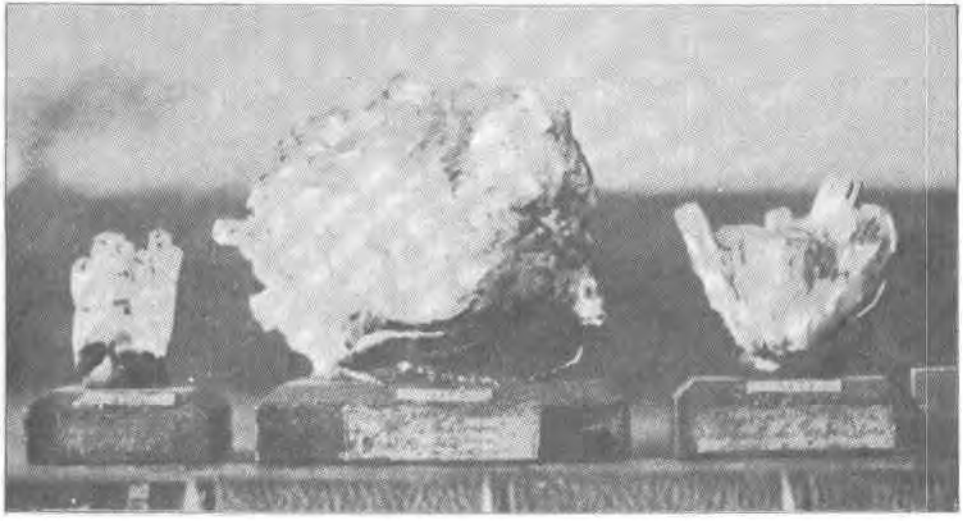
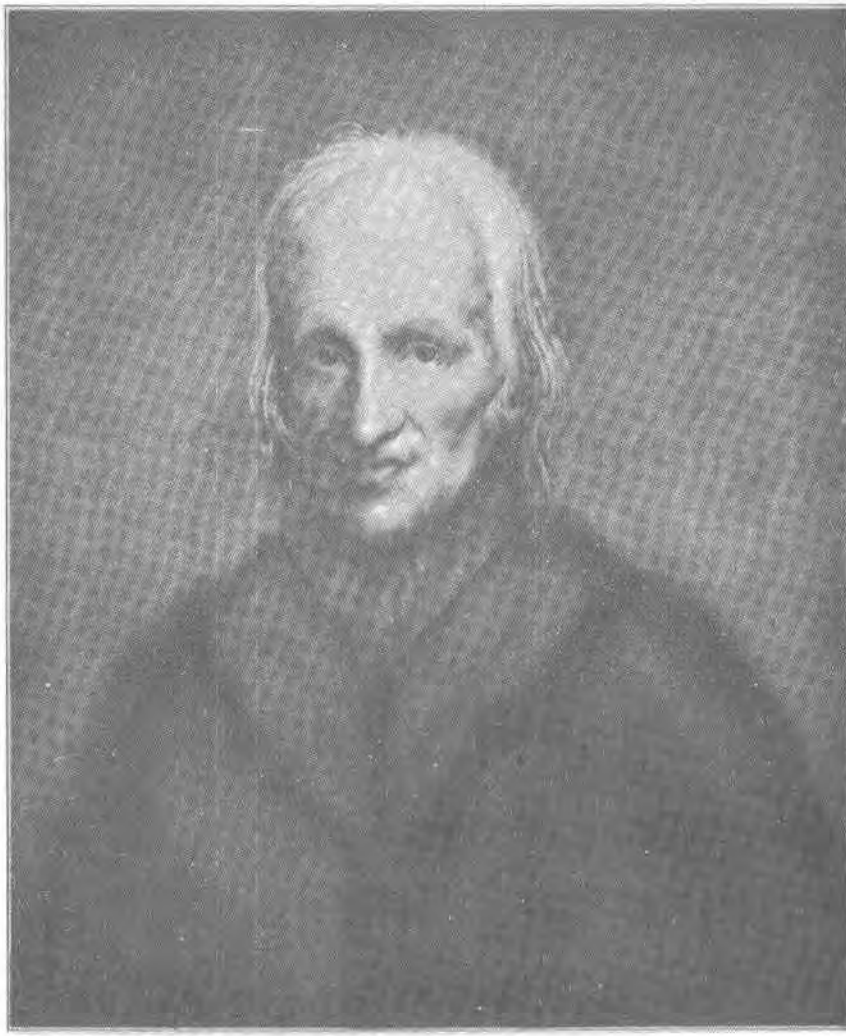
OLD CHURCH AT ST. JUST-EN-CHAUSSÉE, where Haüy was chorister in his childhood; from biography of Haüy in the series "Les Contemporains."



SPECIMENS FROM THE HAÜY COLLECTION IN THE MUSÉUM D'HISTOIRE NATURELLE, PARIS, with Haüy's original labels in his own handwriting. Photographed in the Museum for Haüy celebration at the American Museum of Natural History. New York, February 28, 1918.

PLATE 6



PORTRAIT OF HAÜY, in the possession of Prof. Alfred Lacroix, who occupies the chair of mineralogy in the Muséum d'Histoire Naturelle, formerly filled by Haüy, from 1802 to 1822.

THE LIFE AND WORK OF HAÜY

GEORGE F. KUNZ

Chairman, Haüy Celebration Committee

If a keen and observant mineralogist had not accidentally dropped a group of calcite crystals belonging to a French collector in such a manner that one crystal was broken; and if this crystal had not been presented to the mineralogist who broke it; and if he had not possessed the wonderful gift of thoughtful and conscientious observation that is characteristic of the people of France—even tho he was but the son of a weaver (indeed, this weaver probably possessed the same qualities); and if he had not interested himself in botany and had not casually listened to a lecture of the great Daubenton, professor of mineralogy and curator at the Muséum d'Histoire Naturelle at Paris; then modern crystallography would not have been founded on the scientific basis on which it now rests.

It is because of this event that we are here assembled, at the 175th anniversary of the birth of this mineralogist, to celebrate and do honor to him, and to the great institution with which he was later connected, and to urge, as an added inspiration to our young men, the importance of the study of mineralogy, especially of crystallography, as this would be of the greatest aid to the nation in times of war and in times of peace. So greatly has Haüy's work been appreciated that at this time of stress no difficulty was found in obtaining the coöperation of eminent scientists in nearly forty institutions in the United States and Canada, who have selected as their honorary chairman the present incumbent of the chair of mineralogy in the Muséum d'Histoire Naturelle, Professor Alfred Lacroix, who not only has so ably contributed to the science of mineralogy, but has been further honored with being called to the secretaryship of the Académie des Sciences, a post once occupied by the famous Georges Cuvier, who wrote the great eulogy of Abbé Haüy.

The life of Abbé Haüy, the founder of the science of crystallography, furnishes us with one of the many instances in which a great scientist has developed out of the simplest surroundings, and without having enjoyed any very exceptional advantages.

René-Just Haüy, the son of a poor weaver, Just Haüy, and

of his wife Magdeleine Candelot, was born in the town of St. Just, Dept. Oise, France, on February 28, 1743.[1] In his childhood his religious bent found expression in frequent attendance at the simple services of the village church, whither he may perhaps have been attracted partly by his natural love of music. His assiduity was remarked by the prior of an abbey of Premonstrants near the village who, after having taken occasion to talk with him several times, became impressed with the liveliness of his intelligence, and had him given some lessons by certain of the monks. Believing that he would prove worthy of any assistance that might be afforded him to secure better educational advantages than he could hope for in his native village, the prior suggested to the boy's mother that she take him for a while to Paris, where, by means of letters of recommendation, Haüy could secure entrance to some educational institution, so as to develop his abilities.

The mother's means were very scant, barely sufficient to enable her to subsist for a few months in the great city, but her love for her son and her ambition for his success induced her to take the risk. At first, however, the boy could find no better position in Paris than that of chorister in a small church of the St. Antoine quarter, not an uncongenial occupation, it is true, for a lover of church music, but still one that offered no prospect of mental culture. However, the boy's patient and willing acceptance of this place was before long rewarded. One of the good prior's letters influenced a Parisian friend to secure for Haüy a scholarship in the College of Navarre, where his devotion to his studies and his general good conduct won for him the favor of those in charge of the institution, so that he was accorded the position of usher; and subsequently, in 1764, before he had attained his twenty-first year, an appointment as *régent* (master) of the fourth class. So deceptive are physical indications that when he was named for this position he heard one of his colleagues remark, "There is a young man who will not live out the year." At the end of a few years he was appointed *régent* of the second class in an associated educational establishment, the Cardinal Lemoine College.[2]

[1] At the date of Haüy's birth his native town formed part of the old province Ile de France, the department of the Oise not having yet been constituted.

[2] These two colleges formed part of the complex constituting the Université. The Collège de Navarre dated from 1304, when it was founded by Jeanne de

PLATE 7.

RENÉ JUST HAÜY

PORTRAIT OF RENÉ JUST HAÜY. Drawn by Ambroise Tardieu (1788–1841).

While still in the Collège de Navarre, Haüy was attracted to the study of physics, and followed a course of lectures delivered there by Brisson. To these he listened with such lively interest, and watched the experiments performed by the lecturer so closely, that he was able to repeat many of them for his own instruction. However, altho he was thus laying a foundation for his later work, his knowledge of natural history was still very slight. His first earnest effort in this direction was due to his friendly relations with a fellow instructor, the Abbé Charles Lhomond (1727–1794), who composed a number of elementary educational books for the use of young people. With him Haüy frequently took long walks into the suburbs of Paris, during which Lhomond, an enthusiastic botanist, busied himself with collecting specimens of plant life. The young master soon began to feel regret that he could not intelligently share in the interest of his friend, and this moved him to take up the study by himself, saying nothing to Lhomond about it until he should have attained some degree of proficiency. A good opportunity presented itself during one of his vacations, which he passed in his native village, for he found there a monk who knew something of botany. Haüy profited by this chance so well that on his return to Paris he was able to give Lhomond a pleasant surprise by proving, on their next walking tour, that his own knowledge of botany was now almost on a level with that of his friend. Indeed, he published in the Mémoires of the Académie for 1785 (p. 210) a paper on the "Manière de faire des herbiers." In the preparation of his own herbarium he employed a special process for preserving the colors of flowers.

Thus, little by little, Haüy was moving forward along the path that was eventually to lead him to the discovery which has made him famous. It was but natural that his botanical studies should render him a frequent visitor to the Jardin du Roi, now the Jardin des Plantes, the establishment of which dates back to 1626.[1] On one of these visits he was led, almost by chance, to

Navarre, wife of Philippe le Bel; among its pupils had been the Duc d'Anjou (Henri III), Henri de Navarre (Henry IV), Armand Duplessis (later the famous Cardinal Richelieu) and Bossuet. The Collège du Cardinal Lemoine was of even earlier foundation, since it was established in 1297 by Cardinal Jean Lemoine.

[1] The first idea of the Jardin du Roi has been attributed to the physician of Marie de'Medici, Jean Rolin, who in his travels had visited the recently established botanical gardens in Germany and Italy.

assist at a lecture on mineralogy by Daubenton. His study of physics in general had been sufficiently thoro to enable him to grasp the general principles of mineralogical science, and his quick perceptions were impressed with the difference between the systematic classification of plant forms, and the comparative lack of system in the arrangemént of mineral forms. He soon realized that this must be due to the fact that while it was comparatively easy to trace the relationship of the groups of plants by the constancy of even the most complicated forms, the classification of minerals presented much greater difficulty, since in many cases the external forms of those of identical chemical composition were widely diverse.

The train of thought suggested by these reflections was given a definite direction by what we may call a happy chance, altho the real value of such a fortuitous happening strictly depends upon the preparation of the mind to seize upon its real significance. Haüy himself relates this circumstance as follows in his "Traité":[1]

"The observation I have just noted is that which has served to develop my ideas on the structure of crystals. It presented itself in the case of a crystal that the citizen Defrance[2] was kind enough to give me just after it had broken off from a group this enlightened amateur was showing me, and which formed part of his mineralogical collection. The prism had a single fracture along one of the edges of the base, by which it had been attached to the rest of the group. Instead of placing it in the collection I was then forming, I tried to divide it in other directions, and I succeeded, after several attempts, in extracting its rhomboid nucleus. This at once surprised me, and gave me the hope that I could advance beyond this first step."

In his eulogy of Haüy, delivered before the Academy of Sciences June 2, 1823, the great Cuvier repeats this story with the slight variation that Haüy "by a fortunate awkwardness" had let the group fall so that the crystal broke off. It is a rather curious circumstance that some six or seven years before this time a young Swedish chemist named Gahn, later professor at Abo, Finland, in breaking a pyramidal calcite crystal had also remarked its rhomboid nucleus. He communicated his observation to his master Bergmann, of Upsala, but the latter failed to realize its

[1] *Traité de Minéralogie*, vol. I, pp. 23, 24, 1801.

[2] Defrance du Croisset, a financier (*mâitre de comptes*), who owned fine collections of shells and minerals, which he was always ready to show to savants.

PLATE 8.

1743 ✣ 1822

Publié par L. Curmer a Paris

PORTRAIT OF HAÜY. Engraved from a medallion by A. Féart.

significance and, instead of carrying out experimental research on other crystals, lost himself in a maze of hypotheses.

Haüy, on the contrary, immediately proceeded to utilize this chance observation. On his return to his room he took a piece of spar of hexahedral form and, after breaking it carefully and skillfully, found the fragments of a rhomboid; the same proved true of lenticular spar. Pursuing his researches, he experimented with a great variety of crystals and found that the principle constantly held good. The variation, in most cases, of the exterior form from the primal form was due to the wearing away of superposed layers, either at the angles or along the edges, and to a special and peculiar arrangement of the elementary molecules, subordinated to the same structural laws.

In view of the fact that Romé de l'Isle's investigations and partial results in the domain of crystallography were so soon eclipsed by those of Haüy, we may perhaps forgive him for the satirical turn of certain of his criticisms of his rival. Thus Cuvier tells us that he is said to have found pleasure in calling Haüy a "cristalloclaste" because he was a breaker of crystals, just as in the Eastern Empire those who shattered the church images they considered as lures to idolatry were called "iconoclasts."[1]

Haüy now felt sufficient confidence in the value of his observations and the deductions he had made from them to speak of his results to Daubenton, and the latter communicated them to Laplace, who advised Haüy to present them to the Academy of Sciences. It was not an easy matter to overcome his disinclination to do so, not from any want of confidence in the truth of his discovery but from an inborn lack of self-assurance. Finally, on January 10, 1781, he read before the Academy his first memoir, in which he treated of the crystallization of garnets and calcareous spars. In accordance with the rules of the Academy a communication made by a non-member was only published according to a report made by one or more members. In the present case this duty devolved upon Daubenton and Bezout, but their report, published in the following month, showed that they had failed to grasp the full importance of Haüy's communication. On January 22, however, the latter read a second me-

[1] Baron Georges Cuvier, "Éloges historiques," Paris, in "Éloge historique de René-Just Haüy," p. 261, 1860.

moir in which he confined himself strictly to the calcites. This time, in a report by the same members, the publication of which was delayed until the following December, the scope of the discovery was satisfactorily presented, and justice was done to its importance.

As an acknowledgment of the great service Haüy had rendered to the science of mineralogy, the Academy was eager to include him among its members, but there was at this time no vacancy either in the section of physics or in that of mineralogy. However, he was elected as *adjoint* in the class of botany, a vacancy caused by the promotion of the botanist Jussieu to the rank of *associé*. When it became necessary for him to appear as a candidate, a difficulty arose about his dress, since he was exceedingly loath to lay aside the strictly ecclesiastical garb prescribed by the old rules of the church, and it required the authoritative opinion of a doctor of the Sorbonne to remove his scruples. The date of his election was February 12, 1783, and five years later he became *associé* in the class of natural history and mineralogy.[1]

An unofficial recognition of Haüy's merit, one scarcely less impressive than his speedy election to the Academy, was the request made by such masters of science as Lagrange, Laplace, Fourcroy, Berthollet, and De Morveau, that the diffident master of the second class in the Cardinal Lemoine College should deliver a special course of lectures for them on his new theory. Indeed, this theory was so bound up with his personality, he was so exclusively the fountain-head whence all exact knowledge of it must flow, that the master minds in other fields were for the time being obliged to content themselves with the part of learners.

With the lapse of twenty years from the beginning of Haüy's service in the university, he became entitled to receive a pension as emeritus. This he hastened to ask for, as by adding it to the income from a small benefice, he would be provided with what was strictly necessary; he continued to lodge in the Cardinal Lemoine College. It remained, however, requisite that this small sum should be assured to him. Unfortunately, political events were about to dispose of things otherwise. One of the radical measures adopted by the Constituent Assembly was a law requiring the clergy to take an oath of adhesion to the new form of government, under penalty of being deprived of their

[1] In plate 9, as well as in the frontispiece, Haüy is shown wearing the jacket of the Academy.

PLATE 9.

Hauy

PORTRAITS OF HAÜY, in his uniform as member of the Académie des Sciences.

emoluments and of their places. Haüy's sensitive conscience opposed a bar to his taking this oath. He therefore became subject to the penalty imposed upon those who refused, and as a result he found himself stripped of his little income.

This punishment, however, fell far short of satisfying the anti-clerical partisans of the Revolution, and by another decree passed a few days after the assault on the Tuileries, August 10, 1792, and the imprisonment of the royal family, it was ordered that all priests who had failed to take the oath should be imprisoned. Haüy, in his retired life, solely devoted to scientific study, had but a rather vague sense of the rapid political changes transpiring in Paris, and he was therefore much startled when one day a party of rough men violently entered his modest retreat in the college. Their first question was whether he had any firearms with him. Haüy, who had quickly regained his wonted composure, answered, "I have none but this," at the same time drawing a spark from an electric machine. His quiet bearing and this half-humorous response served to quiet the men a little, but they soon began a hunt for compromising material of any kind. They seized his papers, covered with algebraic formulas, which they may have suspected to be mysterious and treasonable ciphers, and what was much more trying for him, tumbled about his precious minerals, his sole and only treasure. The search being completed, they bore him away to the nearby seminary of St. Formin, which had been turned into a prison. Here he found himself shut up with all the recalcitrant priests and masters of this quarter of Paris.

The change from his simple room in the college to a similar one in the seminary seemed a matter of comparative indifference, and the presence of many of his friends still further tranquilized him. He was also accorded the favor of having the drawers filled with his precious crystals brought to him, and was able to put them again into some sort of order. The very real risk from the passions of the bloodthirsty mob he was far from realizing. Fortunately he had friends outside who were better aware of the dangers of his position. Among them was his colleague of a later time, Geoffroy St. Hilaire, who left no stone unturned to secure the liberation of his friend. His appeal and their own affection and respect for Haüy induced members of the Academy and functionaries of the Jardin du Roi to subject themselves to the humiliation and rebuffs they were sure to encounter in asking

any favor of the ferocious men then in control of Paris. There was, however, so little possible excuse for persecuting one so harmless as Haüy that their efforts were at last crowned with success, and an order of release was granted. Armed with this, Geoffroy St. Hilaire lost no time in hastening to the St. Formin seminary. On his arrival there, rather late in the day, he found Haüy perfectly unconcerned and quite disinclined to leave that same evening. When the morrow came it was still hard to persuade him of the imminent peril in which he was, and to induce him to leave the place. How important haste was in this matter was soon made evident by the dreadful prison massacres that took place a few days later, on September 2, 1792, when eighty priests who had shared his captivity at the St. Formin were done to death by the brutal mob.

This was the only serious danger to which Haüy was subjected during the Revolution, and his experience of the active side of the great political convulsion was limited to a single appearance at the review of the battalion to which he had been assigned. His obvious physical unfitness for military service procured him an immediate discharge. He was called on November 9, 1794, to the professorship of physics at the École Normale; on April 17, 1795, the Commission of Weights and Measures appointed him as secretary, and in the same year he was made Curator of the École des Mines. Here it was that he composed his great *Traité de Minéralogie*, originally published serially in the *Journal des Mines*, and later issued, in 1801, in four octavo volumes. This work was immediately recognized as the most important contribution yet offered by France to the science of mineralogy, one that placed the country in the very forefront of the European nations in this science. In it the author makes crystallography the basis of his determination of mineral species, relegating the data derived from chemical analysis to second rank. The mathematical precision with which the crystallographic facts could be presented provided an absolutely exact basis for mineralogy which it had lacked before that time, as the correctness of the crystallographic determinations could always be proved by rigid geometrical tests.

On Daubenton's death in 1800 Haüy seemed clearly indicated as his legitimate successor in the position of professor of mineralogy at the Muséum, but he himself earnestly solicited that

PLATE 10.

HAUY

D'APRÈS J. BOILLY

PORTRAIT OF HAÜY, engraved from drawing by J. Boilly.

Dolomieu should be chosen, altho the latter was at this time confined in a Sicilian prison, whence he was only able to communicate with his friends by means of a few lines written with lamp-black on slivers of wood, even this poor resource being obtained by bribing his jailor. He was nevertheless elected to the professorship, but only occupied the post for a brief time after his return from captivity, for his health had been undermined by his sufferings. He died in 1801, and in the following year Haüy was chosen to succeed him.

Haüy's entrance into this wider sphere of activity gave new life to the study of mineralogy in the Muséum, for the great reputation he had already acquired attracted students from all parts of Europe. His hearers were not only impressed by the lucidity of his expositions, but were also charmed by the unaffected simplicity and kindliness of his manner.

When public worship was restored in France during the Consulate, Haüy was given the title of honorary canon of Notre Dame, and on the institution of the Légion d'Honneur he was made chevalier in the new order. From the constitution of the Institute in 1795, he formed part of it, with the other members of the Academy of Sciences. Napoleon, the First Consul, who, as is well known, fully realized the great importance of the higher education for the upbuilding of a nation's fame and prosperity, commissioned Haüy to write a treatise on physics to be used in the *lycées* of France. On learning that he was to be given but six months' time for the completion of a work of this scope, the scientist hesitated to undertake it, but was at last persuaded to do so. He took up the task so zealously that at the expiration of four months he was able to offer the two volumes of his "Traité de Physique" to the First Consul.

While exiled on the island of Elba in 1814, Napoleon occupied some of his enforced leisure in reading this treatise, and on his triumphant return to Paris in the spring of 1815, he promoted Haüy to the rank of officer in the Légion d'Honneur,[1] a grade that was taken from him in the Restoration which followed soon.

When the allied sovereigns assembled in Paris on Napoleon's downfall Haüy's modest lodging was visited by the King of Prussia, the father of William I of Germany, by Alexander I of Russia, and by Archduke John of Austria. The Austrian archdukes are said to have tried to induce him to sell his collection

[1] In the frontispiece Haüy is shown wearing the medal indicating this rank.

by the tempting offer of 600,000 francs for it. However, he declared that he had resolved to bequeath it to France. His generous intention was left unfulfilled, and some years after his death his heirs were induced to sell it in England, where it remained until the overthrow of Louis Philip, in 1848; it was then in the possession of the Duke of Buckingham, and was bought from him for £325 or 8,125 francs by the Second Republic, and placed in the Muséum d'Histoire Naturelle, its natural resting place.

In spite of the high reputation he had gained as a scientist, Haüy suffered from straitened circumstances in the closing years of his life. With barely enough to provide for his own absolute needs, he was obliged to receive and care for his brother Valentin, who, after founding the "Institution des Jeunes Aveugles" in Paris, traveled to Germany and Russia and founded there similar institutions for the blind. From these wanderings he returned with broken health and without money, and thus imposed an added burden upon René-Just Haüy. Valentin died a few days before his illustrious brother, on March 19, 1822. However, the latter's simple habits and almost ascetic mode of living made him less sensitive to the inconveniences resulting from his lack of means than would have been the case with many others; indeed, he is said to have even been able to give a little aid now and then to those poorer than himself.

Altho never robust, he must have had an essentially sound constitution, for he had attained the age of seventy-nine years when he passed away on June 3, 1822. His death was the result of an accident, altho the fatal outcome was undoubtedly due to his physical condition. He fell, while walking across his room, and broke his thigh-bone. An abscess formed at the point of fracture and an acute fever which supervened put an end to his life in a few days. M. Brongniart, who had been his assistant in teaching for several years, was called to fill his place as professor in the Muséum.

The 8th of November, 1903, was a festival day in the little city of Saint-Just-en-Chaussée (dept. Oise), for it was on this day that a monument was dedicated there to the brothers Haüy, the scientist René-Just and the philanthropist Valentin. The title the latter possesses to the grateful remembrance of all who are interested in what makes life more bearable for those afflicted with blindness must not be forgotten in our admiration

PLATE 11.

LES FRERES HAÜY.

PORTRAITS OF THE BROTHERS HAÜY (RENÉ JUST AND VALENTIN) drawn by J. Boilly, engraved by Alphonse Boilly.

for the more famous discoverer of crystallography. Valentin Haüy's methods for enabling those born blind to share the power of reading with their more favored brothers and sisters merit a place alongside of the methods initiated by the celebrated Abbé de l'Épée to give the deaf-mutes the power to communicate with those enjoying the powers of hearing and speech.

One of the most illustrious continuers of Haüy's work, the mineralogist and geologist François Mallard[1] (1833–1894); has paid him the following just tribute:[2]

"The science of crystallography was entirely created by Haüy's genius, and his successors have had little to do except to perfect the details of his work. No other branch of human knowledge is in the same degree the work of one man alone."

It is but natural, in view of the surprising revelations as to the structural relationship of minerals due to Haüy's discoveries and researches, that mineralogy, properly so called, should have been for a time thrust into the background. However, during the first quarter of the nineteenth century the development of mineralogical chemistry greatly changed the aspect of things in this respect, and at the time of Haüy's death in 1822, a reaction of the mineralogical chemists against the exclusive pretensions of the crystallographers had already taken place.

The most illustrious predecessor of Haüy in the study of crystal forms was unquestionably Romé de l'Isle (1736–1790), who in 1772 published his *Essai de Cristallographie*, in which he foresaw the importance of crystalline symmetry and announced the constance of crystal faces. The views expressed here were presented in a fuller form in a second edition issued in 1783, in three volumes, and bearing the title *Cristallographie*. To this book Linnæus gives the following high praise: "Among the works produced in this century on mineralogy, it is certain that your *Cristallographie* takes the first place. It testifies to your penetrating intellect, to the immense number of observations you have made, to your wide reading, and, what is rare indeed, to your kindly attitude toward myself."

In this work Romé de l'Isle embodied the results he had been able to obtain by the help of Carangeot's recently contrived

[1] Author of *Traité de cristallographie gćometrique et physique*, Paris, 1879–1884; 2 vols. and atlas.

[2] Cited in *La Science Française*, Exposition Universelle de San Francisco, vol. I, p. 170.

goniometer, for accurately measuring the angles of crystals; this instrument having been made from Carangeot's drawings by the mechanician Vinçard. There can be no doubt that crystallography owed much to the mechanical aid the goniometer afforded; indeed, it has frequently been the case that important discoveries in pure science have depended upon the invention of new mechanical apparatus. In 1809, Dr. Wollaston (1766–1829) invented a perfected instrument, the reflection goniometer, those of the Carangeot type subsequently being known as contact goniometers. For the proper measurement of small crystals the reflection goniometer is needed, but for the larger ones the more easily and quickly operated contact goniometer has been found useful.

The credit of publishing the first accurate observations on a type of crystal has been given to Nicholas Steno, a Danish physician, who later became Bishop of Titupolis. In a work published in 1669,[1] he treated of the characteristics of quartz crystals, carefully noting that whatever may be their apparent diversity of form the angles between similar pairs of faces are always the same. The theory of the upbuilding of a crystal about a definite and constant nucleus is also enunciated by him. The first book devoted to crystallography as a separate branch of mineralogy was the *Prodromus Crystallographiæ* of M. A. Capeller. This appeared in Lucerne in 1723, nearly fifty years before the publication of De l'Isle's *Essai*.

Of the immediate predecessors or contemporaries of Romé de l'Isle one of the most noted was the Swedish physicist Torbern Olaf Bergmann, whose essay on the crystal forms of calcspar was printed in 1773 in the Acta of the Royal Society of Sciences in Upsala. Had he followed out the indications supplied by his observations he might have occupied a much higher place than he does in the history of crystallography. A year later, in 1774, Abraham Gottlob Werner (1750–1817) in his writing *Von den äusserlichen Kennzeichen der Fossilien* treated of the various forms of crystals, and undertook a partial classification of them.

Of the special merits of Haüy's discovery and theory, Von Kobell has written as follows:[2]

[1] "De solido intra solidum naturaliter contento," Florence, 1669; Engl. transl. 1761; see also *American Mineralogist*, 2, 33, 1917.

[2] Franz von Kobell, *Geschichte der Mineralogie von 1650–1860*, pp. 188, 191, 1864.

"The laws governing crystallization as presented by Haüy not only indicated the form derivable from a given nucleus, but at the same time those which could not be derived therefrom, and showed that the dimensions given by calculation constituted the accurate definition of those approximately determinable by the goniometer. One of the most important results of Haüy's researches was the discovery of the law of symmetry, according to which when one form of crystallization is modified by its combination with other forms, all the similar parts, the edges, angles and faces, are always modified at the same time and in the same way. Haüy called the goniometer a kind of geometrical magnifier, which enabled the observer to perceive excessively slight differences, which could not be perceived ocularly. To him is due the credit of recognizing that the so-called Spanish chrysolite was apatite, long before Vauquelin reached the same result thru chemical analysis. He also recognized before Klaproth that the mineral from Norway called vesuvianite was in reality zircon. His crystallography first brought the beryl and the emerald into the same species, and showed that euclase constituted a peculiar species.

We have already alluded to the *Traité de Physique* written in 1803 at the instance of Napoleon Bonaparte, when First Consul In his introduction to this work Haüy remarks that nothing was better calculated to stimulate his zeal than the hope of realizing the views of the "Hero of France," who wished to provide for the students enrolled in the higher schools a grade of instruction calculated to develop their judgment by the acquisition of a thoroly systematized learning, which would assure their success in whatever functions they might later be called upon to fulfill. In this connection, he insists upon the fact that any exposition becomes vague when it is strictly confined to its general outlines, and that details may fairly be called the touchstones of theories, for they either guarantee their value or reveal their weakness.

In 1809, eight years after the publication of his *Traité de Minéralogie*, wherein he states the essential principles of his discovery of the laws governing crystallization, Haüy issued a work entitled *Tableau Comparatif des Résultats de la Cristallographie, relativement à la Classification des Minéraux*.[1] He herein states that his principal object in publishing the book is his wish to

[1] Paris, 1809; 312 pp.; 4 plates.

give to those who had followed his course of lectures a full tabulation of his mineralogical methods, revised in accordance with the discoveries and observations with which science had been enriched since the publication of his *Traité de Minéralogie.* New minerals had been discovered by travellers, and a more thoro study of those already classified had shown many of them to be related to species with which no connection had been suspected.[1]

One of the peculiar merits of crystallography, in his opinion, was that it made use of what might not unjustly be termed a "palpable means" of verification, and that it depended upon the kind of anatomy of which crystals are susceptible, as well as upon modifications of a structure which, to a certain extent in the case of minerals, is what the organism is in regard to beings endowed with life. Thus mineralogy was made to share with zoölogy and botany the merit of making a direct appeal to the eye.[2]

That with all his single-minded devotion to the cause of pure science Haüy was not without a quick sense of the value of applying scientific knowledge to useful ends, is shown in one of his latest works, *Traité des Caractères Physiques des Pierres Précieuses.*[3] In his introduction, to emphasize the chemical importance of gem-stones, he alludes to the fact that thru the analysis of the jacinth and the beryl two new elements had been discovered, Klaproth having recognized zirconium in the former, while the presence of another new element, glucinum, had been found by Vauquelin in beryl. In the preparation of this treatise Haüy asserts that his aim is to present clearly the physical characteristics observable in precious stones that are cut as gems, and to arrange the data in the form of rules that may be used for the determination of these gems. He believes that such rules will prove of great value to the gem-cutters as well as to the dealers in gems, since they enable them to verify impressions received thru the eye.

However, the chief object of the work is to help those forming collections of gem-stones, as among the collectors of these objects, which, as Haüy writes, "form part of what we look upon as

[1] *Tableau Comparatif*, introduction, p. 1.

[2] *Op. cit.*, p. xvii.

[3] Paris, 1817; xvi, xxii and 253 pp., 3 plates.

our riches," there was but little positive knowledge of them. Of this he says:

"The idea that what has been offered them as an Oriental ruby is really one of those eagerly-sought stones which occupy the first rank after the diamond, is a satisfaction that they only enjoy on the bare word of the dealer. I have therefore thought that they would gladly assure themselves, by decisive tests, of the authenticity of an object which had cost them a sum proportionate to their appreciation of it, and learn whether the name under which they had acquired it was really that to which its characteristics entitled it."

It is interesting to learn that the completion of this treatise was hastened by the impression a perusal of the unfinished manuscript produced upon the great English banker and gem-collector, Henry Philip Hope, while he was on a visit to Paris. Haüy adds that as a testimony of his appreciation, Hope generously donated to the scientist's collection a number of rare specimens which were lacking, their place being but poorly supplied by analogous material not possessing all their characteristics. Hope also took occasion to supply himself with the mechanical instruments necessary to prove experimentally the existence of the several properties of the gem-stones.

One of the earliest records of Haüy's crystallographic investigations is the *Mémoire* on the structure of feldspar crystals, read by him before the Académie Royale des Sciences, June 26, 1784. In it he notes that M. Demarest, a member of the Académie, had brought back from his travels, in 1770, specimens of two very interesting varieties of feldspar, one of which he had found among the lavas of Auvergne and the other in the province of Limousin. He deposited in the Cabinet du Roi an especially fine specimen of the latter variety, which was a six-faced prism. The first variety was also of prismatic form, but with ten faces. Haüy describes these crystals exhaustively in his *Mémoire*, treating them as secondary forms of feldspar. Combined with the examples described by Padre Pini, professor of natural history in Milan, in a paper published in 1779, Haüy found that they constituted one of the most complete series of crystal forms that had yet been observed. He adds:

"Besides the fact that feldspar crystals already merit the attention of naturalists for the reason that they are forms of one of the most interesting substances in the mineral kingdom, I have

also been incited to communicate my observations to the Académie, on account of the new proofs they appear to furnish me of the principles I enunciated in the outline of a theory regarding crystals, published toward the end of the year 1783. I have not yet seen feldspar in its simple primitive form, freed from all accidental faces. This form would be that of a quadrilateral prism."

The characteristic letters of Haüy here added give an excellent idea of his quality of mind, of the grace of his style and of his urbanity. The longer one is translated from a facsimile reproduction in *Isographie des Hommes Célèbres* (Paris, 1843), the material for which was assembled by T. Delarue.

PARIS, September 8, 1807

Sir: It would be difficult for me to recall a visit which has given me greater cause to feel flattered at having received it, than that of Mr. Nass. It combined the advantage of becoming acquainted with a very distinguished savant and the lively satisfaction of receiving from you a very precious gift accompanied with an exceedingly kind letter. Your crystals of arsenical cobalt offer a variety lacking in my collection, of which they now form one of the finest ornaments. I finished, a few days ago, my public course of lectures on mineralogy, and I hasten to fulfill the promise I made you to send you an article for the second volume of your excellent manual. It is an epitome of what is new in my lectures relative to the science of which they treated. I add it to my letter, begging you, Sir, to make all the changes and modifications you may judge proper. I speak of myself in the third person, because I have thought it might perhaps be better that the article should be considered to have been communicated to you by one of those who assisted at my course. I could have written at greater length, had I not feared to exceed the limits. I will add here, for yourself alone, a résumé of the observations I have made on a letter written anonymously to M. Berthollet, and which you have doubtless read in the *Journal de Physique*, July, 1807, vol. VI. The writer seems to have failed to grasp

the method I employ in the determination of mineral species. It is not only in the results of mechanical division, or of cleavage, that I make it consist, but also in the relations established by calculation between the dimensions of the primitive form indicated by the operations in question. Thus the cymophane, the apophillite (ichthyophthalmite), the peridot, the mésotype, etc., having been mechanically divided, give as the primitive form a rectangular parallelopiped. On the other hand the phosphate of lime, the sulfate of copper, etc., give hexagonal prisms, such as are determined by the laws of decrescence which produce their secondary forms, varying from one species to another; and it is above all this variation that, in my method, serves to trace the lines of demarcation which sharply separate the bodies I take as types of species. *A fortiori*, the same theory indicates the distinction of species whose primitive forms differ by the respective disposition of their faces. There results from this, in regard to each one of the species in question, a particular system of crystallization to which it is impossible, without violating nature, to bring the varieties comprised in another species. All the subordinate divisions that can be conceived in the sense of diagonals of primitive forms, or in other directions (and in this connection the anonymous writer establishes rules by supposing a multitude of cleavages I have never seen), all these divisions, I repeat, will not become recognizable from the divisions proven to be unrecognizable by calculation. The writer's objections come a little late, since my system is complete from beginning to end, and I can demonstrate to anyone the application of my principles to each one of the species which compose it. I have believed that I ought to communicate these observations to my students, several of whom have already made them on their own account. However, I have never made a printed reply to any objections which have been raised against me; when they seemed to me to be well founded, I accepted the correction. I recall that a famous savant, having composed an answer to an attack directed against him, read it to Daubenton, saying to him, "Is this not victorious?" "Without doubt," replied Daubenton, "but you are going to have a war on your hands, and what victory is comparable to peace?" Daubenton was my master in mineralogy;

I have also taken him as my master in morality. Will you pardon me, Sir, for having entered into all these details with you? I beg you at least to look upon them as a witness of how highly I prize your esteem.

Accept the expression of my lively gratitude and that of the great respect with which I have the honor to be, Sir,

Your Very Humble
and Very Obedient Servant,
HAÜY

If you see fit, Sir, to make any changes in my article, I ask indulgence as to what I write of the arsenical cobalt. I would be flattered to be able to send you some small specimens from among my duplicates; but I should wish to know those which you lack, especially of the minerals of France.

PLATE 12.

Paris, ce 4 Sept. 1813.

Monsieur.

Le plaisir que m'a causé la lecture des vers aussi élégans qu'harmonieux que vous avez eu la bonté de m'adresser, me prouve que l'étude de la minéralogie ne m'a point fait oublier les beautés de Virgile et d'Horace, que j'ai passé vingt années de ma vie à développer. La peinture que vous faites des résultats de mes travaux en histoire Naturelle annonce de votre part cette indulgence qui est la compagne ordinaire d'un grand mérite. Mais je me ferois tort à moi-même, si je désavouois l'idée avantageuse que vous me paroissez, Monsieur, avoir conçue de moi sous le rapport des qualités morales, surtout dans un moment où je me vois sollicité si vivement par la reconnoissance. Agréez l'hommage de celle que je vous ai vouée à si juste titre, et permettez moi d'y joindre l'assurance de la considération très distinguée avec laquelle j'ai l'honneur d'être,

Monsieur,

Votre très humble et très obéissant serviteur Haüy

à Monsieur Marron,

LETTER OF HAÜY TO MONSIEUR MARRON, AND NOTE TO DR. COGSWELL; reduced.

à Monsieur Kogswell,
hommage de la reconnoissance
et du respectueux attachement
de l'auteur.

PARIS, Sept. 4, 1813

Sir: The pleasure caused me by the reading of the verses, as elegant as they are harmonious, which you have the goodness to address to me, proves to me that the study of mineralogy has not made me forget the beauties of Virgil and of Horace, which I have passed twenty years of my life in cultivating. The picture that you draw of the results of my work in Natural History, testifies on your part to that indulgence which is the usual associate of great merit. But I would be doing myself a wrong if I should disavow the good opinion you seem to me, Sir, to have formed of me in the matter of moral qualities, above all at a time when I feel myself so powerfully moved by gratitude. Accept the homage of that which I have so justly dedicated to you, and permit me to join with it the assurance of the very distinguished regard with which I have the honor to be

Sir

Your Very Humble and
Very Obedient Servant

HAÜY

To Monsieur Marron.

A copy of one of Haüy's writings, now in the New York Public Library, an offprint of his memoir *Des surfaces vibrantes*, bears on the title leaf an autograph presentation by the author to "Monsieur Kogswell." This was Dr. Joseph G. Cogswell, the first Superintendent of the Astor Library, who visited Paris in 1819, during his three years' residence in Europe.[1]

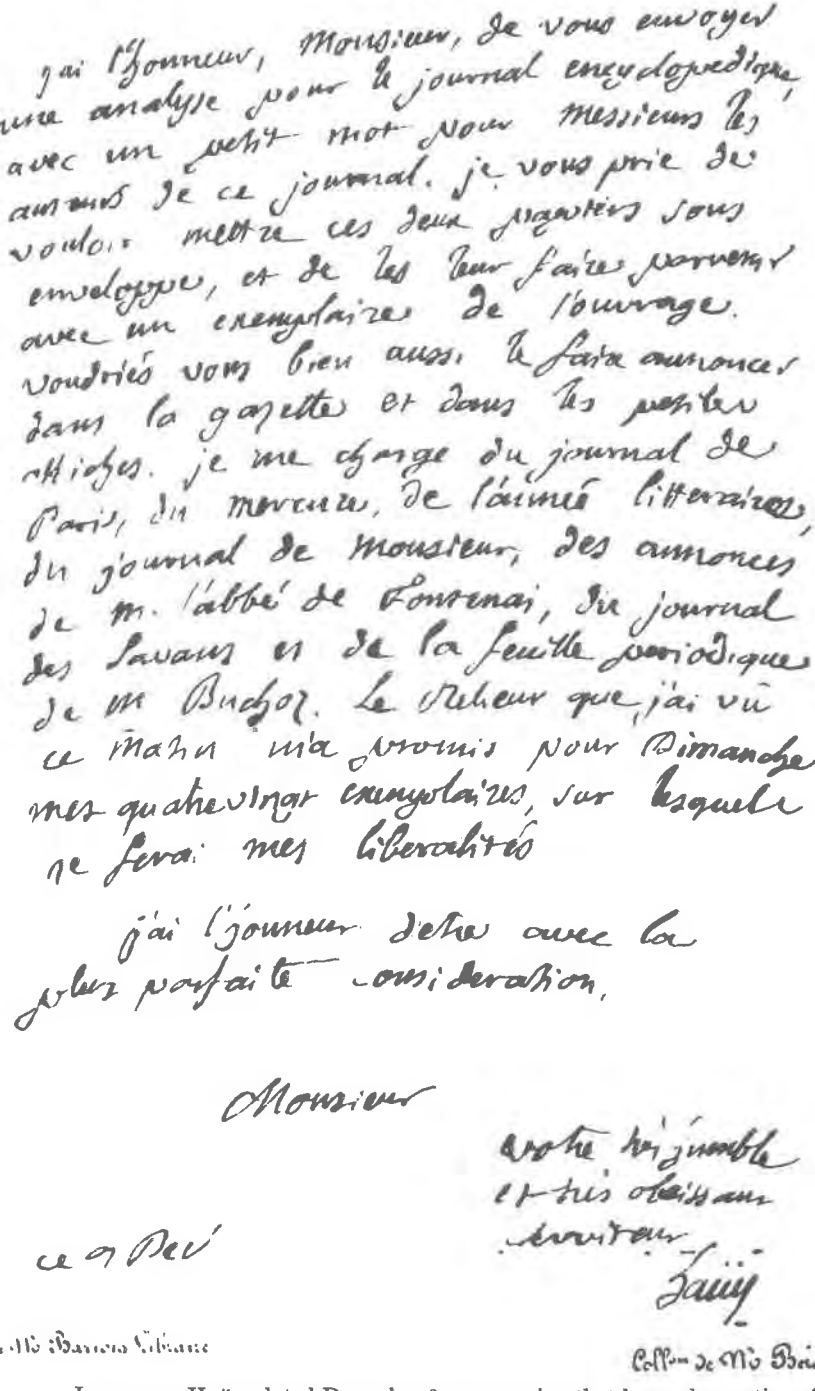
[1] *Bull. N. Y. Public Library*, 22 (3), p. 204, March, 1918.

I have the honor, my dear sir, of sending you a synopsis for the *Journal Encyclopédique*, with a few words for the authors of this publication. I beg you to be so kind as to enclose these two papers in an envelope and to send them to the gentlemen in question, with a copy of the work. Would you also be so kind as to announce it in the *Gazette*, and on the public posters. I charge myself with the *Journal de Paris*, the *Mercure*, the *Année Littéraire*, the *Journal de Monsieur*, the *Annonces* of the Abbé de Fonsenai [?], the *Journal des Savans*, and the law journal of M. Buchoz. The binder whom I saw this morning has promised me, for Sunday, my eighty copies, from which I shall make my presentations.

I have the honor of being, sir,
With the highest regard,
Your very humble and
Obedient servant
HAÜY

December 9th
(Collection Berard)

PLATE 13.



j'ai l'honneur, Monsieur, de vous envoyer une analyse pour le journal encyclopedique, avec un petit mot pour messieurs les auteurs de ce journal. je vous prie de vouloir mettre ces deux papiers sous enveloppe, et de les leur faire parvenir avec un exemplaire de l'ouvrage. voudriés vous bien aussi le faire annoncer dans la gazette et dans les petites affiches. je me charge du journal de Paris, du mercure, de l'année litteraire, du journal de monsieur, des annonces de m. l'abbé de Fontenai, du journal des savans et de la feuille periodique de m. Bachot. Le Relieur que j'ai vû ce matin m'a promis pour dimanche mes quatre vingt exemplaires, sur lesquels je ferai mes libéralités

j'ai l'honneur d'etre avec la plus parfaite consideration,

Monsieur

votre tres humble et tres obeissant serviteur

Hauy

ce 9 Dec.

à Mr Barrois Libraire

Coll.n de Mr Briard.

LETTER OF HAÜY, dated December 9, announcing that he sends a notice of his latest work for the "Journal Encyclopedique." To M. Barrois, Libraire.

Among the many titles and honors bestowed upon Haüy, the following is a list of the principal ones:

Member of the Institut National (Académie des Sciences); Honorary Canon of the Église Métropolitain de Paris (Notre Dame); Professor of Mineralogy at the Muséum d'Histoire Naturelle; Professor of Mineralogy in the Faculty of Sciences of the Université Royale; Member of the Académie Royale des Sciences of Berlin and of the Société des Scrutateurs de la Nature (Naturforscher) in the same place; Member of the Imperial Academy of Sciences of St. Petersburg; of the Royal Academies of Sciences of Lisbon and of Munich; of the Imperial University of Vilna; of the Geological Society of London; of the Mineralogical Society of Jena; of the Société Italienne des Sciences; of the Société des Sciences de Haarlem, etc. Officer of the Légion d'Honneur and Chevalier of the Order of St. Michael, of Bavaria.

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