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schowsky's narrative of Goethe's youth. But the sheer constructive genius of "Dichtung und Wahrheit," its marvellous atmosphere, its significance as a whole for the interpretation not only of "Faust" but of all German literature and history, surely these are matters worth a chapter to themselves in what aspires to be the Goethe biography by eminence.

Of the translator, a word or two. He is gaining in precision and ease with the progress of his work, for he takes his work seriously. It is a credit to our scholarship, and we owe him thanks. Yet the conscientious reviewer may permit himself an occasional grumble. Thus, living unfortunately in an age of *collisions*, we are made uncomfortable by the phrase (p. 19): "This transformation collided with the chief motive." Nor does the phrase (p. 196): "That the beautiful, purposive as it may seem to us, must not serve any particular purpose," sound much happier. "Red-tapism" (p. 222) is a quite unnecessary stretching of the good old red tape. Whether "motivate" (p. 382), "motivation" (p. 138), will ever become standard, is a question we leave to the reader; but certainly "sonnetists" (p. 351) for the time-honored "sonneteers" is a gratuitous irritation.

The illustrations of the present volume strike us as less adequate than those of the first. The English title of Tischbein's painting is usually: Goethe *in* the Campagna.

Abraham Lincoln. By Carl Schurz and Truman H. Bartlett. Boston: Houghton, Mifflin & Co. $10 net.

Here are gathered in one sumptuous, superbly printed volume, Carl Schurz's biographical sketch of Lincoln, Truman H. Bartlett's essay on the portraits of him, Richard Watson Gilder's sonnet on the life-mask of the martyr President, and Edmund Clarence Stedman's poem, "The Hand of Lincoln." There are eighteen splendid illustrations, including some pictures that are relatively little known; and the history of all of them is told in copious notes. The Volk life-mask of Lincoln comes in for especial treatment; there are four engravings of it from different points of view, and it reappears again in profile, side by side with Houdon's mask of Washington. These two pieces are described as "the most important contributions yet made to American plastic portraiture." Whether one agrees with this dictum or not, the profiles of the two great Presidents offer an opportunity for interesting study and comparison.

This treatment of the life-mask would of itself distinguish the work before us; but there are also two rare pictures, one taken in 1859, the other in 1861, the first when Lincoln was without a beard, and the second—far less attractive—when he wore a heavy, bushy beard, but shaved his upper lip. To most people the first of these two will, we think, appeal as perhaps the most winning of any of Lincoln's pictures, since it is full of strength, brings out all the sadness of the face, and yet portrays the clear-eyed and fearless tribune of the people. Two familiar pictures of special historical value are those of President Lincoln sitting in a tent with Gen. McClellan, and standing among his fifteen generals, just after the battle of Antietam. Extracted from a group, there is another engraving of Lincoln, standing with an ugly hat and ill-fitting frock coat, a portrait which brings out the extraordinary length of his limbs. We can only wish that the publishers had included in this series, a reproduction of Saint-Gaudens's wonderful statue at Chicago.

Altogether, this is a volume that no one interested in the subject can afford to overlook. Schurz's tribute has an imperishable place in the literature of the subject. But, were the contents of the volume less worthy, the book itself is an artistic achievement of which the publishers have every reason to be proud.

Science.

LORD KELVIN.

Sir William Thomson, Baron Kelvin, died December 17, after an illness of some weeks. He was the greatest reasoner of his time about physics, and at the moment of his death was, without dispute, the greatest scientific genius living. In the art of subjugating a question of practical physics and bringing it under the salutary domination of mathematics, it may be doubted whether history can show his equal.

He was born in Belfast, in 1824. His father had broken the ancestral line of farmers, and ultimately became professor of mathematics in the University of Glasgow. His brother, Dr. James Thomson, professor of civil engineering in Glasgow, made at least one important and penetrating contribution to mathematical physics—facts indicating a family bent in that direction. William Thomson was a precocious lad; but he retained through life a generous enthusiasm and a sprightly wit that gave him something of the charm of a boy. He entered the university at eleven years of age. He was twelve when the Glasgow circle received an accession in the person of J. P. Nichol, author of "The Architecture of the Heavens," who became a close friend of Thomson's father and of the boy. The latter, late in life, testified that the poetical imagination of Nichol had first fired him with devotion to physics, and that the same master's enthusiasm had incited him to study Fourier's "Théorie de la chaleur." From Glasgow he went to Peterhouse, Cambridge, where he was graduated in 1845 with high honors. Already he had an established reputation as a mathematical physicist. In 1841, at the age of seventeen, he had published an able memoir upon the conduction of heat and upon the connection between the mathematical theories of heat and electricity, involving, too, important new discoveries in pure mathematics. Another paper published by Thomson at the age of eighteen gave his method of determining geological dates by means of underground temperatures. Immediately upon his graduation, Thomson repaired to Paris and entered the laboratory of Regnault, who was then engaged in his fundamental determinations relating to the theory of the steam engine. In the same year, Thomson published in French his vindication of Coulomb's law of statical electricity, for the supposed refutation of which Sir W. Snow Harris had received the Copley medal of the Royal Society. Though Harris's conclusions were based upon an elaborate series of delicate measures, Thomson overthrew them with one blow, and that upon the strength of well-known experiments of a rudimentary nature. A logical objection has of late years been raised to Thomson's argument; yet those who bring it forward do not revert to Snow Harris's conclusion. Ten scientific papers, all of great merit, were published by Thomson the year of his graduation. The following year appeared his wonderful theory of electrical images, which is a geometrical method whereby a certain class of refractory problems about the distribution of electricity receive a solution. This excited high admiration among the mathematicians.

In 1846, at the age of twenty-two, Thomson was made professor of mathematics in the University of Glasgow, and also editor of the Cambridge and Dublin *Mathematical Journal*. He soon began to produce his wonderful series of instruments for electrical measurement, and this modern art, with its extraordinary precision, owes far more to him than to any other individual. We now come to his researches upon heat, which contributed in no small degree to the progress of civilization, both directly and indirectly. Two theories of heat had been entertained from early times, the one, which is now current, that it is an agitation of the particles of the hot body; the other that it is a fluid. Sir Humphry Davy had advocated the kinetical theory, and Rumford had put it into a strong light by his experiments. Nevertheless, the difficulties of this hypothesis seemed to be such that the fluid theory generally prevailed. Sadi-Carnot had in 1826 published a great work upon the steam engine founded on the latter basis. Meantime, general ideas about energy were developing themselves. The now celebrated memoir of Helmholtz on the conservation of forces was published in 1846; but it failed to attract much attention. At length many things—Joule's determinations, certain confirmations of the kinetical theory by Regnault's researches, and the increasing importance of economy in steam engines—brought physicists face to face with the question, How is Carnot's theory to be amended so as to accord with the doctrine that heat is a mode of motion? It was Rankine in 1849 who first answered this question; but only upon an assumption quite unsupported by observed facts. The next year Clausius outlined the theory as it is held to-day, taking for his postulate that temperatures tend to equalize themselves by the flow of heat from hot to cold bodies. Thomson had worked out the problem independently from a slightly more cautious premise, before the memoir of Clausius appeared. This confirmation was useful in giving physicists confidence in the analysis, and hastened the general acceptance of the modern doctrine. Thomson now became much occupied with the theory of heat. In 1852 he announced the principle of the dissipation of energy; that is, that there is a flow of heat from warmer bodies to cooler ones, which goes to waste, since it cannot be reconverted by ordinary means into mechanical work. Thus, the whole universe would seem destined to become lifeless by the conversion of all energy into heat uniformly distributed throughout the whole. From 1852 to 1862 Thomson and

Joule published in collaboration ten memoirs on the thermal effects of fluids in motion. The most important result obtained was that the force between the molecules of an ordinary gas is on the whole attractive, and not repulsive, which was somewhat startling, in view of the expansive power of gases.

One of the first great enterprises with which Thomson was identified was that of the Atlantic cable. Electric signals sent through a submarine cable were found to undergo a peculiar retardation that threatened to blur them beyond recognition. Faraday had long before furnished a partial remedy, but Thomson supplied a complete one, so as to secure reasonably satisfactory clearness and speed. The correctness of his statement of the laws involved was disputed by an electrician of the cable company, Dr. Wildman Whitehouse; but the Glasgow expert disposed of the argument so effectively that he was retained on the spot as consulting engineer. He officiated in that capacity both for the cable of 1858 and that of 1866. He was also electrical engineer for the French Atlantic cable in 1869; the Brazilian and River Plate cable in 1873; the West Indian cables in 1875, and the Mackay-Bennett Atlantic cable in 1879. To the success of these enterprises he contributed in several other ways. He prescribed a method of testing the conductivity of a submarine wire while it was being laid, in order that any defect might be promptly discovered and cured. He also invented instruments to receive messages. Those employed for land wires were not sensitive enough. Thomson so mounted a mirror on a tiny magnet that the feeble electric impulses which traversed a cable would cause it to sway. A beam of light was thus deflected, first to the right and then to the left, on a blank white wall in a dark room. The magnet was suspended by a silk fibre, and its movements were practically unimpeded by friction. This invention was supplemented by one called the "siphon recorder," which would leave a permanent trace on a strip of paper. Without question he did more than any other scientist to promote submarine telegraphy, and in recognition of these services he was knighted in 1866.

Thomson was an enthusiastic yachtsman, and did much for the marine art and science. He published special tables to facilitate Sumner's American method of navigation; he invented the compass now generally used on shipboard, as well as the indispensable method for applying Airy's theory of the correction of compasses on iron vessels. He originated the only practical instrument for deep-sea sounding. He was also one of the chief investigators of tides; he invented the remarkable instrument called the harmonic analyzer, for mechanically determining the magnitudes and phases of the twenty or more different component oscillations which enter into the tide at each port. Thomson invented a number of other calculating machines, among them a tide-predicting machine, a machine for solving equations, and, in conjunction with his brother, a remarkable mechanical integrator.

It is impossible to enumerate here all the lines in which our civilization is in debt to the labors of this indefatigable man. His genius was the dominating influence in investigation of questions relating to the age of the earth, its internal solidity or fluidity, and its rate of cooling. Another great field in which his was the leading mind was that of speculation about the molecular constitution of matter. Upon this subject he delivered a course of lectures at the Johns Hopkins University in 1884. He did much to illustrate the exceeding complexity of the problem and to throw light upon parts of it, while leaving it as a whole unsolved. His last extensive experimental work related to the electrification of air; but he still pushed analytical investigations when he had passed the age of eighty. Besides the treatise of Thomson and Tait, entitled "A Treatise on Natural Philosophy," but confined, in fact, to a part of analytical mechanics, Thomson wrote no books. His Baltimore lectures were reported and lithographed, his scientific memoirs were collected in three stout octavos, and his popular addresses in as many duodecimos. In 1877 he was made foreign associate of the French Academy of Sciences, usually counted as the highest of scientific honors. In 1892, he was raised to the peerage at the instance of Lord Salisbury. Baron Kelvin succeeded another illustrious mathematical physicist, Stokes, as president of the Royal Society. In his later years he was president of the Royal Society of Edinburgh.

The distinguishing characteristic of Thomson's intellect was his power of analyzing physical facts into their elementary components mathematically defined, and of identifying these components with those of other facts. He was a cautious theorizer, taking care not to lose sight of possibilities that other men might not think worth considering. His ingenuity was marvellous. His gyrostat, a thing that would stand in apparently impossible positions; his gyrostatic pendulum and gyrostatic chain, with their weird motions; his bag that would allow water to run in and out freely, and yet was absolutely impervious to air; his instruments for measuring temperature, his jelly model of a molecule, and his paper of February, 1894, on the partition of space (a crystallographic problem), may serve as examples. It is the men who have themselves achieved the most in science who will be most penetrated with admiration for Kelvin. But we can never give full credit to a great man's excellences until we have weighed his defects. Kelvin had become infected by Nichol with a bias in favor of the miraculous. Hence, many of the hypotheses by which he proposed to explain physical phenomena would, if admitted as facts, themselves clamor for explanation. We refer for examples to his theory of germs diffused through the universe, and to the idea that atoms are "manufactured articles." No hypothesis seemed too unaccountable for him, so long as the observed phenomena would be necessary consequences of it. Because he was without a peer in that sort of explanation, because, after all, he did not succeed in explaining the constitution of matter (as he himself confessed), and because more evolutionary hypotheses are likely to be favored in the future, Kelvin's death may mark one of the great epochs in the history of our understanding of the physical universe.

The annual meeting of the American Ornithologists' Union, in Philadelphia, last week, December 10-12, was of greater interest than usual as the twenty-fifth anniversary of the founding of the union. About one hundred members were present and some twenty-seven papers were presented. There was a noticeable falling off in that uninteresting type of paper—local lists, and a reduction in contributions of purely systematic nature. In this systematic work American ornithologists have long led the world, and within the limited field they have accomplished much; but there is a welcome tendency, especially among the younger men, to broaden their research into other fields—notably in the ecological phase of bird study and in experimental investigation. The illustrated papers showed the highest excellence yet attained in photography of wild birds. One of the most interesting papers of a popular nature was Ernest Thompson Seton's account of the birds which he observed during a recent seven months' trip to Great Slave Lake, in northern Canada. What may be accomplished by modern modes of rapid transit was shown by Frank M. Chapman, who, during the present year, followed the progress of summer from the breeding man-o'-war birds and boobies of the Bahamas, north to the heron rookeries of the Southern States. Then swift trains took him to the plains of the Northwest and the summits of the Rockies. Here he again caught up with summer and took a series of remarkable photographs of nesting ptarmigan and other species. The material gathered by collector and artist will be used in the admirable series of bird groups which are being placed in the American Museum in this city. These groups will, when completed, have no equals in the world. Not only will they present a vivid idea of our larger typical American birds, but also a representative series of landscape backgrounds of the scenery of our continent from the Atlantic to the Pacific.

An addition to scientific literature comes in the form of the "Jahrbuch der drahtlosen Telegraphie und Telephonie," edited by Dr. Gustav Eichhorn of Zürich with the collaboration, among others, of Prof. J. A. Fleming and Dr. Guglielmo Marconi of London, and of Count von Arco and Prof. Adolf Slaby of Berlin. Four *Hefte* are to make one volume at a cost of twenty marks. The number before us contains, besides articles some of which can appeal only to the elect, a bibliography and book reviews.

The house of A. Haase in Prague announces a new journal called *Rundschau für Technik und Wirtschaft*, under the editorship of Prof. Alfred Birk of the School of Technology in Prague, who until now has been the editor of the *Zeitschrift für Eisenbahn und Industrie*, but has retired from this position.

A year ago Prof. Pierre Janet gave a course of fifteen lectures on hysteria at the Harvard Medical School, repeating them in part elsewhere. Some of them were fully reported in medical journals, but their publication in book form, "The Major Symptoms of Hysteria" (The Macmillan Co.), will obtain for them the larger class of readers that they richly deserve. The subject is developed in an entertaining way, with a remarkably ready use of English which has only an occasional slight obscur-