RENE-JUST HAÜY AND HIS INFLUENCE

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REVIEWING the history of the modern sciences it appears to us remarkable that in so many instances the person of one individual assembles the scattered observations and deductions of his predecessors, unifies and crystallizes the thought of his epoch and gives to his special branch of learning that impetus which, kindling at the fire of his genius, lights his successors along the way to modern scientific attainment. Thus, we speak of Newton as the father of mechanical physics; of Cuvier as the originator of comparative zoölogy and of Linnæus as the founder of biological classification. The year 1743, to which we direct our attention on this, its 175th anniversary, was remarkable in that it saw the birth, in France, of two such intellectual giants—Lavoisier and Haüy.

It is not without significance that modern mineralogy, based as it is on chemistry and crystallography, should, by a mere coincidence, be heralded into existence by these twins of genius. It is not without significance that, caught in the whirlwind of the Revolution, they should have together endured imprisonment. To what heights the mind of Lavoisier would have attained had his life been spared, we of course have no means of estimating. Suffice it, however, that the Abbé Haüy emerged from that supreme experience as one of the most profound analytical thinkers of two centuries.

René-Just Haüy, honorary canon of Notre Dame, member of the French Academy, creator of the science of crystallography, was born on the 28th of February, 1743, in the village of St. Just, about 70 kilometers north of Paris and directly on that now historic line which marks the limit of the German drive of 1914. As a child Haüy early showed a marked taste for church music, which trait, coupled with his interest in religious ceremonies, attracted the attention of the prior of an abbey at Prémontres; perceiving his aptitude and intelligence, the latter arranged to have him instructed by some of the monks. His progress was such that his instructors prevailed upon his mother to spare enough from her meager livelihood to enable him to go to Paris

in search of ampler educational advantages. In Paris, Haüy was forced to earn his living as a choir boy and became a good musician on the violin and harpsichord. "This employment," said he with some naïveté, "has at least this agreeable quality, that it does not permit me to bury my talent for music." Meanwhile his patrons were not idle, and before long Haüy received a scholarship in the College of Navarre which enabled him to pursue his education in the classics. At Navarre, application and intelligence advanced him from the rôle of student to that of instructor, the gift of teaching which so distinguished his career being thus early recognized and fostered. Here, under M. Brisson, he developed a taste for physical experiments, particularly those relating to electricity. Shortly after attaining his majority and with it his clerical degrees he entered a broader field of study and teaching at the College of Cardinal Lemoine in Paris.

Among his colleagues at Paris was numbered Lhomond, the grammarian, whose passion for botany gave to Haüy his first insight into the realm of natural science, and by directing his attention to the symmetries of plant life paved the way to those more intricate and beautiful symmetries of crystallization which were to render his name renowned. By a happy accident the Jardin du Roi adjoined the college and proved a favorite scene of the botanical walks of Haüy and his "chosen companion and director of conscience." Thence it was that, noticing on one occasion the crowd of students entering the class in mineralogy conducted by Daubenton, he entered with them and found the real goal of his scientific aspiration, the study to which he was to devote his life. Coming to this new world of inorganic shapes, complex and yet regular, fresh from the contemplation of the geometrical symmetry of the forms of plant life, Haüy was struck with the apparent lack of orderly arrangement where his scientific instinct had told him order must be. How, he reasoned, can the same stone, the same salt, reveal itself in cubes, in prisms, in points, without changing its composition to the extent of a single atom, while the rose has always the same petals, the acorn the same curve, the cedar the same relative height and the same development?

To what extent can we assume that the Abbé Haüy owed his great discovery to an accident? Such accidents are only the guiding threads held out by the hand of Opportunity. We know

that in the house of his friend, M. Defrance, Haüy dropped the now historic group of prismatic crystals of calcite and gathered from the ruin of a fine specimen the cleavage pieces to him recognizable as of the same form as other crystals of calcite; it thus appears that he had inevitably thrust upon him the key to the mystery of the mathematical inter-relation of these forms. But without a mind prepared to interpret this chance occurrence, without the imagination reaching out to its interpretation, the incident would have meant no more to him than to his friend who stood beside him. Bergmann, altho unknown to Haüy, had had an almost identical incident called to his attention by his pupil Gahn, but had failed to fully realize its significance. Bergmann did not voice the cry, which on the lips of his illustrious successor has become historic, "*Tout est trouvé.*"

Returning to his cabinet, Haüy lost no time in verifying the principle which was thus revealed to him. Under his hammer were sacrificed successively a scalenohedral crystal of calcite of the form known as "dog tooth spar," and another of a low rhombohedral habit; in each case the primitive cleavage rhombohedron appeared among the fragments, as he expected that it would. With the idea of developing the "primitive form" from other species he ruthlessly attacked the other treasured specimens of his little collection and his sacrifice was fully justified by the results, for the cleavage fragments in many instances furnished him with the basis, significantly termed by him *le noyau*, upon which the complicatedly modified crystal combinations were, as it were, built up. He conceived the theory of modified forms, built up from the primitive by diminishing layers of crystal particles (*decroissements*), each successive layer having a definite relation to the preceding one and to the primitive nucleus.

But the Abbé Haüy had spent fifteen years of his life in teaching Latin and had, like so many of us, forgotten what little geometry he had acquired at the College of Navarre. He set himself assiduously but tranquilly to master enough mathematics to enable him to prove his law. In the introduction to his *Traité de Cristallographie* we find this illuminating paragraph which represents his experience during these days. He says:

"In the solution of analytical problems, the object of which is to represent the progress of nature, we are led by very rapid methods to results which are often overlooked and which now

and then excite our surprise by the paradoxical form in which they are presented. But when, guided by simple reasoning, we return step by step over the course which was so quickly bridged by calculation, we end by perceiving the action of the principles which have given birth to these results."

The researches of the Abbé Haüy, communicated to his master in science, Daubenton, and thru him to Laplace, won for him in 1783 a place in the academy left vacant in the class of botany; and in 1788 he was ranked as associate in the class of natural history and mineralogy. Nor was it long before, armed with this new torch of truth, the science of mineralogy began at the hands of Haüy to undergo a rejuvenation; from the nebulous mineral group which up to that time had gone by the generic name of schorl, there emerged 14 well-defined species. The zeolites yielded 6 species, the garnets 4 and the zircons 5.

In 1784, having been in the service of the university twenty years, on the advice of his friend Lhomond, Haüy availed himself of the right to retire on a pension as emeritus professor and proceeded to devote himself to research.

A man of Spartan simplicity in his secular and religious life, it is said that he, thru ignorance of the formalities and etiquette of the Louvre, appeared at his first lecture before the court in a long ecclesiastical gown, doubtless grown shabby by much wear in his daily round of prayer and teaching.

The Revolution, by depriving him of his pension, further augmented the rigors of his life, but altho forced to earn his living, the placidity of his disposition and the simplicity of his tastes rendered him to an extent immune to the privations of this period of his life. Indeed so immersed was he in worship, labor and study, that it was with astonishment rather than fear that he received the delegation of citizens who came to arrest him. They demanded of him his firearms and he showed them the spark of an electric machine; they searched his papers and found only algebraic formulas. Nevertheless he was apprehended and lodged, together with all the other priests and regents of that part of Paris, in the Seminary of Saint Firmin, which had been turned into a prison. For Haüy it was but the exchange of an ecclesiastical for a secular cell. In the midst of his friends and brothers in religion he prevailed on his jailors to send for his cabinets of crystals and was soon again in the midst of his interrupted researches. And it was thus that his former pupil and

colleague Geoffroy Saint Hilaire found him when, armed with the order for his release, he penetrated the prison, which had become in reality a retreat. Arriving late in the day, he was unable to persuade Haüy to exchange his tranquil incarceration for liberty until the following day, which was the 31st of August, just two days before that fatal 2d of September which, had it dawned upon the Abbé Haüy in prison, would have inevitably seen him mount the steps of the guillotine.

The unobtrusive and almost shrinking modesty which always characterized Haüy, together with his sober garb and peaceful bearing, must have preserved him from further outrage, for we do not hear of his being again molested; and later the Convention nominated him as one of the Commission of Weights and Measures (1793–1794). Under the Republic he was constituted Minister of Mines and prepared his great work, the *Traité de Minéralogie*, which was published in 1801. Of this Cuvier writes:

"He has made of mineralogy a science just as precise and just as methodical as astronomy. . . . In a word we may say that M. Haüy is to Werner and Romé de l'Isle what Newton was to Kepler and Copernicus."

One incident may be cited to illustrate his characteristic charity and lack of self-assertion. On the death of Daubenton in 1799, when, according to precedent, Dolomieu, his assistant, would have been named as a successor to the chair of mineralogy at the Museum of Natural History, it happened that Dolomieu had been arrested and held as a political prisoner in Sicily. Haüy, who was the obvious candidate for this honor, so urged the claims of his absent rival that thru sentiment rather than merit Dolomieu was given the chair; however, he never lived to fill it, his premature death in 1802 leaving the field free to his generous colleague, who was immediately elected to the professorship.

Haüy had never relinquished his studies in physics; indeed, he constantly drew upon his skill and knowledge as a physicist in his mineralogical researches. On being asked by the government, however, to prepare a treatise on Physics, to be used as a text book in the schools, he hesitated to undertake a task which would cause him to abandon even temporarily his chosen field. The Abbé Emery, the ancient superior of Saint Sulpice, advised him in these words:

"Do not hesitate; you would commit a grave mistake if you lost this occasion, in treating of nature, to speak of its Author."

"And do not forget," he added, "to take on the title page your title of Metropolitan Canon."

The Treatise on Physics, like everything else from the pen of Haüy, is a model of purity of thought and clarity of expression, to which sterling literary qualities his natural love of teaching has added a charm of interest calculated to inspire the young students with his own love of the natural sciences.

The closing years of his life were marked by another reversal of fortune, when under the Restoration he was deprived of his pension and honors. But no administration, no political reversal, could take from him the fame which he had earned or the satisfaction of a life well spent in the elevation of the science which he loved. Cuvier has given us a striking picture of the true greatness of the unassuming Abbé of Revolutionary France —sought out by every visitor of distinction who entered Paris, yet never inaccessible to the poorest and humblest student. He never changed the hours of his meager meals, of his rising and retiring, day by day he took the same exercise, he traversed the same streets, losing no opportunity to show the small kindnesses and courtesies which so distinguished him, directing strangers whom he found embarrassed by the intricacies of Paris, and distributing to them cards of admission to the coll ons. On his occasional visits to his native village none of his ancient neighbors could detect by his manner that he had in Paris become a person of distinction.

His death was hastened by a fall which fractured the crown of his thigh bone and resulted in a painful abscess. Despite his condition he labored to the end on a new edition of his *Traité de Minéralogie*, which appeared in 1823, a year after his death.

Such was the man whose name we honor today. As to his influence, no one of us who has dipped more than casually into the wonderful science of crystallography has failed to have felt it. Beginning with that admirable mineral species calcite, called by him the "Protheus" among minerals, from a meaningless chaos of unrelated forms he produced an ordered science. To any one who will consult the literature of mineralogy in the latter half of the eighteenth and the first half of the nineteenth centuries there will appear a well-marked line of distinction between the old and the new, between those who wrote before Haüy published his *Essai d'une théorie sur la structure des cristaux* and those who succeeded him and profited by his teachings.

William Phillips writing in 1823 says:

"The labors of the Abbé Haüy have shed over mineralogy a purely philosophical luster which indeed has been one of the chief causes of raising the study to the rank of a science; this he has done by showing the consonance of the laws of crystallization with rigid calculation: he has proved that in crystallization there is a *natural geometry.*"

It was as tho he took as his motto the inspired words of Gulielmini, uttered nearly a century before the publication of his *Traité de Minéralogie:*

"Crystallization is a curious and wonderful operation of Nature's geometry, and therefore worthy of being investigated with all the genius of man and with the whole energy of the mind, not because of the pleasure which always attends the knowledge of wonders, but because of its great usefulness in natural science; for Nature here as it were discloses herself, and having cast aside every veil, permits us to behold not merely the results of her operation, but the very processes themselves."

The century and three quarters since the birth of Haüy has been marked by many crystallographic milestones. Deep cut on the cornice of this Hall of Fame are the names of Weiss and Naumann, of Miller, Mohs and Zippe; of Haidinger, Dana, Vom Rath and Goldschmidt; high priests of the altar of mathematical crystallography, the fire of which was first kindled by that other priest whose name we honor today. And beside these names I read the names of those others no less illustrious, Bravais, Sohncke, Schönflies, Fedorov, Barlow, Tutton and last and greatest the elder and the younger Bragg.

Just as in the Mont Cenis tunnel the engineers of France and Italy could hear each other's blows from the other side of the barrier of rock, so today the advance guard of workers in organic and inorganic sciences seem to hear rumors from the other side of that wall of the unknown which hides the origin of life. Who can say but that when the future has yielded up that supreme secret, biologist and crystallographer may not reëcho the words of Haüy: "*Tout est trouvé.*"