now involves terms linear in the velocity-components as well as quadratic terms. The procedure of Lagrange, evolved originally from the side of the Principle of Action, constituted the science of general dynamics by eliminating from the problem all variables the values of which are prescribed in terms of the remaining ones by relations of permanent constraint, thus reducing the dynamical analysis to the discussion of just as many quantities as are required to specify the state of the system. It gives cause for some surprise that nearly a century elapsed before the correlative step was taken, namely, the elimination from the analytical specification of the system of permanently steady or cyclic motions, as well as the permanent geometrical constraints above mentioned. In the hands of the analysts who treated the subject meanwhile, the requirements of the actual planetary and lunar theories were perhaps the main aim; it is only recently, and largely in the hands of the English school, notably Lord Kelvin and Clerk Maxwell, in later conjunction with Helmholtz, and building largely on the earlier work of W. Rowan Hamilton, that the subject of general dynamics has been welded into an instrument for the inductive, and in many cases speculative, exploration of physical processes in general. Anyhow, it will be evident how fundamental an advance in the principles of the dynamical interpretation of nature was involved in Routh's formulation of what he called the "modified Lagrangian function."

The problem thus solved by Routh with remarkable simplicity had already been some time in evidence. In the first edition of Thomson and Tait's "Natural Philosophy" in 1868, the equations of Lagrange had been applied in most effective manner to problems of motions of solids in fluid media, the energy function involved being determined in terms of the motions of the solids alone, and the fluid thus being *ignored* in the subsequent work. This procedure was soon challenged by Kirchhoff, as going beyond the existing conditions of validity of general dynamical theory; and a special justification for the case of motion in fluids was given by him on the basis of a Least Action analysis. Soon afterwards the same difficulty was pressed on Lord Kelvin independently by J. Purser, who also published a justification on more physical lines. This was, not unlikely, the origin of Lord Kelvin's general theory of "ignoration of coordinates," first published in 1879 in the second edition of Thomson and Tait's work, but which probably existed in manuscript anterior to Routh's essay. A report was once current that most of it was worked out in the harbour of Cherbourg, while his yacht was refitting, and the carpenters were all the time hammering overhead. This form of the theory, though more expressly suggested by the needs of physical dynamics, was less complete in one respect than Routh's, in that it did not bring the matter into direct relation with a single characteristic function (Lagrangian function of Routh, kinetic potential of Helmholtz), but simply obtained and illustrated the equations of motion that arose from the elimination of the cyclic coordinates that could be thus ignored.

Later still, Helmholtz, in his studies on monocyclic and polycyclic kinetic systems, which began in 1884 and culminated in the important memoir on the physical meaning of the Principle of Least Action in vol. c. (1886) of *Crelle's Journal*, developed the same theory more in Routh's manner, and built round it an extensive discussion of physical phenomena, so that on the Continent the whole subject is usually coupled with his name. Shortly before, the work of Routh and Kelvin had already been coordinated with the Principle of Action by more than one writer in England.

The most elaborate published result of Dr. Routh's scientific activity was the "Treatise on the Dynamics of a System of Rigid Bodies," which began as a thorough, though rather difficult, handbook in one octavo volume, but expanded in successive editions in a manner of which other classical instances readily occur to mind, until it became a sort of cyclopedia of the dynamical section of theoretical physics. In the course of an inquiry some ten years ago as to the reason why English mathematical physicists had so much practical command over the application of their knowledge, the mode of teaching in Cambridge came under review; and in particular this book was discovered by Prof. F. Klein, of Göttingen, who made arrangements for its introduction to the Continental public in a German translation, containing some brief valuable annotations such as the wide analytical outlook at Göttingen suggested. Especially was emphasis given to the great extension of the scope of abstract dynamics above described, with which Routh's name was associated, it is to be hoped permanently. Somehow the book does not seem to have attracted even yet much sustained attention in France.

Until lately, Dr. Routh's presence was a familiar and welcome one to residents in Cambridge. Though he never sought public positions, his services were in requisition in many ways, as Senator and Fellow of the University of London, as member of the University Council at Cambridge, member of council of the Royal Society, and in other activities; while he declined more prominent offices more than once. In society he was bright and attractive though somewhat retiring, simple, and entirely free from any suggestion of superiority. The respect and affection which he inspired in a long succession of distinguished pupils found expression on the occasion of his partial withdrawal from work in 1888, when at a remarkable gathering of judges, engineers, and men of science, his portrait by Herkomer was presented to Mrs. Routh, with many expressions of warm appreciation. His leisure he employed mainly in mathematical research and in the preparation of a series of treatises on subjects of mathematical physics, of which the only criticism to be made is that his wealth of valuable material tended to convert them into cyclopedias rather than text-books. His last public action was to take the lead in opposition to the proposals for change in the system of the mathematical tripos at Cambridge. It is possible that he did not fully realise the altered circumstances of the time, and the insistent claims of other studies; anyhow, it will be matter for congratulation if the new arrangements work as well and as smoothly as did the older mathematical tripos during the long period when the practical direction was mainly in his hands.

J. L.

PROF. A. S. HERSCHEL, F.R.S.

THE death of Prof. Alexander Stewart Herschel, F.R.S., on June 18 will be deplored by many astronomers. Prof. Herschel was born in 1836, and was the second son of Sir John Herschel. He was appointed professor of physics at the Durham College of Science, Newcastle-on-Tyne, in 1871, and was honorary professor and governor of the college at the time of his death, though he left Newcastle about twenty years ago, and resided with his brother, Col. John Herschel, F.R.S., at Observatory House, Slough, which was the home of his renowned grandfather, Sir William Herschel, and of his father. Prof. Herschel was elected a Fellow of the Royal Astronomical Society in 1867, and of the Royal Society in 1884.

Inheriting an illustrious name, Prof. Herschel also inherited the love for astronomy, the indomitable perseverance and capacity for work,

and much of the ability which distinguished his father and grandfather. As a mathematician, physicist, and observer, Prof. Herschel was *facile princeps*, and it was fortunate for meteoric astronomy that he devoted himself to its practical and theoretical investigation. Sir John and Sir William Herschel had swept the heavens with large telescopes in quest of nebulæ, double stars, and other objects, but Prof. Alexander Herschel appears to have preferred naked-eye observation to instrumental work. For about half a century he watched diligently for meteors, and obtained numerous and valuable results, as past volumes of the Monthly Notices of the Royal Astronomical Society and NATURE fully attest.

Apart from his observational results Prof. Herschel accomplished a large amount of important work in the summation, reduction, and discussion of various other observations. In conjunction with Mr. R. P. Greg he formed several extensive catalogues of the radiant points of shooting stars, and the most important of these were published in 1868, 1872, and 1874. One of his greatest successes, though it has been little commented upon, was the prediction made in the Monthly Notices, vol. xxxii., p. 355, of the great Bielid shower of 1872 November 27. For many years he compiled the annual reports of the luminous meteor committee of the British Association, and contributed, until 1880, the yearly notes on meteoric astronomy published in the anniversary number (February) of the Monthly Notices.

Prof. Herschel was a voluminous writer, and all those who enjoyed the pleasure of corresponding with him will agree that his letters were just as interesting as they were long. The writer of this notice will always have reason to be grateful to him for kind encouragement, advice, and instruction in the earlier years of his observing career. It is not too much to say that without the deep interest incited by Prof. Herschel's letters the meteoric observations obtained at Bristol during the last thirty-five years may never have been made.

As an observer of shooting stars Prof. Herschel was remarkably accurate, and he not only recorded their apparent paths with fidelity, but accompanied his results with descriptive details marvellous in their fulness. He computed the real paths of a great many fireballs and ordinary falling stars, and very ably discussed the often discordant observations which formed the basis of these inquiries.

The present writer has often been impressed at the acumen and sound judgment he displayed in dealing with difficult materials of this character. Meteoric astronomy has indeed lost one of its ablest votaries in Prof. Herschel, and it may truly be said that the present high position of this branch of science is due in no small measure to his prolonged and able researches. W. F. DENNING.

NOTES.

A CORRESPONDENT recently directed our attention to a sensational report that certain signals are regularly received at one of the Marconi wireless telegraph stations, and are believed to be communications from Mars or another planet. As Mars will be in opposition on July 6, and is well situated for observation in southern observatories, the rumour will probably be extensively circulated during the next few months. A copy of the report was sent, therefore, to Mr. Marconi, who has favoured us with the following reply:—"There is no truth whatever in the statement which has been freely published for the last year or two that mysterious signals have been received at Cape Clear from probably some distant planet. There is, in the first place, no wireless telegraph station at Cape Clear. The stray or vagrant electrical effects which do manifest themselves from time to time at wireless telegraph stations are due to atmospheric discharges or other natural causes. To attribute this phenomenon to any such source as is contemplated in these newspaper reports is, so far, purely imaginative and idle speculation."

WE regret to have to record the death of the well-known ironmaster, Mr. Thomas Andrews, F.R.S., at Wortley, near Sheffield, on June 19. Mr. Andrews was born at Sheffield in 1847, and succeeded his father as proprietor of the Wortley Iron Works many years ago. He was the author of numerous papers, chiefly on metallurgical subjects, but his researches were of a varied nature, and included such widely separated subjects as the composition of river waters and the strength of railway axles. Of late years his writings dealt chiefly with the microstructure of metals, carrying on work which originated in Sheffield. He was awarded a Telford medal and premium by the Institution of Civil Engineers in 1884, and was elected a Fellow of the Royal Society in 1888. He was also a gold medallist and Bessemer prizeman of the Society of Engineers, London.

MR. A. W. HILL, fellow and dean of King's College, Cambridge, and university lecturer in botany, has been appointed assistant director of the Royal Gardens, Kew.

PROFS. GUIDO CASTELNUOVO, of Rome, George William Hill, of New York, Camille Jordan, of Paris, and Vito Volterra, of Rome, have been elected honorary members of the London Mathematical Society.

A CHARTER of incorporation has been granted by the King to the Society of Chemical Industry, which was founded in 1881 to promote the application of chemical science to arts and manufactures.

A COMMITTEE has been appointed by the President of the Board of Agriculture and Fisheries to inquire into the nature of distemper in dogs in Great Britain and the methods of its infection, and to report whether any, and, if so, what, preventive or remedial measures, exclusive of ordinary medical treatment, can with advantage be taken with respect to it.

A CONFERENCE on the prevention of infant mortality and the welfare of nursing mothers and suckling infants will be held at the Town Hall, Pancras Road, N.W., on July 1, at 3.30 p.m., to inaugurate the opening of the School for Mothers at 6 and 7 Chalton Street, Euston Road, N.W., the centre of the St. Pancras Mothers' and Infants' Society. The Mayor of St. Pancras will welcome the conference, and Lord Robert Cecil will preside.

ON Monday next, July 1, at 2.30 (weather permitting), there will be a display of scientific kites and other aëronautical experiments on Chobham Common, Sunningdale, where the Aëronautical Society will hold the concluding meeting of the present session. Kites will be displayed by Mr. W. H. Dines, F.R.S., Mr. C. J. P. Cave, Mr. S. H. R. Salmon, and Mr. R. M. Balston. Mr. Cave will send up pilot balloons to determine the rate and direction of the wind at different heights, and demonstrations of the method will be given by means of a theodolite specially made from designs by M. de Quervain. Mr. Cave will also send up a *ballon-sonde* carrying self-recording instruments complete, as used by him for the international aëronautical ascents, which take place on fixed days simultaneously throughout Europe. Mr. José Weiss will perform experiments with model gliders.