 23, 410-423.

There was another person who opposed the direction the Academy took under Arago's directorship: the physicist Jean-Baptiste Biot, a relic of Laplacian physics. He had lost an election for *secrétaire perpétuel* in 1822 to Arago's favorite Fourier. Arago and Biot had had several fights over priorities and other issues, which led to Biot's momentary distance from the Academy during the 1820s. Biot defended a line of research that did not exclude mathematics, but that was based on Newtonian physics and focused on solid experimental work, meaning observation, experiment, and mathematical calculations.

Many themes that Libri had raised were also of concern to Biot, however with differences in style and tact. Like Libri, Biot took care to draw a line between scientists and the public, and feared for the dignity of the institution: meetings had turned into a «spectacle,» he deplored, where scientists cultivated their vanity. What was at stake, was the «seriousness» and the «depth» of science. Biot argued that scientists became more and more reluctant to discuss and speculate in the Academy, as every dispute or possible error was commented upon in the *feuilleton scientifique* of the journals some days later. These fears, expressed in the 1840s, Biot was to regard as fully confirmed in the 1850s, when he severely criticized the Academy for dealing more with demands from outside, than with research from within, and for its lack of discussion. By then the Academy had become for Biot populist and had lost its independence; it had turned into an «office for free scientific advertisement»<sup>22</sup>.

Biot also regarded the publication of the Academy's *Comptes-rendus* from 1835 on with mixed feelings: though they contributed to the creation of an «intellectual forum of high energy», he was doubtful whether this excitement was compatible with science real progress, which was the result of careful, long-lasting studies. Biot took care to develop his argument about why he wanted to separate the public and scientists. He stressed the *provisional* character of science, and argued that this provisional character lay outside the public's perception. Biot did not present science as a catalogue of truths, but as a process on its way to truth. Science was an on-going project. He feared that the public might not distinguish enough between the lasting mathematical methods, and the provisional nature of the results that one can deduce from them. Biot propagated the ideal of a scientist in the ivory tower, but he was also the first to recognize that this ideal was out of fashion. In the end the public stance of science was for him only an inevitable sign of modern times.

Thus the common characteristics of Arago's opponents were an option for an elitist science, advocacy of a separation of research from applied science, and the preference for mathematical and abstract research. They all meant more or less an adherence to traditional values and the exclusion of the public from scientific inquiry.

### 3. Rendering scientists' life and work public: Arago's éloges

One of the most important public tasks of the *secrétaire perpétuel* was to hold the eulogies on deceased members. Eulogies occupied an important position at the interface between science and the public. The genre of *éloges* flourished in France after the foundation of the academies in the seventeenth century. By holding *éloges* academicians affirmed their in-

<sup>22</sup> BIOT, Jean-Baptiste (1858), *Mélanges scientifiques et littéraires*. Paris, vol. 2, pp. 278, 292.



dependence from political interference establishing thereby their own norms; they used them as powerful new tools to propagate new criteria for honor and distinction, a task that formerly had been restricted to kings. *Eloges* appealed to the French literary mind; firmly anchored in French culture, they engaged large sections of the French public, –and even the Catholic church<sup>23</sup>.

The rules in the Académie des Sciences were quite different from the Académie Française as the eulogies were held in public sessions. In the course of the eighteenth century the *éloges* turned into important public manifestations of science. Held at public meetings, the *éloges* reached out to a wide audience that included professional and amateur scientists, politicians, literary critics, journalists, and a curious public. Wrapped in elegant rhetoric the eulogies made science more digestible for the public. For the *secrétaire perpétuel* holding a eulogy was an ultimate consecration –and a torment, as it led the *secrétaire perpétuel* on unfamiliar terrain and put his diplomatic, rhetorical, and literary skills to severe public scrutiny.

The *secrétaires* were generally free in their choice about whom they wished to speak, usually a former member of the Academy. Arago put a considerable amount of work into these *éloges*: in their written form their length often exceeded 100 pages, for which Arago had studied original manuscripts and letters. Altogether he wrote 13 of them (Condorcet, Bailly, Watt, Volta, Monge, Carnot, Poisson, Ampère, Gay-Lussac, Malus, Fresnel, Fourier, Young). This was yet another facet of his ambitious programme of educating the public.

Arago's *éloges* included many moral judgments on his former colleagues, and not always favourable ones. In fact, he refused to call them *éloges*, but preferred instead the more neutral term *notices biographiques*. Arago rejected any heroic story, but rather wished to provide a complete account of the scientists' life. «The men of the elite have to be looked at under all possible aspects: it is important for the history of human intelligence to say whether the same individual may be a genius under some aspects and an ordinary man under all other aspects», he wrote<sup>24</sup>. By telling scenes from scientists' private lives, he aimed to demonstrate what price scientists paid for their careers, where they succeeded and failed. This turned sometimes to a more amusing, or embarrassing side, when he described the physicist Ampère complaining loudly about bad food at an official dinner. For Arago these anecdotes were part of his investigation of to what extent science was compatible with happiness and political and social life.

By laying open the weaknesses of even the most respected scientists, Arago did not intend to attack the dignified facade of science, but to make scientists more likeable and more accessible, for the public. He wanted to overcome the eighteenth century, where scientists and mathematicians had been regarded as coming from another planet. Unsurprisingly, these attempts provoked anger and distaste from conservative colleagues and literary critics, for whom the strength of the traditional *éloge* lay in beauty of style and abstraction from concrete and disturbing facts. With Arago the public reading of the *éloges* turned into a political

<sup>23</sup> For the history of the *éloges* see BONNET, Jean-Claude (1986), «Les morts illustres: Oraison funèbre, éloge académique, nécrologie», in: NORA, Pierre(ed.) (1986), *Les lieux de mémoire. La nation*. Paris, vol. 3, 221-224.

<sup>24</sup> ARAGO (1854-1862), *Oeuvres*, vol. 2, p. 663.

event; they provided an occasion for releasing political and social messages. This was yet another facet of his ambitious programme of educating the people.

Arago's eulogies were of a deeply moral character and sent strong social messages. In his *éloge* on James Watt of 1834, he inserted a most extraordinary section on *Des machines, considérées dans leurs rapports avec le bien-être des classes ouvrières*, 'On machines considered with their relations to the welfare of the working class'. Here he tried to prove to the working class that the introduction of steam engines represented the solution to social problems. Workers should welcome technological innovations rather than fear them<sup>25</sup>. He also spoke out against child labor, against the hideous exploitation of the poor by the rich, against the death penalty; he opposed the slave trade and argued in favour of political rights for women. From 1837 on Arago felt confident enough to deal with those scientists who had lived through the political troubles of the French revolution. Arago's *éloges* analyzed scientists' political actions during the French revolution, and aimed to rehabilitate men such as Carnot, Fourier or Monge whose career had suffered during the restoration.

Arago used every possible occasion to speak at length about the humble origins of many scientists, thus indirectly drawing parallels to his own life. This was part of a political message that scientific genius was not linked to social rank or fortune and that innovative work could also come from places, like a workshop, as was the case with the inventor of steam engine Watt<sup>26</sup>. When Arago detailed the youth and education of eighteenth-century scientists, he listed the numerous obstacles they had encountered in the course of their scientific career. For Arago, scientists had fought a heroic battle because they had succeeded in crossing traditional barriers between social classes. Defending the ideal of *égalité*, Arago very much sympathized with Thomas Young's ideas (derived from Quaker thought) which argued that the intellectual capacities of children differed far less than assumed: «Every human being could have done what another human being has done»<sup>27</sup>. At least it was the duty of a just society to foster a society of merit.

#### 4. Conclusion

Arago did not always speak positively about the public. At times he scorned it as full of prejudices<sup>28</sup>. He pointed out that public judgment could sometimes be simply wrong, especially on scientific matters where its judgments depended on other sources. When he criticized the public Arago probably wished to reassure his scientific colleagues who disliked his frequent flirtation with it. He also wished to provoke the public and challenge it in preparation of its future role in science and society. Arago was firmly convinced that the public –despite

<sup>25</sup> *Ibid.*, vol. 1, pp. 431-449.

<sup>26</sup> *Ibid.*, vol. 1, p. 298.

<sup>27</sup> *Ibid.*, vol. 1, p. 281.

<sup>28</sup> *Ibid.*, vol. 1, p. 478.

all of its shortcomings— was genuinely morally good in the end. To justify this opinion he pointed to the public's unfailing ability to judge character (especially of those who ruled over them)<sup>29</sup>.

His educational program, the *vulgarisation* of science, encountered considerable difficulties. Arago had to admit that generally, the public—more interested in political and military events— was indifferent to scientific and technological discoveries with the exception of some spectacular objects, like the balloon. For the general public, scientific publications were difficult, if not impossible, to read; the nature and methods of scientific research were complicated and often obscure, particularly the use of numbers and mathematical calculations. Even for the *secrétaire perpétuel* it was difficult to explain adequately in a eulogy how a steam engine worked, and even harder to find a popular language for mathematics. Scientific investigation seemed a preoccupation for those who lived outside the real world. It was detrimental to passions and desires and threatened to distort human nature. The aseptic character of science, its lack of spontaneity, intuition and playfulness, its arrogant insistence on truth, its ridiculous presumptions, its offenses against religious aspirations made life unpleasant, or, as the poet Lamartine saw it, sterile.

How then to convey a vision that made science attractive? Where to find arguments to convince a hesitant public that the pursuit of science was worthwhile? These questions became increasingly important after the 1820s, when the manipulation of public opinion turned into a powerful political tool for politicians and scientists. Arago seduced the public by suggesting political participation via political reform, and *vulgarisation* provided initiation to the cult and practice of science. Science was the only means to overcome inequalities and the sole guarantee for a society free of social hardships. Technological advances meant benefits for all members of society, particularly the working class.

It is therefore unsurprising that the emphasis of Arago's message clearly shifted to the political realm (where the public was also much easier to reach). The literary critic Sainte-Beuve has distinguished between two series of Arago's *éloges*. For him, Arago's early eulogies on Fresnel, Fourier, Young and Watt were instructive and of good quality, whereas the later ones on Carnot, Bailly, Monge, and Condorcet formed a series of semi-political notes<sup>30</sup>. While Sainte-Beuve's distinction might be too clear-cut, it nevertheless points to an important shift. In his early eulogies Arago was still very optimistic about the public's intellectual capacities. He defended his eulogies against criticism that considered them as dry scientific lessons. However, this ideal of a purely rational *vulgarisation* of first-rate science rapidly vanished. Increasingly Arago problematised the possibility of *vulgarisation*, regretting for example that the *éloge* was too short to deal with scientific issues in sufficient detail<sup>31</sup>.

Arago took on the role of a mediator between science and the public, government and Academy, scientists and industrialists, poor and rich, between those scientists who focu-

<sup>29</sup> *Ibid.*, vol. 3, p. 51.

<sup>30</sup> SAINTE-BEUVE, Charles-Augustin (1855), «Oeuvres de François Arago,» *Causeries du lundi*, 10, 1-15, p.10.

<sup>31</sup> *Ibid.*, vol. 2, p. 42, p. 604.

sed on research and those who were first and foremost excellent teachers. He was driven in his actions by the strong belief in the necessity of a gradual solution to social conflicts after long and tumultuous debates. Arago was willing to make concessions to the public; in fact the very act of popularization was a concession. He denied the apparently dry character of science, taught with passion, and tried to stimulate the public's curiosity in scientific matters. What came out of Arago's science policy might be roughly defined as 'breadth rather than depth'. Arago aimed to obtain the highest number possible of scientifically educated people; in his eyes, only wide-spread education would assure the future of science and therefore of France.

Arago's 'science militante' was very short-lived. In fact, it collapsed at the very moment it seemed the time had come for its realization. In 1848 came the turning point, when Arago rose to power as a minister in the government only to abandon his political career a few weeks later. Still he had laid the ground on which science journalists, a profession that emerged during the 1850s and 1860s, could build. With Arago science had met a public.