THURSDAY, AUGUST 7, 1873

GUSTAV ROSE

THE son-in-law of Gustav Rose, Professor G. vom Rath, has sent us the Nekrolog which affection and custom in the Fatherland unite in issuing in honour of those who are no more.

The first line of this tribute to the memory of the great mineralogist tells truly that Germany has lost one of her great ones in this learned and noble man: but it is for us to say that it is even a wider world than his fatherland that has lost in him one of its conspicuous citizens. For the two brothers Heinrich and Gustav Rose formed a double star in the constellation of illustrious men who have illuminated with a brilliancy all its own the first half of this great century; and, indeed, for now fifty years their twin lights have guided the course of their contemporary and of a younger generation of wayfarers on the track of Science.

Certainly the death of a man like Gustav Rose is calculated to call up some wonderment in our minds as we look back over the brief period that even his 76 years ot life embrace, and think in what relation that little space of time stands to the long history of man in regard to the sciences that these two illustrious brothers cultivated so pertinaciously and so well. Berzelius spoke of looking back within his own memory to the dark age of phlogistic chemistry. Heinrich Rose first reduced to a scientific system the methods of inorganic chemical analysis, as J. von Liebig did afterwards for organic chemistry; it is but yesterday that the one, and but a few brief years since the other died. And now Gustav Rose, the first man in Germany who used the reflective goniometer, has followed them and Mitscherlich and Haussmann, and Haidinger. There still remain Breithaupt and Naumann, Wöhler, and a few other honoured men on whom the patriarch's mantle must successively devolve. Let us at least pay the tribute due to the memory of the last of these illustrious workers whose chair is empty by endeavouring to take a survey of the work he did, and by recognising the debt we owe him for the results that have accrued to our knowledge from the toil "Ohne Hast und ohne Rast," of fifty out of his seventy-six years, and no less for the example he has set of method and of energy in achieving them.

The sciences that Gustav Rose devoted himself to, crystallography and mineralogy, have been for many years so little or so superficially studied in England, that probably few of our countrymen are familiar with the continuous succession and admirable quality of the work turned out from the study of one of the soundest-minded, and, let us add, one of the soundest-hearted men that Germany ranked among her sons.

His country's troubles, though they ended as far as the great war was concerned in 1815, had called into the ranks even the youngest of the four brothers Rose. Their father, a not undistinguished pharmaceutical chemist in Berlin, had died in 1807, leaving his children to the care of his widow, who appears to have borne out the tradition of able men owing much to remarkable characteristics in their mothers. Young Gustav was not old enough in the days of the terrible conflicts to have borne his musket. But he was seventeen, in time to make the long march from Berlin to Orleans; and after the peace in 1815 he set himself to obtain a livelihood in the occupation of mining. Overtaken by an attack of inflammation of the lungs, his thoughts became directed into a new direction. For the contagious passion for the pursuit of truth in its most tangible form by the path of natural science seized him by contact with his elder brother Heinrich; and Gustav followed his example in going to Stockholm for a similar object to that which has drawn so many Englishmen and English-speaking men since to Germany. Berzelius was then in Sweden what afterwards were Heinrich Rose, Wöhler, Liebig, in the Fatherland; the great master in the science as in the practice of chemistry. Gustav Rose was twenty-six when he ceased to be a student, and of the fifty years that have run out their sands since 1823, there is scarce one that has not recorded some work or memoir by the great crystallographer; and in some of those years he produced several.

And Gustav Rose was a crystallographer and mineralogist in the completest sense. The first man in Germany, as we have said, who adopted the use of Dr. Wollaston's reflective goniometer, he aided Mitscherlich in his discovery of Isomorphism; and this must have been one of his earliest labours.

His first paper was an exercise in Latin on the Crystallography of Sphene; and in 1830 he brought out his treatise on Crystallography, in which recognising the simplicity introduced by the use of geometrical axes as employed by Weiss, he adopted that method of expression for the relations of the faces of a crystal, a method which has in fact been only carried out to its last logical form and simplest expression by the admirable system of our countryman Prof. W. H. Miller.

It is not easy now to transport ourselves back to the time when scientific men of high eminence deliberately closed, or rather refused to open, their eyes to the chemical composition of a mineral as the most fundamental point in its definition and description, and to its chemical relations as affording the only philosophical basis on which to form a classification of minerals. But this difficulty of placing ourselves in the position taken up by Mohs and his school, very much arises from our not appreciating the situation of chemical and crystallographic research in their mutual valuation twenty years before the death of Mohs. We may for instance take two garnets, one consisting of aluminium and magnesium silicate, another of iron and calcium silicate. The two minerals contain notably differing proportions of the only ingredient they have in common, namely silica; and yet their crystalline forms are the same, and the mineralogist could not fail to recognise so close a parallelism and similarity between the two minerals as to compel him to unite them under one general "natural-history" division.

The chemistry of that day, however, was not yet ripe for acknowledging such a classification. But when, on the other hand, the mineralogist assembled under one group minerals that differed in the way that, for instance, Linavite and blue copper carbonate (chessylite) differ in their chemical composition, or such widely different minerals as diamond and topaz, on the ground that they were hard and lustrous, and had the character of precious stones; then the remonstrance of the chemist was founded in truth and reason.

It was the discovery of isomorphism that explained the anomalies and enigmas which thus in many cases seemed to justify the mineralogist in standing apart from the chemist, and preferring to discriminate, define, and classify minerals by appealing to superficial characteristics, rather than to the most fundamental feature of such bodies, their chemical molecular structure.

It came now to be seen that in the language of the earlier chemistry alumina and sesquioxide of iron, on the one hand, were able to represent the same ingredient in the garnet, while on the other hand, also, the lime, the magnesia, and the protoxide of iron might equally represent one another in the silicate in question, provided that the chemical structure of the compound was not altered, that is to say, could be expressed by a general formula that was equally applicable to each variety of the mineral; the identity of the crystallographic features of all those garnets being the evidence that the unity of the mineral type had not been overstepped by the interchanges of the elements. The application of this great discovery left chemistry master of the situation, and relegated into the regions of darkness the systems of classification that were not built on chemical and crystallographic principles. It was Mitscherlich, aided as vom Rath tells us by the young Gustav Rose, who made this grand announcement to the world in the year 1823. The light which was thus shed on the dark and till then uncertain problems that might connect the crystalline form with chemical structure, gave, as it were, new life to the vigorous school that owed its chemical precision to the great Professor at Stockholm, the school to which the two Roses and Wöhler belonged. The purely chemical problems of mineralogy received their constant attention; and Gustave Rose, by publishing his crystallography, asserted the co-ordinate functions of the goniometer and the balance in the future discussions of all the larger questions of the mineralogist.

He, in fact, unconsciously perhaps, was now initiating the method to which, with a fine unity of purpose, he adhered through his life.

Thus, for instance, we find him in 1831-33 discussing the somewhat paradoxical resemblance in the crystallographic constants of the minerals augite and hornblende, as suggested by Uralite, a mineral uniting the outline form of the one with the internal structure of the other; in fact a pseudomorph of hornblende after the form of augite.

Then in 1836 came his masterly memoir on the forms of Aragonite, the distinction of which from calcite had been established by Haüy in the beginning of the century. Afterwards, among a mass of works, we find memoirs on the differences of crystallographic habit in Albite, and the nearly related variety of the same felspar pericline, a subject to which he returned in later times; on the dimorphism of iridium, of palladium, and again of zinc; several treating on the marvellous connection by which certain kinds of hemisymmetry in crystals are associated with the localisation on them of opposite electric conditions under changes of temperature (pyro-electricity), which he illustrated in the case of the tourmaline, and among his latest memoirs by a most masterly one on pyrites and cobalt-glance. Quartz he made an object of especial study, explaining the character of its twin forms; and no memoirs in the whole range of crystallographic research, not excepting the splendid work in which Des-Cloiseaux capped, as it were, the labour of Rose, can surpass, in originality and precision, that by this great master on the crystallography of quartz.

Meteorites and the minerals which they contain have challenged the attention and been a sort of exercising-ground for several of the great mineralogists of Germany. Berzelius, indeed, set the example, but it was Rose who, in 1825, measured the first olivine crystal from the Pallas meteorite, and he, Haidinger, Breithaupt, and Wöhler, have all contributed invaluable material for the scientific history of these very difficult and interesting objects of investigation. And to G. Rose we owe the most penetrating insight into their structure, and the best attempt thus far made at classifying them. So, too, the sum of his thought and labour on the classification of minerals was given in his "crystallo-chemische mineral-system," published twenty-one years ago, in which he, so to say, demolished, by leaving no further excuse for perpetuating, the system which was identified with the name of Mohs, or indeed any other system to which chemical law was not the master key.

But one great work that Gustave Rose might have done, and better done perhaps than any living man, was the writing a treatise on Petrography. Mineralogy, the science of minerals, stands to petrography, the science that describes rocks and investigates their history, somewhat as biography stands to history itself, or as histology to physiology. The reason why a geologist is hardly ever a master of petrography is that he is so seldom, in England, at least, a mineralogist. And it is precisely because Gustav Rose was, and Naumann is, a complete mineralogist and crystallographer, and that both have profoundly studied the characters of the minerals in association which form rocks, that either of these two veteran professors might have written—alas! a month ago we might have said may yet write—such a treatise on rocks as probably no other living man could write. Gustav Rose began an admirable training in the field for such a study when, in the company of A. von Humboldt and G. Ehrenberg, he traversed European Russia and found himself among the rocks of the Ourals in 1829. The results of this historical progress were given to the world in two volumes in 1837-1842. The memoirs which he published subsequently to this time and to his becoming full professor (he had been extraordinary professor since 1826) of mineralogy at Berlin, treat very frequently of rock minerals; and indeed deal, in the majority of instances, with those more ordinary minerals which perform an important function as constituents of rocks; quartz, felspar, mica, hornblende, augite, seem never to weary him in observation or exhaust his powers of telling some new fact regarding them. One of his latest papers on the very common mineral, mica, is one of the most admirable of his researches. It was published, like most of his memoirs, in Poggendorff's *Annalen*, and treated on the interpenetration by one another, of various kinds of mica, and of these, with hematite and pennine.

It would be unnecessary, for the purpose of this slight sketch of Gustav Rose's labours, to go further into details regarding his works. He is gone; but his work lives after him.

The two Roses were men of a distinguished presence. Heinrich was the taller, but each was a man of spare and somewhat stately figure, with an eye of peculiar force and truthfulness of glance; an eye that spoke out the character of the man, that beamed with kindliness and was ever staunch to truth. N. S. M.

CHALLIS'S "MATHEMATICAL PRINCIPLES OF PHYSICS"

An Essay on the Mathematical Principles of Physics, &c. By the Rev. James Challis, M.A., F.R.S., F.R.A.S., Plumian Professor of Astronomy and Experimental Philosophy in the University of Cambridge, and Fellow of Trinity College. (Cambridge: Deighton, Bell, and Co., 1873.)

THIS essay is a sort of abstract or general account of the mathematical and physical researches on which the author has been so long engaged, portions of which have appeared from time to time in the *Philosophical Magazine*, and also in his larger work on the "Principles of Mathematics and Physics." It is always desirable that mathematical results should be expressed in intelligible language, as well as in the symbolic form in which they were at first obtained, and we have to thank Professor Challis for this essay, which though, or rather because, it hardly contains a single equation, sets forth his system more clearly than has been done in some of his previous mathematical papers.

The aim of this essay, and of the author's long-continued labours, is to advance the theoretical study of Physics. He regards the material universe as "a vast and wonderful *mechanism*, of which not the least wonderful quality is, its being so constructed that we can understand it." The Book of Nature, in fact, contains elementary chapters, and, to those who know where to look for them, the mastery of one chapter is a preparation for the study of the next. The discovery of the calculation necessary to determine the acceleration of a particle whose position is given in terms of the time led to the Newtonian epoch of Natural Philosophy. The study from the cultivation of which our author looks for the "inauguration of a new scientific epoch," is that of the motion of fluids, commonly called Hydrodynamics. The scientific method which he recommends is that described by Newton as the "foundation of all philosophy," namely, that the properties which we attribute to the least parts of matter must be consistent with those of which experiments on sensible bodies have made us cognizant.

The world, according to Professor Challis, is made up of atoms and æther. The atoms are spheres, unalterable in magnitude, and endowed with inertia, but with no other property whatever. The æther is a perfect fluid, endowed with inertia, and exerting a pressure proportional to its density. It is truly continuous (and therefore does not consist of atoms), and it fills up all the interstices of the atoms.]

Here, then, we have set before us with perfect clearness the two constituents of the universe: the atoms, which we can picture in our minds as so many marbles; and the æther, which behaves exactly as air would do if Boyle's law were strictly accurate, if its temperature were invariable, if it were destitute of viscosity, and if gravity did not act on it.

We have no difficulty, therefore, in forming an adequate conception of the properties of the elements from which we have to construct a world. The hypothesis is at least an honest one. It attributes to the elements of things no properties except those which we can clearly define. It stands, therefore, on a different scientific level from those waxen hypotheses in which the atoms are endowed with a new system of attractive or repulsive forces whenever a new phenomenon has to be explained.

But the task still before us is a herculean one. It is no less than to explain all actions between bodies or parts of bodies, whether in apparent contact or at stellar distances, by the motions of this all-embracing æther, and the pressure thence resulting.

One kind of motion of the æther is evidently a wave-motion, like that of sound-waves in air. How will such waves affect an atom? Will they propel it forward like the driftwood which is flung upon the shore, or will they draw it back like the shingle which is carried out by the returning wave? Or will they make it oscillate about a fixed position without any advance or recession on the whole?

We have no intention of going through the calculations necessary to solve this problem. They are not contained in this essay, and Professor Challis admits that he has been unable to determine the absolute amount of the constant term which indicates the permanent effect of the waves on an atom. This is unfortunate, as it gives us no immediate prospect of making those numerical comparisons with observed facts which are necessary for the verification of the theory. Let us, however, suppose this purely mathematical difficulty surmounted, and let us admit with Professor Challis that if the wave-length of the undulations is very small compared with the diameter of the atom, the atom will be urged in the direction of wave-propagation, or in other words *repelled* from the origin of the waves. If on the other hand the wave-length is very great compared with the diameter of the atom, the atom will be urged in the direction opposite to that in which the waves travel, that is, it will be *attracted* towards the source of the waves.

The amount of this attraction or repulsion will depend on the mean of the square of the velocity of the periodic motion of the particles of the æther, and since the amplitude of a diverging wave is inversely as the distance from the centre of divergence, the force will be inversely as the square of this distance, according to Newton's law.

We must remember, however, that the problem is only imperfectly solved, as we do not know the absolute value of this force, and we have not yet arrived at an explanation of the fact that the attraction of gravitation is in exact proportion to the mass of the attracted body, whatever be its chemical nature. (See p. 36.)

Admitting these results, and supposing the great ocean of æther to be traversed by waves, these waves impinge on the atoms, and are reflected in the form of diverging waves. These, in their turn, beat other atoms, and cause attraction or repulsion, according as their wave-length is great or small. Thus the waves of shortest