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MEMOIR OF HAÜY. (1743-1822)

READ BEFORE THE FRENCH ACADEMY OF SCIENCES, BY BARON CUVIER, PERPETUAL SECRETARY.

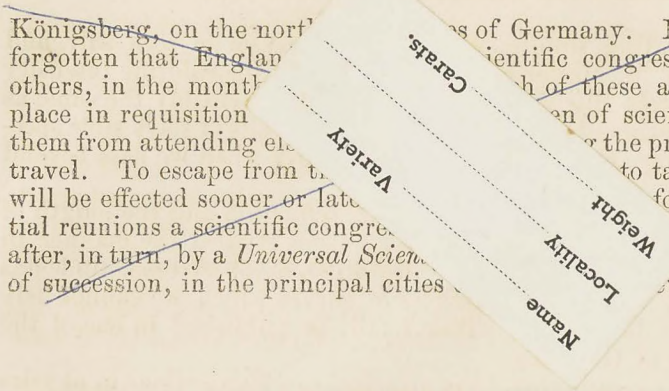
TRANSLATED FOR THE SMITHSONIAN INSTITUTION BY C. A. ALEXANDER.

In the history of science, epochs occur when the human mind seems to take a surprising stride. When years have been spent in the patient accumulation of facts and observations, and the received theories no longer suffice to harmonize them, ideas respecting natural phenomena become in some measure incoherent and contradictory. System is no longer possible, and the need is universally felt of some new bond of connection. Should a genius appear at such a juncture, capable of rising to a point of view from which some of the required relations may be embraced, fresh courage is diffused among cotemporary inquirers, each throws himself with ardor into the new paths which have been opened, and discoveries succeed one another with increasing rapidity. Those who have successfully associated their names with the movement assume, in the eyes of their followers of a later generation, the proportions of some superior race; and, as they pass successively from the stage of life, are deplored as heroes whom the world must despair of ever seeing equaled.

Such an epoch the close of the eighteenth century unquestionably was, as regards the natural sciences.

The laws of a geometry, as concise as comprehensive, extended over the entire heavens; the boundaries of the universe enlarged and its spaces peopled with unknown stars; the course of celestial bodies determined more rigorously than ever, both in time and space; the earth weighed as in a balance; man soaring to the clouds or traversing the seas without the aid of winds; the intricate mysteries of chemistry referred to certain clear and simple facts; the list of natural existencies increased ten-fold in every species, and their relations irrevocably fixed by a survey as well of their internal as external structure; the history of the earth, even in ages the most remote, explored by means of its own monuments, and shown to be not less wonderful in fact than it might have appeared to the wildest fancy: such is the grand and unparalleled spectacle which it has been our privilege to contemplate, but which renders only more bitter the disappearance of those great men to whom we owe it. Few are the years which have seen the tomb close upon a Lavoisier, a Priestley, a Cavendish, a Camper,

Königsberg, on the nort[illegible]s of Germany. Nor should it be forgotten that Englan[illegible]ientific congress, and, like the others, in the month[illegible]h of these assemblages will place in requisition [illegible]n of science and prevent them from attending ei[illegible]r the present celerity of travel. To escape from t[illegible] to take a step which will be effected sooner or late[illegible] for all these partial reunions a scientific congre[illegible] replaced hereafter, in turn, by a *Universal Scien*[illegible]all sit, in order of succession, in the principal cities [illegible]w continents.



a De Saussure, a Lagrange; and who but must be startled at the acceleration in our losses, when a few months only have snatched from us Herschel and Delambre, Haüy and Berthollet, leaving us scarce power to render, within the prescribed time, the homage due to them by the societies of which they were the ornament.

We might be the more tempted to believe that Haüy felt this irresistible impulse of his epoch, from his having been determined, almost without being aware of it, to a career for which, during the first forty years of his life, he had never thought of preparing himself. In the midst of obscure occupations an idea dawns upon him; a single idea, but one equally luminous and prolific. From that moment he never desists from following it; he devotes to it his time, his faculties, his undivided attention, until finally a brilliant success is the crown and recompense of his efforts. No example could better show the grand, I had almost said miraculous, results which spring from the profound and exhaustive study of a subject upon which the mind is concentrated, nor prove more clearly the truth of the maxim, that, at least in the exact sciences, it is the patience of a sound intellect, when that patience is indomitable, which truly constitutes what we call genius.

René-Just Haüy, an honorary canon of Notre Dame, a member of this academy, and of most of those of Europe and America, was born the 28th of February, 1743, at Saint-Just, a small market town in the department of the Oise. A younger brother of his has made himself known by an original method for instructing those born blind; while the father of both was a poor weaver, who could probably have given them no other profession than his own, had not the liberality of others come to his aid.

The first change for the better in the fortunes of the two brothers may be ascribed to the pious turn of the elder, manifested in his earliest years and governing his whole life. Even in infancy he evinced a singular pleasure in religious ceremonies, especially in the choirs of the church; a taste for music, the natural concomitant of tender sentiments, having thus early allied itself in him with the feelings of devotion. A Premonstratensian prior of his native town, who had observed the assiduity of his attendance at Divine service, engaged him one day in conversation, and, being struck with the vivacity of his intelligence, procured him the instruction of some of his monks. The child's progress, promptly responding to the care of these masters, interested them more and more, and led them to suggest to his mother that by removing him to Paris she might shortly procure through their recommendation such resources as would enable him to complete his studies.

This excellent woman had scarcely sufficient means for a few months subsistence in the capital; but she preferred encountering any extremity to proving false to the future which might await her son. It was long, however, before her tenderness met with any but the most slender encouragement. The place of chorister in a church of the quarter Saint Antoine was the only means of livelihood available to a youth whose name was destined to be one day known to all Europe. This post, he used afterwards pleasantly to say, was at least so far propitious that it prevented him from burying his musical talents; at

any rate, by fostering his original taste, it enabled him to become a respectable performer on the violin and harpsichord, two instruments with which he solaced himself during life. Finally, the interest of his patrons of Saint-Just obtained for him a scholarship in the college of Navarre, where it first became possible for him to enter regularly on a course of classic instruction.

Here his conduct and application gained him favor, as they had done at Saint-Just. The heads of the college engaged his services as teacher as soon as he had ceased to be a pupil, and even advanced him to the mastership of the fourth class before he had quite reached the age of twenty-one years. Transferred some years later to the College of the Cardinal Lemoine, in a similar but higher capacity, he might seem to have limited his ambition to such modest, however useful, functions. It is true that, at Navarre, he had imbibed from M. Brisson, of that Academy, some taste for experimental physics, and at moments of leisure had even experimented with electricity; but this was rather by way of recreation than study; while natural history, properly so called, does not appear to have, in the least, occupied his attention.

If, at last, he found the path which was to conduct him in the end to so high a renown, it was still owing to the gentler dispositions of his nature; so that the fame and fortune of Haüy may be said, with literal exactness, to have been, at every step, the recompense of his virtues.

Among the regents of the College Lemoine there was at this time a learned individual who had devoted himself to the instruction of youth from a principle of piety. Capable of enlightening persons of the maturest age, Lhomond had chosen to restrict himself to compositions for the use of the young; but had contrived to impart to them so admirable a tone of simplicity and clearness that their success has been seldom equaled by works of greater pretension. Between him and Haüy there existed so striking a conformity of character and sentiments that the latter had chosen him for his friend and confessor; interested himself, with the devotion of a son, in his affairs; tended him in sickness, and was the companion of his walks. Lhomond cultivated botany, and Haüy, who had scarcely heard of it, felt a chagrin at not being able to add the common study of this as a new charm to their intercourse. In one of his vacations he discovered that a monk of Saint-Just amused himself with the study of plants. The idea at once struck him that he might give an agreeable surprise to his friend, and, with this sole view, he requested the monk to convey to him some notions of the science and some acquaintance with different species. His heart came to the aid of his memory; he comprehended and retained all that was shown him, and the surprise of Lhomond was unbounded, when, at their next herborization, Haüy named to him, in the language of Linnæus, most of the plants they met with, and showed that he had studied and analyzed their structure.

From that time everything was common between them, even their amusements; but from that time, also, Haüy became thoroughly a naturalist, and an indefatigable one. It might be said that his mind had been wakened of a sudden to this new kind of enjoyment. He

prepared a herbarium with unusual care and neatness, and even invented processes by which the color of his flowers has been preserved to the present day.* Here he took his first lesson in the right use and aims of method, and by frequenting the "Jardin du Roi," which was near his college, he extended his ideas and exercised himself more and more in the work of classification and comparison.

Happening one day to join the crowd which at that time attended the lessons on mineralogy given by Daubenton in the "Jardin du Roi," he unexpectedly found himself in the presence of a new object of study, more congenial to his first taste for physics than even that of plants. Numerous, however, as was the attendance on Daubenton's lessons, it was mainly of such auditors as left botany and mineralogy where they found them. Having come earlier to the study, they might know more of both than Haüy; but custom itself, in familiarizing them with the difficulties of those sciences, had caused them to disappear. To Haüy, who came later, these difficulties presented themselves after a different manner. The contrarieties and gaps in the series of ideas strongly arrested the attention of a vigorous thinker, who, in the height of his powers, approached for the first time a new object of study. If the constancy observable in the complicated forms of flowers and fruits, and all the parts of organized bodies, affected him with admiration and wonder, how is it, he might ask, that the forms of minerals, so much more simple and even geometric, are not subjected to similar laws? for, at that time, even the partial and imperfect relationship proposed by Romé Delisle, in the second edition of his Crystallography, was unknown. How is it, might Haüy say, that the same stone, the same salt, show themselves in cubes, in prisms, in needles, without the change of an atom in their composition; while the rose has always the same petals, the acorn the same curvature, the cedar the same height and the same development?

While absorbed in these ideas, it chanced that in examining some minerals at the house of a friend, he was so fortunately awkward as to let fall a beautiful group of calcareous spar crystallized in prisms. One of these prisms broke in such a way as to exhibit at the point of fracture planes not less smooth than the original surface, but presenting the appearance of a new crystal, wholly different in form from the prism. Haüy observes this fact, and attentively examines the planes and angles of the fragment. To his great surprise, he finds that they are the same with those of Iceland spar crystallized in rhomboids. He returns to his own cabinet, selects a specimen crystallized in the form of a six-sided pyramid, such as is usually called *dog tooth spar*, and breaking it, sees the same rhomboid of the Iceland spar emerge; the splinters which fall are themselves smaller rhomboids. He tries a third spar, called from its form *lenticular*, and still it is the rhomboid which discloses itself in the center, and smaller rhomboids detach themselves in the fragments.

He might well exclaim, all is clear; the particles of calcareous spar have but one and the same form: it is only in grouping themselves

* See his "manner of forming herbariums," in the Memoirs of the Academy for 1785, page 210.

differently that they compose the crystals whose external shape deludes us by its variety. Setting out with this idea, he could readily imagine that those particles, in accumulating and disposing themselves in layers, might form pyramids and polyhedrons of a new configuration; enveloping the primitive crystal as with another whose exterior faces might differ much, both as to number and inclination, from those of the first, according as the successive layers had diminished on one side or another, and in such or such proportions.

If this, then, was the true principle of the crystallization in question, it could not but prevail in the crystals of other substances; each of which ought, in like manner, to have its constituent particles the same, a nucleus alike in each species, and superposed or accessory layers producing all the varieties. Haüy, who hesitates not to submit to the hammer his own crystals, as well as those he could obtain from his friends, finds everywhere a structure based upon the same laws. In the garnet it is tetrahedral; in fluor spar, octahedral; pyrites presents a cube; while gypsum and heavy spar offer straight four-sided prisms, whose bases, however, have different angles. Invariably the crystals break with faces parallel to those of the nucleus, the exterior form being but the result of the more or less rapid decrease of the superposed laminæ, a decrease which takes place sometimes at the angles and sometimes on the sides. Thus, the new surfaces presented are in reality a succession of minute points produced by the retreating laminæ, though they appear smooth to the eye from their extreme tenuity. No crystal which Haüy examines offers any exception to his law, so that he exclaims, and this time with more assurance, *all is clear*.

But, that this assurance should be complete, a third condition is to be fulfilled. The nucleus or constituent molecule having in each case a fixed form, geometrically determinable as to its angles and the correspondence of its lines, every law of decrement must cause the secondary surfaces to be in like manner determinable; indeed, the nucleus or molecule being given, it should be possible to calculate beforehand what angles and lines the decrease in each instance would prescribe to all the secondary surfaces. In a word, that the theory should be certain, it was necessary here, as in astronomy and every part of physics, that it should not only explain with precision all known facts, but that it should provide with equal precision for those which had not yet come to light.

This Haüy perceived, but fifteen years passed chiefly in teaching Latin had nearly effaced the small portion of geometry taught him at college. Without being deterred by this, he tranquilly set himself to regain it; and as he had so quickly learned botany to please his friend, he could not be long in acquiring enough geometry to complete his discovery. Nor was his recompense delayed beyond the first trial of this new auxiliary. The hexahedral prism which he had broken by accident was found, upon calculation, to yield a value closely approximate to that of the angles of the molecule of the spar; other calculations gave him that of the retreating surfaces, the application of the instrument to the measurement of the angles giving direct confirmation to the previsions of theory. In other crystals the secondary were found to be as easily deducible from the primitive planes, while in

nearly all cases the decrements, by which the secondary planes are produced, were found to exhibit the simple proportions which nature seems to have established in all the relations of number. Without further hesitation might Haüy now, for the third time, exclaim—*all is clear;* and at this stage only of his discoveries did he feel confidence enough to speak of them to Daubenton, the master whose lessons he had hitherto followed in modest silence. We may judge in what manner they were received from the fact that Laplace, to whom they were communicated by Daubenton, and who at once foresaw their consequences, lost no time in pressing the author to come forward and present them to the Academy.

This it was not so easy to induce him to do. To the worthy professor of the College Lemoine the Academy was a *terra incognita* at which his diffidence took alarm. Its usages were so little known to him that he at first presented himself in the long robe which ancient canons of the church are said to prescribe, but which no ecclesiastic has for a long time worn in society except on strictly professional occasions. Certain friends were apprehensive that, at a period of so much levity, this robe might occasion a loss of votes; but to induce so scrupulous a casuist to quit it, nothing less was necessary than an appeal to the advice of a doctor of the Sorbonne. "The ancient canons of the church," said this wise referee, "are no doubt highly respectable, but what is of consequence at this moment is, that you should belong to the Academy." We are at liberty, however, to believe that the precaution was superfluous, and that he would have been received, no matter in what vestments he had presented himself. So emulous, indeed, was the Academy of such an acquisition that, without waiting for the vacancy of a place in physics or mineralogy, one in botany, which circumstances had rendered disposable, was conferred on him with nearly entire unanimity, and even in preference to learned botanists.

A still more flattering proof of the regard of his new colleagues was, that, by several of the most distinguished among them, he was pressed to give a course of lectures and demonstrations in elucidation of his theory. Lagrange, Lavoisier, Laplace, Fourcroy, Berthollet, and Morveau might have been seen repairing to the College Lemoine to attend the lessons of the modest professor, whom we may well suppose confounded at finding himself become a master where he would have scarcely presumed to call himself a disciple. But in a doctrine so new, yet already nearly complete, the most skillful could be but learners. Never, perhaps, had a theory of the same extent been presented in the same state of clearness and development from its very origin as that of Haüy, who had invented even the required methods of calculation, and had represented in advance, by formulas of his own, all the possible combinations of crystallography.

From no instance more clearly than from this may we learn to distinguish between the solid labors of genius, on which imperishable structures are reared, and the ideas, more or less happy, which present themselves for a moment to certain minds, but, for want of being elaborated, produce no durable results.

Six or seven years before Haüy, Gahn, a young Swedish chemist,

since professor at Abo, had likewise remarked that in breaking a crystal of pyramidal spar its nucleus was a rhomboid similar to Iceland spar, and he had communicated this observation to his master, the celebrated Bergman, who would have been thought capable of following it into all its consequences. But in place of extending it to different crystals, and thus ascertaining by experiment within what limits the fact might be generalized, Bergman launched into hypothesis and lost his way from the outset. From the observed rhomboid of spar he pretended to deduce not only the other crystals of spar, but those of the garnet and hyacinth, which have no conformity of structure. Thus, a savant of the first order, a proficient in physics and geometry, bewildered himself in the path to a great discovery, and left it to be made by a man who was scarcely beginning to occupy himself with science, but who knew how to pursue truth as Nature wills it to be pursued; in proceeding step by step, observing without remission, and not suffering oneself to be carried away or turned aside by the imagination.

The mineralogists, however, who had been unable to find the right way, now, from the same cause, proved themselves as little capable of perceiving how far that of Bergman diverged from it, and they charged Haüy with borrowing Bergman's ideas—Haüy, who scarcely knew the name of Bergman, and had certainly never seen his memoir. They added, as is always done on similar occasions, that not only was the discovery not Haüy's, but that it was false.

Romé Delisle, a mineralogist, not otherwise without merit, but who had long been occupied with crystals without once suspecting the principle of their structure, had the weakness to deny it when discovered by another. He amused himself with calling Haüy a *crystalloclast*, as the breakers of images were called *iconoclasts* under the Lower Empire. But happily we know no heretics in science except those who do not choose to follow the progress of their age; and it is Romé Delisle himself, and others actuated by similar jealousies, who must be referred to the class of the perverse and contumacious.

The only response of Haüy to his detractors consisted in new researches, and a still more fruitful application of them. As yet, he had but given the solution of a curious problem in physics; his further observations were destined to furnish indications of the highest importance to mineralogy.

In his numerous experiments upon the spars, he had remarked that the stone called *pearl spar*, which till then had been regarded as a variety of the heavy spar, or sulphate of barytes, has the same nucleus with the calcareous spars; and his analysis proved that, like them, it consists only of carbonated lime.

If minerals, he reasoned, well ascertained as to their species and composition, have each a determinate nucleus and constituent molecule, the same must be the case with all the minerals distinguished by nature whose composition is not yet known. For the distinction of substances, then, this nucleus or molecule may supply the place of their composition; and from the first application of this idea he was enabled to carry light into a part of the science which all the labors of his predecessors had failed to make clear.

At this epoch, the most expert mineralogists, Linnæus, Wallerius,

Romé Delisle, even Saussure himself, confounded under the name of *schorl* a multitude of stones which had nothing in common but a certain fusibility joined to a form more or less prismatic; and under that of *zeolite* a multitude of others, whose sole distinctive character was to change, with acids, into a sort of jelly. The schorls especially formed a most heterogeneous assortment; every mineral of which there existed no clear idea being referred to it; which led the illustrious Lagrange to say, jestingly, that schorl was the *nectary* of the mineralogists, because the botanists were similarly accustomed to call by the name of *nectary* every part of the flower whose nature they were ignorant of.

On subjecting to mechanical division the stone known as white schorl, (*schorl-blanc*,) Haüy was surprised at finding the nucleus and molecule of feld-spar. A test supplied upon this indication, by the chemist Darcet, manifested the identity of the schorl in all its physical and chemical characters with the feld-spars.

Thus encouraged, Haüy proceeded to examine other schorls. He discovered that the black stone with which so many lavas are strewn, and which had been called *volcanic schorl*, has for its nucleus an oblique prism with rhombic base, and the pretended *violet schorl* of Dauphiné a nucleus whose prism is straight; both, therefore, were to be separated from the family of schorls. Still later, he succeeded in distinguishing the *electric schorl* or *tourmaline* from the *black schorl of primitive formation*, the nucleus of the first being a regular hexahedral prism, that of the last simply tetrahedral. Thus, one after another, under his continued researches, the pretended schorls were divorced from the varieties with which they had been improperly associated, and assigned by fixed characters to their proper groups. The same success attended his method in distinguishing the stones confounded under the name of zeolites. Chemistry and physics, prompted by these results of crystallography, were everywhere enabled to find in minerals characters or elements which had not before been detected.

From this time Haüy might be said to have become the lawgiver of mineralogy. By his researches on the schorls he had inaugurated a new era in the science; and every subsequent year has witnessed some unexpected discovery, due to the study of the crystalline structure of minerals.

Among the schorls, he finally distinguished fourteen species, six among the zeolites, four among the garnets, five among the jacinths. Not only were the chemists guided by these labors to the detection of unsuspected differences in the composition of stones; there were scarcely less frequent occasions when Haüy could predict that the differences which they had assumed could not exist. Thus, Vauquelin, who had before discovered *glucine* in the *beryl*, was led by the indications of crystallography to find it also in the *emerald*.

It was not always that Haüy recognized at first the indications furnished by his own researches; he might sometimes neglect to compare their results. When Klaproth and Vauquelin, for instance, had discovered that the *apatite* and the *chrysolite* of the jewelers were but phosphate of lime, Haüy, on recurring to his papers, found that he had himself long before determined the same structure for both; and

this coincidence in the result of operations conducted separately and without concert was, in his eyes, a decisive triumph for crystallography.

It was imperative on a man who served the sciences after this manner to devote himself exclusively to them. By the counsel of Lhomond himself, when the twenty years' service requisite for a pension of *emeritus* in the University was fulfilled, Haüy lost no time in demanding it. He had, besides, a small benefice, the whole not amounting to more than what was strictly needful; but for him, who knew no pleasure but in work, it would have sufficed if that needful, at least, had been assured to him. Unfortunately, he was to learn, within a very short time, that the effects of human passions are not so easily calculated as those of the forces of nature.

It will be recollected with what imprudence the Constituent Assembly, under the control of factious spirits, allowed itself to combine theological disputes with all the other disputes which then agitated France, thus doubling the asperity of political quarrels by giving them the character of religious persecutions. The new form of government imposed on the Church had divided the clergy, and the men who wished to carry the revolution to extremes took a pleasure in exasperating their dissensions. Such ecclesiastics as resisted innovation were deprived of their places and pensions, and Haüy, whose scrupulous piety consigned him to that class, found himself in a moment as poor as on the day when he aspired to the situation of singing boy.

He would have been content, however, had he been allowed to live by his labors; but the persecutors could not be satisfied with a first vexation. One of the earliest acts of the reckless men who mounted to power on the ruins of the throne, August 10, 1792, was to imprison the priests who had not taken the prescribed oath, and the scientific celebrity of Haüy furnished but a reason the more for including him in the common lot.

Little aware, in his solitude, of what was passing around him, it was with surprise that he one day saw a party of rough men insolently entering his modest retreat. They begin by demanding if he has fire-arms. "None but this," said Haüy, drawing at the same time a spark from his electric machine. For an instant these brutal personages feel themselves disarmed; but the next, they proceeded to seize upon his papers, which contain nothing but algebraic formulas; overturn the collection, his only property; and end with conducting him to the Seminary St. Firmin, contiguous to the College Lemoine, and recently converted into a prison, where all the priests and professors of that part of Paris were confined.

One cell for another made but little difference to Haüy. Tranquilized, moreover, at finding himself in the midst of many of his friends, he felt but little concern, except to send for his cabinet of drawers and endeavor to restore his crystals to order. Happily, outside the prison there were friends of his, better informed as to the course which things were taking.

Geoffroy de Saint-Hilaire, Haüy's pupil and subsequently his colleague in this Academy, lodged, then, at the College Lemoine. No sooner did he learn what had happened, than he hastened to implore

the intervention of all the personages who were likely to be of service. Members of the Academy, and functionaries of the "*Jardin du Roi*," did not hesitate to throw themselves at the feet of the ferocious men who were conducting this frightful tragedy. An order of deliverance is obtained and borne by St. Hilaire to the prison. But he arrives a little late in the day. Haüy is so tranquil, so comfortable, that nothing can determine him to leave that evening. The next morning it is almost necessary to withdraw him by force. One shudders to think that the day after was the 2d of September!

It is a singular fact that from that time he was never molested. Nothing certainly could have induced him to lend his countenance to the extravagances of the period; but no one proposed to him to do so. The simplicity and mildness of his manner and character seem to have stood him in stead of all else. Once only was he summoned to appear at the review of his battalion, but they cashiered him on the spot for his awkward appearance. This was nearly all that he knew, or at least saw, of the revolution. The convention, at a time when it was proceeding with the most violence, named him a member of the Commission of Weights and Measures, and Keeper of the Cabinet of Mines. And when Lavoisier was arrested, and Borda and Delambre dismissed, it was Haüy, a recusant priest, discharging every day his ecclesiastical functions, who alone found himself in a position to write in their behalf, and who did so without hesitation and without incurring inconvenience. Considering the time, there is even more cause to wonder at his impunity than his courage.

It was at the Cabinet of Mines, and on the invitation and with the aid of the enlightened administration of that department, that Haüy prepared his principal work, the treatise on mineralogy. Having at his disposal a vast collection, to which minerals were consigned from all quarters, and at the same time the services of the young and ardent scholars of the polytechnic school, (more than one of whom have since become eminent mineralogists,) Haüy promptly retrieved the time consumed in other labors, and in a few years reared that admirable monument of which it may be said that it effected for France what retarded circumstances had accomplished for the author himself; having at once restored that country, after long years of neglect, to the first rank in this division of natural history. This work unites, indeed, two advantages which seldom meet: the first, that it is founded on an original discovery, entirely due to the genius of the author; the second, that this discovery is followed up and applied with unexampled perseverance, even to the most minute mineral varieties. All is grand in the plan; all is precise and rigorous in the details. It is complete; like the doctrine itself of which it contains the exposition.

Of the departments of natural history, mineralogy, whose objects are the least numerous and least complicated, is that, notwithstanding, which yields itself least readily to a rational classification.

The first observers distributed and named the minerals vaguely from their external appearance and use. Only towards the middle of the eighteenth century was the attempt made to submit them to the methods which had rendered such service to zoölogy and botany; though in thus aiming to establish among them genera and species as among

organized beings, it was forgotten that in mineralogy the principle is wanting which has given birth to the idea of species, namely, that of generation; and that even the principle of individuality is scarcely admissible, when our conception of it is founded, as in the organic world, on a unity of action among different organs concurring to the support of a single life.

It is not by the material that the identity of species in plants and animals manifests itself, but by the form, as the name of the species itself indicates. No two men, perhaps, nor oaks, nor roses, have the substances which compose their material in the same proportions; and even those substances are in a state of incessant change: they circulate rather than reside within that abstract space and outline which we call the form of the object. In a few years there will remain, perhaps, not not an atom of what composes our body to-day. It is the form alone which is permanent, and which, transmitted by the mysterious process of generation, will continue to attract to itself, through an endless succession of individuals, molecules as different in their source as transitory in their condition.

On the contrary, in minerals, where there is no apparent movement, where the molecules remain fixed until separated by some external force; where the material, in a word, is permanent, it would seem at the first glance that this, or in other terms the chemical composition, ought to constitute the essence of the thing. But reflection teaches us that if the things themselves are different, this can scarcely happen except through the form of their molecules; that from the peculiar form of these molecules, and their respective mode of grouping, there must necessarily result determinate forms in the mass; and that in mineralogy, if there is anything which can represent the individual, it must be those resulting forms when they exhibit a regular whole; that is to say, a crystal; since at the moment, at least, when this crystal came together, all its constituent molecules must have concurred in a common movement and grouped themselves by the force of some common law. Now, nothing proves that in this common movement particles of a different nature which happened to be within the same sphere of action may not have been involved in it, nor that elements or atoms identical in their nature may not, at the moment of contracting their original union, have grouped themselves into different crystallized molecules. But that which the mind conceives as possible, experience has taught us to be real; whence, it is evident that, in these two cases, chemical analysis would give but an incomplete idea of the mineral, and one not at all in accordance with those of its properties which are most obvious.

Such are the views, doubtless, which, without being very distinctly taken into account by Haüy himself, guided his genius, or, if the expression be preferred, his scientific instinct, and led him to assign crystallization the first rank in his determinations of mineralogical species.

All the discoveries and observations since made, even those which have been looked upon as objections to this fundamental rule, may be said rather to be confirmations of it. Thus, for example, what has been just said of the crystallizing force and its power of engaging other molecules with the essential ones, is so true that the former are attracted

sometimes in much the greater quantity; and this to such an extent that a single mineralogical species, iron spar (*le fer spathique*) for instance, which is specifically a calcareous spar or carbonated lime, may contain a fourth, or even third, of its weight of iron, and thus become, for the metallurgist, a real mine, rather than a simple stone; as muriatic spar, which is likewise a calcareous spar, may envelop grains of grit (*grès*) in such measure as to contain little else, without having the angles of its crystals changed by a single second.

It is the same thing in our own laboratories as in that of nature. In causing a mixture of two salts to crystallize, Beudant observed that one of them constrained the other to blend with its crystals in a much larger proportion than that furnished by itself. Which, then, of the two ought to characterize the mineral? The most abundant? By no means; for, with the exception of that abundance, all the characters of the product are given by the other.

Nor is it less certain that the same substance, at the instant of passing into a crystallized form, or of individualizing itself, if the expression may be allowed, takes sometimes a very different form from that in which it usually appears. All the efforts of chemists have failed to discover in *arragonite* any essential matter but the carbonated lime, of which calcareous spar is likewise composed; for the small portion of strontian found in the former can only be regarded as accidental; and yet the crystals of arragonite are octahedral, and those of the spar rhomboidal. And here the art of man equally succeeds in imitating nature, or, indeed, effects at will what nature has rarely done. Recent experiments by Mitscherlich seem to prove that certain salts, in crystallizing, take different elementary forms, according to the circumstances under which they are made to crystallize. But in the small number of cases, where nature herself has produced such differences, are we justified in making but one species of these several crystallizations? As well might we make but one of almost all the warm-blooded animals, for they, too, are as identical in the chemical nature of their elements as the two stones named above. An eagle and a dog have the same fibrine in their muscles; the same gelatine in their membranes; the same phosphate of lime in their bony structure. Like the calcareous spar and the arragonite, they differ only in the form which these materials have taken at the moment of constituting the individual.

Let it be remarked that what is here said imports no neglect of the chemical analysis of minerals, as none certainly was ever countenanced by Haüy himself. Such analysis is quite as essential to a knowledge of them as is that of their form; it is much more important as regards their uses. Haüy maintained only that analysis is generally powerless to determine the species of minerals, because it has no certain means of distinguishing their accidental from their essential substances; because it is not competent, as to certain classes of stones, to affirm that it has detected their elements, and every day brings to light results which had escaped its observation.

Werner, long regarded by Europe as the rival and even adversary of Haüy, differed from him in effect only, in not having carried the research of principles to so high a point. Hardness, fracture, tissue,

the qualities to which Werner attached himself by preference, are in reality but consequences of the form of the molecules, and of their arrangement; and the happy use which this great mineralogist made of them, to recognize and determine so many species of minerals, may enable us to judge with what success he might have resorted to the source, when its simple derivatives were made by him so fertilizing. But of that source we are indebted to Haüy, not only for the knowledge, but for the measure, also, of its force and its abundance. Hence it was practicable for him alone to carry or to reduce to their just value many results which had remained, in a manner, but half truths in the hands of Werner.

There is, at this day, scarcely a known crystallizable mineral whose nucleus and molecules, with the measure of their angles and the proportion of their sides, have not been determined by Haüy, and of which he has not referred to those first elements, all the secondary forms, by discriminating for each the different decrements which produce it, and ascertaining by calculation their angles and faces. In this way he has at length made of mineralogy a science as precise and methodical as astronomy itself.

We may say, then, in a word, that Haüy is to Werner and Romé Delisle what Newton was to Kepler and Copernicus.

But what is more peculiarly his own, is, that Haüy's work is not less remarkable in point of composition and method, than for the original ideas on which it is founded. The purity of the style, the elegance of the demonstrations, the care with which all the facts are collected and discussed, would have made a classic of the most ordinary system of mineralogy. The trace of his earlier studies reappears in the skillful writer and sound geometrician; and even that of his first scientific recreations may be distinguished in the readiness with which the physicist always comes to the support of the crystallographer; supplying him with ingenious processes and convenient instruments, whenever it becomes necessary for him to appreciate the electricity of bodies, their magnetism, and action upon light. There is a rank in science which must be accorded as soon as challenged, and to that rank did Haüy ascend from the day his work was given to the world.

Nevertheless, on the death of Daubenton, it was Dolomieu, and not Haüy, on whom the professorship of mineralogy in the Museum of Natural History was conferred. But, at that moment, arrested in violation of all law, Dolomieu languished in the dungeons of Sicily. The only token that he yet lived, consisted in a few lines, which, from the midst of his chains, he had found the means of writing with a splinter of wood and the smoke of his lamp, and which the ingenious humanity of an Englishman, seconded by gold, had contrived to extract from the hands of the gaoler. These lines spoke as eloquently in his behalf as his works; and among those who solicited the most warmly for him was Haüy, the rival from whom he had most to apprehend.

It might be thought that such marks of consideration, rendered by such men, would have softened the executioners of Dolomieu; but men in authority, urged by the passions of the hour, as seldom inform themselves of the sentiments of their cotemporaries as they foresee the

scorn and indignation of posterity. Dolomieu emerged from his dungeon only through an article in the treaty of peace, and a premature death, the fruit of such treatment, but too soon devolved on Haüy the place which he had so generously renounced. He was nominated the 9th of December, 1802.

From that time new life was infused into the establishment; the collections were quadrupled; an order, constantly conforming itself to the most recent discoveries, reigned throughout. The mineralogical public of Europe pressed forward, as well to observe objects so judiciously arranged as to hear a professor so elegant, clear, and withal so complaisant. His natural kindliness showed itself at every instant towards all who desired to learn. He refused himself to no explanations, but received in his privacy, and with equal benignity, persons of the most opposite conditions in life; for the most learned and august, as well as the humblest, might have been seen in the retinue of Haüy's disciples.

From its foundation the University had felt itself honored in placing the name of Haüy on the list of one of its faculties, and, as no lessons were required from him, an adjunct every way worthy had been assigned him in the person of Brougniart, since a member of the Academy, and his successor in the Museum of Natural History. But Haüy had no wish to bear a title without fulfilling its duties. He drew around him the pupils of the normal school, and in varied and familiar conversations initiated them into all his secrets. His college life seemed thus to revive for him, as he entered even into the sports of these young people, whom he never dismissed without an ample collation.

In this manner his days flowed on, occupied completely by his religious duties, by profound researches continually renewed, and by acts of kindness, especially towards the young. Equally tolerant and pious, he suffered no difference of opinion to influence his conduct towards others; equally pious as faithful to his studies, he would have allowed no contemplation, however sublime, to interfere with the observances prescribed by the ritual: placing, for the rest, on the things of this world, only the value which they bear in the eyes of a man penetrated by such sentiments. From the nature of his researches, the gems of all Europe were constantly passing under his eyes, and even gave rise to a special treatise from his pen; but to him they were only so many crystals; a degree, more or less, in some angle of a schorl or spar would beyond doubt have interested him more than the treasures of the two Indies. Indeed, if he can be reproached with too warm an attachment to anything, it was to his ideas on this subject. It was not without impatience, sometimes, that he saw them controverted, and here only, where he had concentrated all his interest, could a motive sufficiently powerful be found to disturb his habitual serenity and kindliness. Thus he was prevented from accepting, with due acknowledgment, probably, the observations made by means of the new goniometer of Wollaston, on the angles of the calcareous and iron spar. But who will not excuse a valetudinarian and recluse, who had been attacked from the outset in the most unjust and offensive manner, if he sometimes failed to distinguish from his first ignorant assailants

those who, enlightened by his own discoveries, arrived in the sequel at a different estimate of certain facts of detail, or even principles, which he had too widely generalized? Certain it is, that in those moments, when such a tribute to human weakness was extorted from him, he felt only for what he supposed to be the interests of science, and if angry, it was simply at what he considered some new obstacle opposed to the triumph of truth.

The government of France, at the time when it was seeking to restore some activity to public instruction, proposed to Haüy the preparation of a treatise on physics, for the use of colleges. He had more than one title to this commission, whether from the ingenious manner in which he had applied physics to mineralogy, his many interesting memoirs on the electricity and double refraction of minerals, the elegant exposition which he had given of the theory of Æpinus on electricity and magnetism, or the success which had attended the course of physics delivered at the Normal School, established by the Convention in 1795. Notwithstanding these titles, however, Haüy scrupled to abandon, even for a time, the successful researches to which, as he thought, he had been guided by the hand of Providence, nor did he enter on the task without first consulting the Abbé Emery, a former superior of St. Sulpice. "Do not hesitate," said the latter; "it will be your own fault, if, in treating of nature, you neglect to speak of its Author; and fail not to designate yourself on the title page a Canon of the Metropolis." The abbé, whose ability is to be as little questioned as his sincerity, knew that there is no profession which is not exalted by the talents of those who exercise it, and remembered, doubtless, that the epoch when Christianity made most conquests and its ministers were held in most respect, was that when the latter carried the light of letters among the nations they converted, and by the union of these with the truths of religion constituted themselves at once the most eminent and most enlightened order of the State.

If this treatise on physics added little to the scientific reputation of its author, it by no means impaired his literary standing. Marked by the same clearness and purity of style as his mineralogy, it possesses even more interest; it is a book eminently qualified to inspire youth with a taste for the natural sciences, and to be received with interest by all. Hence, it soon passed to a third edition.

At different times Haüy had been warmly pressed to designate some post for himself, adapted to his pursuits and inclination. As his wishes extended no further than to be enabled to bring his family around him, as a solace in age and infirmity, this object seemed to be accomplished by the appointment of the husband of his niece to a petty place in the public revenues. But, strange to say, this slight recompense disappeared at the next reform, and no other answer to the remonstrances of Haüy's friends could be obtained but that there seemed to be no relation between crystallography and taxation.

Newton, it will be remembered, had in like manner been recompensed for the glory which his genius shed upon his country, by an appointment (far more considerable, it is true) of a financial nature; but he kept it under three kings and ten ministers. How is it that the men

who dispose, commonly for so short a time, of the lots of others, forget so often that acts like these will find a more enduring place in history than all the ephemeral details of their administration?

Nor was this the only trial that Haüy had to encounter. A short time afterwards the regulations of finance caused him the loss of his pension, as being incompatible with a salary for actual services; while his brother, who had been attracted to Russia with a view to the instruction of the blind, returned without the fulfillment of the promises held out to him, and with health so shattered as to be thrown entirely on his family for support.

Thus it was that, towards the end of his life, Haüy saw himself suddenly reduced to the strictly needful, of which he had before had experience. It would have required all his pious resignation to support this reverse, but for the care used by his young relatives to dissemble their own concern for his misfortunes. They redoubled their attentions as his means of acknowledgment diminished, and in recompense might find consolation in the devotion manifested by his pupils and the respect borne him by all Europe. Enlightened men, of whatever rank, arriving at Paris, hastened to tender him their homage; even the day before his death the heir of a great kingdom was to be seen sitting by his pillow and evincing his interest by expressions of the most touching sympathy. But to Haüy it was a more solid ground of support that, in the midst of his honors and prosperity, he had quitted none of the habits of his college, or even of his native village. His hours of repast, as well as of rising and lying down, were the same; each day he took nearly the same exercise, and in the same places, and while doing so still contrived to manifest his kindliness by conducting strangers who were at a loss, or by giving them tickets of admission to the collections. Many have received these little attentions who never suspected from whom they proceeded. His old-fashioned attire, his simple air, his language, (always of an excessive modesty,) were not likely to cause his recognition. His former townsmen, when he visited the place of his birth, could little divine from his deportment how considerable a personage he had become at Paris. It may be mentioned, as characteristic, that on one occasion, having met two old soldiers who were going out for a fight, he inquired into the subject of their quarrel, brought about a reconciliation, and, to make sure that the dispute would not revive, went with them to seal the peace after military fashion—at the ale-house.

The extreme simplicity of his habits would have probably prolonged his life, notwithstanding the frailty of his constitution, had not an accident accelerated the fatal event. A fall which he met with in his chamber fractured the neck of his thigh, and an abscess forming in the articulation rendered the injury incurable. During the long sufferings which preceded his death, he ceased not to exhibit the same gentleness, the same pious submission to the decrees of Providence, the same ardor for science, which had characterized his life. His time was divided between prayer, the superintendence of a new edition of his book, and a zealous solicitude for the future welfare of the students who had assisted him in its preparation.

He died the 3d of June, 1822, at seventy-nine years of age, leaving his family but one legacy—a magnificent one, it is true—in that precious collection of crystals of every variety, which the contributions of all Europe, during twenty years, had enhanced to a degree of which there is no equal.

He was succeeded in each of his places by one of his own pupils; by Brongniart at the Museum of Natural History, Beudant in the Faculty of the Sciences, and Cordièr in this Academy. It may be added, indeed, by way of worthily closing this account of his life and labors, that it would be difficult to find in Europe, at this day, a mineralogist worthy of the name, who, if not actually a pupil of Haüy, may not be considered such by the assiduous study of his works and his discoveries.