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James Lequeux

François Arago

A 19th Century French Humanist
and Pioneer in Astrophysics

 Springer

James Lequeux
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Preface

Arago had more ideas by himself than a full generation.

(Léon Foucault 1853)

Many streets and places in France bear the name of Arago, and there are statues of him in Paris, Perpignan, and Estagel, the small city near Perpignan where he was born. The prestigious *École Polytechnique* has named an amphitheater from him, and one also finds his name written on the front of several high schools and of the Laboratory of Marine Biology of Banyuls, in the south of France. But if one asks: who was François Arago, one obtains in general only embarrassed answers. Some physicists remember him as a collaborator of Fresnel; a few persons interested in history cite his participation in the ephemeral government of France that followed the 1848 Revolution. But no one knows that Arago was basically an astronomer.

Arago has had no luck with History. Historians know Arago the political man, but his importance is too often underestimated,¹ and Arago the scientist is almost forgotten. However, the “Great Arago” was probably the best-known French scientist of his time. His contributions to science are far from negligible, and he played an eminent role in the promotion of science and of its applications. Arago is a rare case of a scientist who was also a statesman: It is exactly that which does harm to his posthumous reputation. There are other French scientists who were politically active during the French Revolution and later, for example, Jean-Sylvain Bailly, an astronomer who was the mayor of Paris, or Nicolas de Condorcet or Joseph Fourier, but none was as far-reaching as Arago in both domains. The only person who can be compared to him in this sense is Benjamin Franklin.

Arago had a prodigious scientific knowledge and a vast intellectual curiosity. His centers of interest were very diverse: he explored astronomy, geophysics, meteorology, and also physics in the emerging domains of thermodynamics, optics,

¹For details on the political activity of Arago, see Sarda (2000).

electromagnetism, and photography. It was still possible for a single mind of his time to cover the whole science as scientists were generally not very specialized. Ever generous, Arago never used his fame and his dominant position in French science for his own promotion; conversely, when he collaborated with other scientists like Fresnel or Ampère, he managed to make them known and let them have the full glory of their discoveries, even if his own contribution was important. This is another reason for which he has been somewhat forgotten. The physicist Charles Fabry wrote about him²:

He had a beautiful and generous personality, able to understand and to take interest in everything, with a devouring activity, passionate in his friendships as well as in his antipathies, always ready to defend his friends in all circumstances and to crush his enemies. Remarkable professor, outstanding popularizer, he had an enormous influence on all the audiences.[...] He managed to keep a large influence whatever the political regime, even under those he did not like, and this not by flattery, but because it was considered advisable not to have him as a declared opponent.

Guillaume Bigourdan summarizes Arago's activities as a scientist in his *History of the Board of Longitudes*³:

The discoveries of Arago in optics and in electricity could be claimed by the Board [sic!]; however I will only cite them here: they are in particular the electromagnet, which is presently very widespread—the discovery of chromatic polarization which dates from 1811, then of rotational polarization—the magnetism of rotation—finally a considerable number of applications, in particular the determination with Dulong of the elastic force of water vapor, a method to locate reefs at sea in 1835, etc. I will emphasize what concerns meteorology and [terrestrial] magnetism.

The contemporaries of Arago would speak of him as an astronomer rather than as a physicist. Indeed, he spent his entire scientific career at the Paris Observatory, from 1805 to his death in 1853. Still, the astronomer is even less known than the physicist, and it is significant that Guillaume Bigourdan does not mention his astronomical activities. The excellent biography⁴ of Arago by Maurice Daumas does not contain many details on them, and this is regretted by Jean Dhombres in his preface to this book.

Our knowledge of Arago's scientific activity has improved since Daumas, and I naturally wanted to place it within the science of the time, which was in a kind of ebullition. I also found it desirable to describe in some detail his instruments and his experiments, which could pose problems of interpretation to the readers of his publications. Finally, I found it interesting to discuss of Arago's considerable contributions to the technical developments of this period of intense industrial activity. Unfortunately, many people only remember a negative aspect: his inaction concerning the construction of railroads. This book will provide an opportunity to

²Fabry, C. (1938) in « La vie et l'œuvre scientifique d'Augustin Fresnel », paper inserted in *La vie et l'œuvre de Charles Fabry, Œuvres choisies publiées à l'occasion du jubilé scientifique de M. Charles Fabry*, Paris, Gauthier-Villars.

³*Bigourdan (1928–1932).

⁴Daumas (1987).

examine physics in a fascinating period when most of what serves in our daily life was created, with of course the exception of the telephone, the radio, and the electronics: optics, electricity, heat, thermodynamics, and photography.

This book is therefore mainly devoted to the scientific activity of Arago, with a survey of research during his lifetime and somewhat later. The first chapter describes the scientific institutions, which were often created during the French Revolution, and the conditions of research at the time; the second chapter summarizes the life of Arago; the two following chapters describe his work on the nature and velocity of light; the next one examines the beginning of electromagnetism, with Arago's discovery of "magnetism of rotation," which led Faraday to his discovery of induction. Chapters 6–9 are devoted to Arago's astronomical activity, in the broad sense as defined in his time: geodesy, then astronomical instrumentation and astronomy proper. The following chapters discuss his activities related to geophysics and applied physics, and Chap. 11 his actions to promote science. The last chapter summarizes the heritage of this great scientist. These chapters are independent and can be read in any order, but it is recommended to consult first Chaps. 1 and 2, and to read Chap. 7 before Chap. 8.

The works of Arago and many other documents cited in this book are accessible on Gallica, the Internet site of the *Bibliothèque Nationale de France* (<http://gallica.bnf.fr>); they are indicated by an asterisk.

Paris, France

James Lequeux

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