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FAMOUS MEN OF SCIENCE.

LOUIS AGASSIZ.

MOUS MEN OF SCIENCE

BY

SARAH K. BOLTON

AUTHOR OF
"SUCCESSFUL MEN WHO HAVE RISEN FROM THE RANKS"

"The heights by great men reached and kept
Were not attained by sudden flight;
But they, while their companions slept,
Were toiling upward in the night."

LONGFELLOW.

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GALILEO GALILEI.

"THE same memorable day is marked by the setting of one of the most brilliant stars in the firmament of art and the rising of another in the sphere of science, which was to enlighten the world with beams of equal splendor. On the 18th of February, 1564, Michael Angelo Buonarotti closed his eyes at Rome, and Galileo Galilei first saw the light at Pisa."

Thus writes young Karl von Gebler, in the best life of Galileo ever written, his dying contribution to literature. Some other authorities place Galileo's birth on February 15.

He was the oldest in a family of five children born to Vincenzo Galilei, a Florentine noble, and Giulia Ammanati, who also belonged to an ancient family. Vincenzo wrote learnedly about music, and taught his boy to play on the lute and the organ; but he was poor and life was a struggle. However beneficial poverty may be in the development of character, most of us do not crave it for our children, so Vincenzo decided to place his son where he could earn a comfortable support. Music did not bring money. Galileo therefore should

become a dealer in cloth; a necessity of life, rather than a luxury.

But the boy soon showed great skill in music, surpassing his father. He excelled in drawing and color, and could have become a noted artist. He loved poetry, and had a decided taste for mechanics, making machines of great ingenuity. It soon became evident that such a lad would not be satisfied to spend his life trading in wool.

He must be educated, but how? The family had moved from Pisa, where there were schools of repute, to Florence. An effort had to be made, by the greatest economy, to prepare Galileo to go back to the Pisan University. He showed great aptitude for Latin and Greek, and at seventeen was ready for Pisa.

For what profession should he study? Not what best suited his tastes, but that in which his father thought he could make money, medicine. Poor Vincenzo! who can blame him that he hated poverty for his brilliant son?

At college, Galileo became an ardent student of philosophy, and because he dared to think for himself, and did not always agree with the teachings of Aristotle, he was called "the wrangler." Until he was twenty he was scarcely acquainted with the rudiments of mathematics, because his father thought this study was a waste of time for a man who was to become a physician. How many parents make the mistake of bending their children to their own plans, instead of ascertaining what a

boy or girl can do best in the world, and then fitting him or her for it!

While Galileo was studying medicine in Pisa, boarding with a relative, the court of Tuscany came to the city for a few months. Among the suite was Ostilio Ricci, a distinguished mathematician, and Governor of the Pages of the Grand Ducal Court. He was a friend of the Galilei family, and was pleased to see the bright young son, Galileo. When he taught Euclid, the medical student would stand shyly at the schoolroom door, and listen with intense interest. Soon he began to study mathematics secretly; then begged Ricci to teach him, who gladly consented, till the father forbade it, seeing that Euclid interfered with medicine.

Meantime, the youth of nineteen, kneeling at prayers in the Pisa Cathedral, had dreamily watched a bronze lamp swinging from an arch. The oscillations were at first considerable, but as they grew less and less, Galileo observed that they were all performed in the same time, measuring the time by feeling his pulse. The idea occurred to him that an instrument could be constructed which should mark the rate and variation of the pulse. He began to experiment, and soon invented the pulselogia, which the physicians hailed with great delight. The pendulum was not applied to clocks till a half-century later, but its invention attracted the attention of all scholars.

After four years' residence at Pisa, Vincenzo Galilei appealed to the reigning Grand Duke, Ferdinand de Medici, to grant to his son one of the forty free places founded for poor students, but the request was denied, and Galileo, unable to pay for his doctor's degree, was obliged to leave the university without it. Already he had learned bitter lessons of privation and disappointment, but youth has a brave heart, and looks ever toward the sunlight.

He went back to his home in Florence to study the works of Archimedes, whom he called his "master," to write his first essay on his Hydrostatic Balance, and to earn the reputation of a bold inquirer in geometrical and mechanical speculations. The father had now given up all hope of a fortune coming through medicine! Henceforward, the genius which was to shed lustre on his own name, otherwise buried in obscurity, was to have its own bent, and work out its own destiny.

If we are in earnest, a door opens sooner or later; but our own hands usually open it. At twenty-four a door opened to Galileo. Marquis Guidubaldo, a celebrated mathematician, appreciating what the young scientist had done, began a correspondence with him, and a valuable friendship resulted. The marquis asked him to study the position of the centre of gravity in solid bodies. Galileo applied himself to it, and wrote a valuable essay, which waited fifty years for publication.

Perhaps no person can be really great who has not learned patience, and Galileo had many lessons in this virtue before he died.

Through the influence of the marquis, he was brought to the notice of Ferdinand I., reigning Grand Duke, who appointed him to the mathematical professorship at Pisa. This was a great honor for a young man of twenty-six, one who had been too poor to take his degree. The salary was small, less than twenty pounds a year; but he earned somewhat by the practice of medicine, by lectures on Dante and other literary subjects, and by lessons to private pupils. Of course, he had little or no leisure; but he thus learned one of the most valuable lessons of life, — to treasure time as though it were gold. How glad his father and mother must have been that their wool projects had come to naught!

The professors at Pisa, with a single exception, Jacopo Mazzoni, in the chair of philosophy, were opposed to the new-comer. They were all disciples of Aristotle, and had not Galileo, when a boy among them, dared to oppose the great Grecian? And now, to make matters worse, he had taken some friends to the top of the Leaning Tower, and had put to the test the belief of two thousand years, — that the rate at which a body falls depends upon its weight. When the different weights fell to the pavement at the foot of the Leaning Tower, at the same time, the learned were astonished. If Aristotle could be wrong in one

thing, he might in others, and this young man would revolutionize the teaching of the times!

The feeling became so strong against the investigator that after three years at Pisa he resigned. When will the world learn toleration for those whose opinions are different from the popular thought? From Galileo to Darwin we have persecuted the men and women whose views were unlike our own in theology, in science, or in social matters.

Through his friend, the Marquis Guidubaldo, the mathematical professorship at Padua was obtained for Galileo. He was now twenty-nine, and becoming widely known throughout Italy. His father had just died, leaving the whole family, a wife and four children, dependent upon him for support; not a small matter for an ambitious and hard-working professor.

Padua gave the young man cordial welcome. Vincenzo Pinelli, a learned nobleman, who possessed eighty thousand volumes, mentioned him to Tycho Brahe, the great Danish astronomer, as a man whom it would be well to cultivate; but the Dane was too cautious about his own reputation, and did not write Galileo till eight years later, and died the following year.

An associate of Tycho Brahe was wiser than his master, and sent Galileo his new book, "Prodromus Dissertationum Cosmographicum." A warm letter of thanks went back to the immortal John Kepler, saying: "Many years ago I became a convert to

the opinions of Copernicus, and by that theory have succeeded in fully explaining many phenomena which on the contrary hypothesis are altogether inexplicable. I have drawn up many arguments and compilations of the opposite opinions, which, however, I have not hitherto dared to publish, fearful of meeting the same fate as our master Copernicus, who, although he has earned for himself immortal fame amongst the few, yet amongst the greater number appears as only worthy of hooting and derision; so great is the number of fools."

John Kepler, like Galileo, lived a pathetic life. His childhood was spent in the little beer-shop of his wretchedly poor father. At six he had a severe attack of small-pox, and his eyes were permanently weakened. He was put to the plough, but his delicate body could not bear the work. At last, through charity, he became a theological student at Tübingen. But here he began to think for himself, and, probably, would have been obliged to leave the university.

Fortunately for science, he heard some lectures given by Michael Möstlen, famous in mathematics and astronomy. A new world opened to Kepler. He applied himself with all the ardor of youth, and at twenty-two became professor of mathematics at Grätz, in Styria. He was soon driven away from this Catholic stronghold, on account of his Protestant faith. Tycho Brahe heard of his needs, and made him his assistant at Prague, with a salary of one hundred and fifty pounds a year. This

seemed regal splendor to the poor astronomer. Now he studied the heavens with hope and delight.

But sorrows soon came. His children died, his wife became insane, and died also. The salary could not be paid, on account of the religious wars which convulsed Germany. He wrote almanacs, took private pupils, and in all ways tried to support his second wife and children, while he studied the heavens year by year, discovering his three great laws. The mathematical calculations for the first law, that the planets move in elliptical orbits round the sun, which is placed at one of the foci, filled seven hundred pages. His "Harmonies of the World" contained his third great law: "The squares of the periodic times of the planets are proportioned to the cubes of their mean distances from the sun."

Such was his joy when he discovered this law, after seventeen years of labor, that he said, "I have written my book. It will be read; whether in the present age or by posterity matters little. It can wait for its readers. Has not God waited six thousand years for one to contemplate his works?" In a last fruitless attempt to recover twenty-nine thousand florins, owed him by the government, worn out with want and disappointment, he fell ill and died at Ratisbon, leaving thirty-three works, twenty-two volumes in manuscript, and his family in the direst poverty. Such was the man who admired Galileo in his youth, and who stands with him in the admiration of the

generations that have come and gone since these two men lived and wrote and suffered.

At Padua, Galileo soon attracted great numbers to his class-room. Often a thousand gathered to hear his lectures, and when the hall was too cramped, he spoke to the people in the open air. He was above the middle height, well proportioned, with cheerful countenance, witty in conversation, and enthusiastic in his manner. So learned that he could repeat by heart much of the works of Virgil, Ovid, Horace, and Seneca; he was yet modest and unassuming, saying that he never met a man so ignorant but that something might be learned from him.

He labored incessantly. He wrote treatises on Fortifications, on Mechanics, on Gnomonics, on the laws of motion, on the celestial globe, which were copied by his pupils, and sent by them far and wide over Europe. He took a workman into his family, and began to superintend the making of the compass which he had invented, and the thermoscope, or heat indicator, which led in later years to the thermometer. His experiment was made by a "glass bottle about the size of a hen's egg, the neck of which was two palms long, and as narrow as a straw. Having well heated the bulb in his hands, he placed its mouth in a vessel containing a little water, and withdrawing the heat of his hand from the bulb, instantly the water rose in the neck, more than a palm above the level of the water in the vessel."

During the first six years at Padua, his salary rose from about twenty pounds to one hundred pounds, yearly. All this time when his mind should have been free from care for his great work, he was beset with difficulties. His sister, Virginia, had married before his father's death, but a promised dowry had never been paid, and now the brother-in-law demanded the payment. The mother, worried over the prospect, wrote to her son, Galileo, "If you carry into effect your intention of coming here next month, I shall be rejoiced, only you must not come unprovided with funds, for I see that Benedetto is determined to have his own, that is to say, what you promised him; and he threatens loudly that he will have you arrested the instant you arrive here. And as I hear you bound yourself to pay, he would have the power to arrest you, and he is just the man to do it. So I warn you, for it would grieve me much if anything of the kind were to happen."

Livia, another sister, had become engaged to a Pisan gentleman, with the promise of a dowry of eighteen hundred ducats, eight hundred of which must be paid down. The "Pisan gentleman" could not burden himself with a wife, without funds to help support her and himself. So Galileo generously, if not wisely, borrowed six hundred ducats, and paid the necessary eight hundred, giving his sister beautiful clothes and house furnishings.

Besides these sisters, Galileo had a lazy brother to provide for, Michelangelo, a young man of some

musical talent and elegant manners, with the not unusual gift of being able to spend much and earn little. Galileo obtained a situation for him with a Polish prince, and spent two hundred crowns in getting him ready for the new position. He went thither, but soon returned, and another place had to be procured for him, at the court of the Duke of Bavaria.

While there, instead of helping to pay his sister's dowry, as he had promised, he married; had an extravagant wedding feast, and then wrote his hard-working brother: "I know that you will say that I should have waited, and thought of our sisters before taking a wife. But, good heavens! the idea of toiling all one's life just to put by a few farthings to give one's sisters! This yoke would be indeed too heavy and bitter; for I am more than certain that in thirty years I should not have saved enough to cover this debt."

With all the pressure upon him for money, Galileo kept steadily on in his absorbing studies. In the year 1609, he constructed a telescope. It is true that Hans Lipperhey, of Germany, had invented a spy-glass, and presented it to Prince Maurice, so that the principle was understood; but nobody gave it practical illustration till Galileo, having heard of the glass, began to reflect how an instrument could be made to bring distant objects near. In a leaden tube, he fixed two glasses, both having one side flat, and the other side of the one concave, and the other convex. By this, objects

appeared three times nearer and nine times larger. A few days later, he hastened with his leaden tube to Venice, to exhibit it to the Doge and the Senate. He wrote to a friend: —

"Many gentlemen and senators, even the oldest, have ascended at various times the highest bell-towers in Venice, to spy out ships at sea, making sail for the mouth of the harbor, and have seen them clearly, though without my telescope they would have been invisible for more than two hours. The effect of this instrument is to show an object at a distance of, say, fifty miles, as if it were but five miles off.

"Perceiving of what great utility such an instrument would prove in naval and military operations, and seeing that His Serenity greatly desired to possess it, I resolved four days ago to go to the palace and present it to the Doge as a free gift. And on quitting the presence-chamber, I was commanded to bide awhile in the hall of the senate, whereunto, after a little, the Illustrissimo Prioli, who is Procurator and one of the Riformatori of the University, came forth to me from the presence-chamber, and, taking me by the hand, said, 'that the senate, knowing the manner in which I had served it for seventeen years at Padua, and being sensible of my courtesy in making it a present of my telescope, had immediately ordered the Illustrious Riformatori to elect me (with my good-will) to the professorship for life, with a stipend of one thousand florins yearly.'"

This must have been a comfort to the now famous Galileo, as it was, doubtlesss, to the useless Michelangelo, and the two brothers-in-law! He could now live in comparative peace and rest.

On his return to Padua, he began eagerly to study the heavens. He found that the surface of the moon was mountainous; that the Milky Way was composed of an immense number of small stars and nebulous matter; that Orion, instead of being made up of seven heavenly bodies, had over five hundred stars; and that the Pleiades were not seven, but thirty-six. In January, 1610, he discovered the four moons of Jupiter, and that they revolved around him. July 25 of the same year, he discovered the ring of Saturn; in October, the phases of Venus, and later, the solar spots.

Florence and Padua were in a blaze of excitement. These new discoveries seemed to prove that the earth was not the centre of the universe, but that Copernicus was right when he declared the sun to be the centre. Great opposition began to develop itself. Some of the Aristotelians declared that the telescope of Galileo showed things which do not exist. "It was ridiculous," they said, "that four planets (Jupiter's moons) were chasing each other around a large planet.

"It is angels who make Saturn, Jupiter, the sun, etc., turn round. If the earth revolves, it must also have an angel in the centre to set it in motion; but if only devils live there, it would,

therefore, be a devil who would impart motion to the earth.

"The planets, the sun, the fixed stars, all belong to one species; namely, that of stars — they, therefore, all move, or all stand still.

"It seems, therefore, to be a grievous wrong to place the earth, which is a sink of impurity, among the heavenly bodies, which are pure and divine things."

Libri, one of the Pisan professors, spoke of the new discoveries as "celestial trifles." When he died, Galileo naïvely remarked, "Libri did not choose to see my celestial trifles while he was on earth; perhaps he will, now he is gone to heaven."

Galileo now longed for freedom from teaching, that he might have his time for study and writing. He had planned, he said, "two books on the system of the universe; an immense work (idea, *concetto*), full of philosophy, astronomy, and geometry: three books on local motion, a science entirely new; no one, either ancient or modern, having discovered any of the marvellous accidents which I demonstrate in natural and violent motions; so that I may, with very great reason, call it a new science, discovered by me from its very first principles: three books on mechanics, two on the demonstration of its first principles, and one of problems; and though this is a subject which has already been treated by various writers, yet all which has been written hitherto neither in quantity nor otherwise is the quarter of what I am

writing on it. I have also various treatises on natural subjects, on sound and speech, on sight and colors, on the tide, on the composition of continuous quantity, on the motion of animals, and others; besides, I have also an idea of writing some books on the military art, giving not only a model of a soldier, but teaching, with very exact rules, all which it is his duty to know that depends on mathematics; as, for instance, the knowledge of encampment, drawing up battalions, fortifications, assaults, planning, surveying, the knowledge of artillery, the use of various instruments, etc."

With all this work in mind, he resigned the professorship at Padua, and removed to Florence, the Grand Duke Cosmo II. giving him a yearly salary of about one thousand dollars, and the title of Philosopher to His Highness.

His first thought, as ever, was for his family. He asked an advance of two years' salary, and paid the dowry debts of his sisters' grasping husbands.

In 1611, his expenses paid by the Grand Duke, he went to Rome to show his "celestial novelties," as they were called, to the pope and the cardinals. He was received with great attention, and all seemed delighted to look upon the wonders of the heavens, provided always that nothing could be proved against the supposed assertion of the Bible that the earth did not move!

Galileo soon published his "Discourse on Float-

ing Bodies," which aroused violent opposition; "Spots observed on the Body of the Sun," and the "Discourse on the Tides."

Four years later, he was again in Rome to plead for the Copernican system, and to defend his own conduct in advocating a thing in opposition to the Catholic church. He said: "I am inclined to think that the authority of Holy Scripture is intended to convince men of those truths which are necessary for their salvation, and which, being far above man's understanding, cannot be made credible by any learning, or any other means than revelation by the Holy Spirit. But that the same God, who has endowed us with senses, reason, and understanding, does not permit us to use them, and desires to acquaint us in any other way with such knowledge as we are in a position to acquire for ourselves by means of those faculties, *that*, it seems to me, I am not bound to believe, especially concerning those sciences about which the Holy Scriptures contain only small fragments and varying conclusions; and this is precisely the case with astronomy, of which there is so little that the planets are not even all enumerated."

However, in spite of Galileo's logic, the church decreed that all books which stated the Copernican system as true should be prohibited; as a mathematical hypothesis, it might be speculated upon. This was a great disappointment to Galileo, who loved and revered the Roman Catholic faith. He went home to the Villa Segni, at Bellosguardo,

near Florence, and for seven years led a studious and secluded life.

His greatest comfort, during these quiet years, was the devotion of his daughter, Polissena, who had entered a convent as Sister Maria Celeste. While in Padua, Galileo had three children by Marina Gamba, a Venetian woman of inferior station. She afterwards married a man of her own class, and Galileo took his children to his own home; a condition of things possible with the low moral standard of the time. The two daughters were placed in a convent, while the son, Vincenzo, was educated for the profession of medicine, but he seems to have been a disappointment and a source of discomfort.

Maria Celeste, in the convent of St. Matthew, loving and tender, and helpful to all around her, wrote constantly to the man whom she idolized. "I put by carefully," she says, "the letters you write me daily, and when not engaged with my duties, I read them over and over again. This is the greatest pleasure I have, and you may think how glad I am to read the letters you receive from persons who, besides being excellent in themselves, have you in esteem."

Again she writes, "I leave you to imagine how pleased I am to read the letters you constantly send me. Only to see how your love for me prompts you to let me know fully what favors you receive from these gentlemen is enough to fill me with joy. Nevertheless I feel it a little hard to hear that you

intend leaving home so soon, because I shall have to do without you, and for a long time too, if I am not mistaken. And your lordship may believe that I am speaking the truth when I say that except you there is not a creature who gives me any comfort. But I will not grieve at your departure because of this, for that would be to complain when you had cause for rejoicing. Therefore I too will rejoice, and continue to pray God to give you grace and health to make a prosperous journey, so that you may return satisfied, and live long and happily, all which, I trust, will come to pass by God's help.

"I send two baked pears for these days of vigil. But as the greatest treat of all, I send you a rose, which ought to please you extremely, seeing what a rarity it is at this season. And with the rose, you must accept its thorns, which represent the bitter passion of our Lord, while the green leaves represent the hope we may entertain that through the same Sacred Passion we, having passed through the darkness of this short winter of our mortal life, may attain to the brightness and felicity of an eternal spring in heaven."

"Only in one respect does cloister life weigh heavily on me; that is, that it prevents my attending on you personally, which would be my desire, were it permitted. My thoughts are always with you."

And so the seven years of study went by, with the sweet love of Maria Celeste to brighten them.

There are none so great that they can live without affection.

At the end of the seven years, Urban VIII. came to the pontifical throne, and Galileo and other scientists rejoiced, for he had seemed liberal in thought and generous in heart. When he was cardinal, he had sent a letter to Galileo, saying, "The esteem which I always entertain for yourself and your great merits has given occasion to the enclosed verses. If not worthy of you, they will serve at any rate as a proof of my affection, while I purpose to add lustre to my poetry by your renowned name. Without wasting words, then, in further apologies, which I leave to the confidence which I place in you, I beg you to receive with favor this insignificant proof of my great affection."

At Easter, 1624, Galileo, now sixty years old, resolved to proceed to Rome, to welcome the new pope, and urge his approval of the Copernican theory. Frail in health, he was carried most of the way in a litter. During a visit of six weeks, he had six long audiences with Urban VIII.; but, though he was affably received, the pope was in no wise convinced, but rather tried to convince Galileo that he was in error.

Yet so kind was he that Galileo went back to Florence with the hope and belief that he could bring out his great work, "Dialogues on the Two Principal Systems of the World, the Ptolemaic and Copernican," without opposition from the church.

In this book, Galileo gave the results of scientific research and discovery in the half century preceding, using such clear yet brilliant style in writing as to make the work attractive even to the unlearned.

It was ready for publication in March, 1630, but to be sure that the pope did not object, Galileo was urged to go in person to Rome. He went and presented the matter to Urban, who gave his consent provided that the title should show that the Copernican system was treated as a hypothesis merely, and that he, the pope, should write the closing argument.

Rather than forego the publication of that upon which he had worked for years, Galileo consented, and returned to Florence. A license to publish was then obtained from the Inquisitor-General, and the Vicar-General of Florence, after great delay. A second and a third time the papal authorities wished to look over the manuscript. Two years went slowly by.

Other anxieties came to the man of sixty-eight, besides the long delay. The impecunious Michelangelo sent his wife, seven children, and a German nurse, to the home of Galileo, to be taken care of. The eldest nephew was sent to Rome to study music. He was found to be obstinate, impudent, and dissolute, "wicked ways" which his weak and indulgent father said "he did not learn from me, or any one else belonging to him. It must have been the fault of his wet nurse!"

Galileo's son Vincenzo had married and brought his wife home to live. Strange fortune for this man of genius! Strange that he must have helpless relatives, and constant pecuniary troubles. Most great lives are as pathetic as they are great.

As ever, the one gleam of light was the daily letter from Maria Celeste, in which she expressed a tenderness beyond what any daughter ever had for a father. "But I do not know how to express myself, except by saying that I love you better than myself. For, after God, I belong to you; and your kindnesses are so numberless that I feel I could put my life in peril, were it to save you from any trouble, excepting only that I would not offend His Divine Majesty."

Finally Galileo moved to Arcetri, over against the convent, to be near the one who alone satisfied his heart.

In January, 1632, the "Dialogues" appeared. Copies were sent to his friends and disciples throughout Italy. The whole country applauded, and at last Galileo seemed to have won the homage he had so long deserved.

But a storm was gathering. Enemies were at work prejudicing the mind of Urban VIII., making him feel that Galileo had wrought evil to the church. At once an order came from the Inquisition to secure every copy in the booksellers' shops throughout Italy, and to forward all copies to Rome.

In October of the same year of publication,

Galileo was summoned to appear at Rome, to answer to that terror of past centuries, the charge of heresy. His friends urged that he was old and feeble, and that he would die on the journey, but Urban's commands were peremptory.

Galileo was deeply depressed by the summons, and wrote a friend: "This vexes me so much that it makes me curse the time devoted to these studies, in which I strove and hoped to deviate somewhat from the beaten track generally pursued by learned men. I not only repent having given the world a portion of my writings, but feel inclined to suppress those still in hand, and to give them to the flames, and thus satisfy the longing desire of my enemies, to whom my ideas are so inconvenient."

On January 20, 1633, the decrepit old man set out in a litter for Rome, arriving on February 13. On April 12, he was brought before the Inquisition, and briefly examined and then remanded to prison, though treated with great leniency. The anxiety and deprivation from outdoor exercise brought on illness, and he was confined to his bed till led a second time before the Inquisition, April 30.

Weak, aged, in fear of torture, he made the melancholy confession that his "error had been one of vainglorious ambition, and pure ignorance and inadvertence." Pure ignorance! from the man who had studied for fifty years all that the world knew of science! But he recalled how men had died at the stake for offending the church. The

world is not full of men and women who can suffer death for their convictions, however much we may admire such courage. On May 10, he was summoned a third time before the Inquisition, and told that he had eight days in which to write his defence. In touching language he stated how the book had been examined and re ëxamined by the authorities, so that there might be nothing heterodox in it; and then he urged them to consider his age and feeble health.

A fourth time he came before the Holy Congregation, June 21, and was asked whether he held that the sun is the centre of the solar system, and that the earth is not the centre, and that it moves. He replied, "I do not hold, and have not held this opinion of Copernicus since the command was intimated to me that I must abandon it; for the rest, I am here in your hands, — do with me what you please."

And then June 22, in the forenoon, in the large hall of the Dominican Convent of St. Maria sopra la Minerva, in the presence of cardinals and prelates, he heard his sentence.

"The proposition that the sun is the centre of the world and does not move from its place is absurd, and false philosophically, and formally heretical, because it is expressly contrary to the Holy Scripture.

"The proposition that the earth is not the centre of the world and immovable, but that it moves, and also with a diurnal motion, is equally absurd and

false philosophically; and theologically considered, at least, erroneous in faith. . . . Invoking, therefore, the most holy name of our Lord Jesus Christ and of His most glorious mother and ever Virgin Mary . . . we say, pronounce, sentence, declare, that you, the said Galileo, by reason of the matters adduced in process, and by you confessed as above, have rendered yourself, in the judgment of this Holy Office, vehemently suspected of heresy, — namely, of having believed and held the doctrine, which is false and contrary to the sacred and divine Scriptures, — that the sun is the centre of the world and does not move from east to west, and that the earth moves and is not the centre of the world. . . . We condemn you to the formal prison of this Holy Office during our pleasure, and, by way of salutary penance, we enjoin that for three years to come you repeat once a week the seven Penitential Psalms."

Galileo was also required to "abjure, curse, and detest the aforesaid errors and heresies." And then the white-haired man of seventy, humbly kneeling before the whole assembly, made the pitiful abjuration of his belief. "I abjure with a sincere heart and unfeigned faith, I curse and detest the said errors and heresies, and, generally, all and every error and sect contrary to the Holy Catholic Church."

Pitiful spectacle of intolerance! If we of this nineteenth century have learned to tolerate and treat with respect the beliefs of others though

widely divergent from our own, perhaps this wretched drama was not acted in vain.

It has been said that Galileo exclaimed as he rose from his feet, "*E pur si muove,*" "It moves, for all that," but this would have been well nigh an impossibility, in the midst of men who would instantly have taken him to a dungeon, and the story is no longer believed.

On July 9, poor Galileo was allowed to leave Rome for Siena, where he stayed five months in the house of the archbishop, and then became a prisoner in his own house at Arcetri, with strict injunctions that he was "not to entertain friends, nor to allow the assemblage of many at a time."

He wrote sadly to Maria Celeste, "My name is erased from the book of the living." Tender words came back, saying that it seemed "a thousand years" since she had seen him, and that she would recite the seven penitential psalms for him, "to save you the trouble of remembering it."

In less than a year, sweet Maria Celeste had said the last psalms for him. She died April 1, 1634, at thirty-three years of age, leaving Galileo heart-broken; "a woman," he said, "of exquisite mind, singular goodness, and most tenderly attached to me."

He went to work on another book, but he said, pathetically, "I hear her constantly calling me!" Beautiful spirit, that will forever shed a halo around the name of Galileo Galilei!

In the summer of 1636, he completed his "Dia-

logues on Motion," and sent it to Leyden for publication. The next year he made his last discovery, known as the moon's librations.

The house at Arcetri had become dark and lonely. The wife of Michelangelo, her three daughters and a son, had all died of the plague. It was doubly dark, for Galileo had become hopelessly blind, "so that this heaven, this earth, this universe, which I by my marvellous discoveries and clear demonstrations had enlarged a hundred thousand times beyond the belief of the wise men of bygone ages, henceforward for me is shrunk into such a small space as is filled by my own bodily sensations."

His last work was a short treatise on the secondary light of the moon. "I am obliged now," he said, sadly, "to have recourse to other hands and other pens than mine since my sad loss of sight. This, of course, occasions great loss of time, particularly now that my memory is impaired by advanced age; so that in placing my thoughts on paper, many and many a time I am forced to have the foregoing sentences read to me before I can tell what ought to follow; else I should repeat the same thing over and over."

He had planned other work, but death came on the evening of January 8, 1642, eight years after Celeste left him. His beloved pupils, Torricelli and Viviani, and his son Vincenzo, stood by his bedside.

He desired to be buried in the family vault of

the Galilei in Santa Croce, at Florence, and the city at once voted a public funeral and three thousand crowns for a marble mausoleum. But the church at Rome prevented, lest the pernicious doctrine that the earth moves, should thereby have confirmation. He was therefore buried in an obscure corner of Del Noviziato, a side chapel of Santa Croce.

A century later, March 12, 1737, in the presence of the learned men of Italy, with great ceremony, the bones of Galileo were removed to a new resting-place in Santa Croce, and buried with his beloved friend, Viviani. An imposing monument was erected over him. The truth finally triumphed, as it always does. The works of Galileo, in sixteen volumes, are no longer prohibited, as they were in his lifetime.

SIR ISAAC NEWTON.

IN the same year, 1642, in which Galileo, sad and blind, went away from the earth, Sir Isaac Newton came to make his home upon it.

He was born December 25, the only child of Isaac Newton and Hannah Ayscough. The father died at thirty-seven, a few months after his marriage, and the young wife, after the birth of her child, was both father and mother to the helpless infant. He was so frail that there seemed little probability that he could live to manhood, or even boyhood. Naturally, between mother and son there grew a most ardent affection, which neither time nor death could change.

The manor-house of Woolsthorpe in Colsterworth, Lincoln county, was a two-story stone building, owned for a century by the Newton family, and bringing a limited income from the little farm in connection with it. Here Isaac passed his childhood, going to the schools near by, and learning to read, write, and cipher.

At twelve, he was sent to the public school at Grantham, where he showed little taste for study, and managed easily to stand at the foot of his

class. When he was the last in the lowermost form but one, the boy next above him, as they were going to school, gave Isaac a kick, which occasioned severe pain. Stirred with wrath, Isaac challenged the other boy to a fight. For this purpose, they repaired to a neighboring churchyard, where young Newton, though much the smaller and weaker of the two, pounded his antagonist till he was glad to come to any terms of submission.

He resolved now that this boy should no longer stand above him in scholarship, and with a new ambition and energy born of his insult, he soon rose to the highest place in the school. It was not idleness, probably, that made Newton a poor scholar, but his mind was absorbed with making saws, hammers, hatchets, and other tools.

He made a windmill and placed it on the top of his home, the wind putting it in motion. When there was no wind, a novel expedient was resorted to. A mouse, which was called "the miller," was trained to turn the windmill by walking on a tread wheel, with some corn just beyond his reach! All through life, he was exceedingly kind to animals, and could never tolerate shooting or hunting for sport. He objected to one of his nephews, when praised in his presence, "that he loved killing of birds," and this was sufficient to win his disesteem. It is probable, therefore, that the little mouse was kindly cared for by the young experimenter.

He also made a water clock, about four feet high, with a dial-plate at the top, with figures of the hours. The index was turned by a piece of wood, which either fell or rose by water dropping. Every morning the lad supplied his clock with the proper amount of water.

Besides these, he invented a four-wheeled carriage, which was moved with a handle by the person who sat in it. For his boy friends, he made lanterns of "crimpled paper" with a candle inside, to light them to school in the dark winter mornings, and paper kites of the best form and proportion. In dark nights he tied the lanterns to the tails of his kites, and ignorant people sometimes mistook them for comets!

On the manor-house at Woolsthorpe he carved sun-dials, which were visible a century later. He was a "sober, silent, and thinking lad," who was always hammering in his room, or making drawings with his pen and pencil, designing with charcoal on his walls, birds, animals, ships, and mathematical diagrams.

Mrs. Newton, the mother, had married again, after a singular courtship. "Mr. Smith, a neighboring clergyman, who had a very good estate, had lived a bachelor till he was pretty old, and, one of his parishioners advising him to marry, he said he did not know where to meet with a good wife. The man answered, 'The widow Newton is an extraordinary good woman.' 'But,' said Mr. Smith, 'how do I know she will have me, and

I don't care to ask and be denied; but if you will go and ask her, I will pay you for your day's work.'

"He went accordingly. Her answer was, she would be advised by her brother Ayscough, upon which Mr. Smith sent the same person to Mr. Ayscough on the same errand, who, upon consulting with his sister, treated with Mr. Smith, who gave her son Isaac a parcel of land, one of the terms insisted upon by the widow if she married him."

Though for a time she was thus removed from Isaac, leaving him with his grandmother, on the death of Rev. Mr. Smith, she returned to the manor-house.

When Isaac had reached his fifteenth year, his mother, not seeming to think of any profession for her mechanical son, decided to make of him a farmer and grazier. On Saturdays, the market day at Grantham, she would send him with grain and other agricultural produce, in the care of an old and trusty servant. The boy had no taste for selling produce, and would hasten to the attic in the house of Mr. Clark, an apothecary, with whom he had boarded while at school, and there spend his hours in reading old books, till the time came for him to go home, the servant meantime having sold the vegetables.

Sometimes, however, the lad would not go as far as Grantham, but, seating himself beside a hedge along the road, would read some favorite author

till the servant returned. When his mother sent him to watch the cattle, they enjoyed a neighbor's corn-field, while he enjoyed a book or whittled out water-wheels. It did not seem intentional disobedience toward a mother of whom he was very fond, but complete absorption in some other pursuit.

When he was sixteen he was greatly interested in finding the proper form of a body which would offer the least resistance when moving in a fluid. In a severe storm, to test the force of the gale, he jumped first in the direction in which the wind blew, and then in opposition to the wind, and after measuring the length of the leap in both directions, and comparing it with the length to which he could jump in a perfectly calm day, he was enabled to compute the force of the storm.

His mother soon found that her boy would not make a successful farmer, and sent him back to school at Grantham, to prepare for Trinity College, Cambridge, which he entered when he was nineteen.

It is probable that the time spent at Grantham was a happy time; for young Newton there met and, it is said, loved Miss Storey, sister of Dr. Storey, a physician near Colsterworth, and daughter of the apothecary's second wife. She was two or three years younger than Newton, a girl of attractive face and unusual talents. As his income as a Fellow was small, after leaving college, they did not marry, though his interest in her continued

unabated through life. Though she was twice married, he never paid a visit to Woolsthorpe without going to see her, and liberally relieved her from little pecuniary embarrassments, when his own circumstances had become easy. How the world loves constancy; an affection which knows no change! That he would have been happier in those quiet years of study, even in his poverty, had he married, is probable; but that the world gained by his undivided devotion to science, is equally probable.

On July 8, 1661, Newton entered college, and soon, through the study of Descartes' Geometry, showed his skill in higher mathematics. And now began an almost unexampled development of mind.

At twenty-two, he was studying a comet so closely, and the circles and halo round the moon, that he impaired his health by sitting up late at night. In 1665, May 20, when he was twenty-three, he committed to writing his first discovery of fluxions — "the infinitely small increase or decrease of a variable or flowing quantity in a certain infinitely small and constant period of time."

The same year, when the college had been dismissed on account of the plague in Cambridge, Newton made his immortal discovery of the Attraction of Gravitation. While sitting alone in his garden at Woolsthorpe, and observing an apple fall to the ground, it occurred to him that as the same power by which the apple fell was not sensibly diminished at the summits of the loftiest spires,

nor on the tops of the highest mountains, it might extend to the moon, about which he had been studying, and retain her in her orbit. If to the moon, why not to the planets?

The tree from which the apple fell was so much decayed in 1820, that it was cut down, but the wood was carefully preserved by Mr. Turnor of Stoke Rocheford.

In the beginning of the following year, 1666, when Newton was twenty-four, he purchased a prism, in order to make some experiments on Descartes' theory of colors. He made a hole in his window shutter, darkened the room, and admitted a ray of the sunlight. On the opposite wall he saw the solar or prismatic spectrum, an elongated image of the sun, about five times as long as it was broad, and consisting of *seven* different colors; red, orange, yellow, green, blue, indigo, and violet. White light was thus discovered to be of a compound nature; a mixture of all the colors. He said, "Whiteness is the usual color of light; for light is a confused aggregate of rays endued with all sorts of colors, as they are promiscuously darted from the various parts of luminous bodies." If any one color predominates, the light will incline to that color, as the yellow flame of a candle. Heretofore, there had been all sorts of conjectures about the nature and origin of colors. Descartes believed them to be a modification of light, depending on the direct or rotary motion of its particles. But Newton showed by many experiments that

color is a property of light, or innate in light itself. We speak of a thing as red because it reflects red, and absorbs all the other colors. The green leaf stops or absorbs the red, blue, and violet rays of the white light, and reflects and transmits only those which compose its green.

He also found that the red rays are refracted or turned out of their course least of all the colors, and violet most, thereby discovering the different refrangibility of the rays of light; "a discovery which has had the most extensive applications to every branch of science, and, what is very rare in the history of inventions, one to which no other person has made the slightest claim."

His beautiful experiments with rings resulted in his Scale of Colors, of great value in optical research.

In 1668, when Newton was twenty-six, he constructed a small reflecting telescope, and soon a larger one, which he sent to the Royal Society; and was made a member of that body in 1671. Two years previously he had been appointed to the Lucasian professorship of mathematics at Cambridge.

He was now, at twenty-seven, spoken of as a man of "unparalleled genius." He had discovered the compound nature of white light, the attraction of gravity, fluxions, and made the first reflecting telescope ever directed toward the heavens, though one had been invented previously, by James Gregory, of Aberdeen. The boy who had thought of a mouse to turn his windmill had thought out

some of the sublimest things in nature, and was henceforward to rank as one of the few master-minds of science. Newton's doctrine of colors met with the most bitter opposition. At last, he became so tired of the controversy, that he wrote Leibnitz, "I was so persecuted with discussions arising out of my theory of light, that I blamed my own imprudence for parting with so substantial a blessing as my quiet to run after a shadow." To another he wrote, "I see I have made myself a slave to philosophy; but if I get free of Mr. Linus's business, I will resolutely bid adieu to it eternally, excepting what I do for my private satisfaction, or leave to come out after me; for I see a man must either resolve to put out nothing new, or to become a slave to defend it."

Newton was also troubled pecuniarily at this time, and asked to be excused from the weekly payments to the Royal Society, thereby resigning his membership. He even meditated the study of law, as his income was so limited. Strange that so many of the great things of this life are wrought out by those who are in sorrow or privation.

But amid all the opposition to his discoveries and his poverty, the unparalleled devotion to study was continued. When he was weary of other branches, he said "he refreshed himself with history and chronology." Years afterward he published the "Chronology of Ancient Kingdoms amended, to which is prefixed a short chronicle, from the first memory of things in Europe, to the Conquest

of Persia, by Alexander the Great." Says a gentleman who was with him for years, "I never knew him to take any recreation or pastime, either in riding out to take the air, walking, boating, or any other exercise whatever, thinking all hours lost that were not spent in his studies, to which he kept so close that he seldom left his chamber except at term time, when he read in the schools, as being Lucasianus Professor, where so few went to hear him, and fewer that understood him, that oftentimes he did in a manner, for want of hearers, read to the walls. . . .

"So intent, so serious upon his studies that he ate very sparingly, nay, ofttimes he has forgot to eat at all, so that, going into his chamber, I have found his mess untouched, of which when I have reminded him he would reply, 'Have I?' and then making to the table, would eat a bit or two standing, for I cannot say I ever saw him sit at table by himself. At some seldom entertainments the masters of colleges were chiefly his guests.

"He very rarely went to bed till two or three of the clock, sometimes not till five or six, lying about four or five hours, especially at spring and fall of the leaf, at which times he used to employ about six weeks in his elaboratory, the fire scarcely going out either night or day, he sitting up one night, and I another, till he had finished his chemical experiments, in the performances of which he was the most accurate, strict, exact. . . ."

When his most intense studies were carried on,

"he learned to go to bed at twelve, finding by experience that if he exceeded that hour but a little, it did him more harm in his health than a whole day's study."

"He very rarely went to dine in the hall, except on some public days, and then if he has not been minded, would go very carelessly, with shoes down at heels, stockings untied, surplice on, and his head scarcely combed. . . . At some seldom times when he designed to dine in the hall, he would turn to the left hand and go out into the street, when making a stop when he found his mistake, would hastily turn back, and then sometimes, instead of going into the hall, would return to his chamber again. . . . In his chamber he walked so very much that you might have thought him to be educated at Athens, among the Aristotelian sect."

So absent-minded was he, the story is told of him, that going home to Colsterworth, he led his horse up a hill. When he designed to remount, the animal had slipped the bridle and gone away unperceived, though Newton held the bridle in his hand all the time. He would often sit down on his bedside after he rose, and remain there for hours without dressing, so completely absorbed was he in his thought. How few in all this world have been so devoted to science! And yet how many expect success without this devotion!

The same gentleman writes of Newton, "His carriage was very meek, sedate, and humble, never seemingly angry, of profound thought, his counte-

nance mild, pleasant, and comely. I cannot say I ever saw him laugh but once."

In 1687, when Newton was forty-five, his *Philosophiæ Naturalis Principia Mathematica* was published. "The *Principia* consists of three books. The First Book, besides the definition and axioms, or laws of motion, with which it begins, consists of fourteen sections, in the first of which the author explains the method of prime and ultimate ratios used in his investigations, and which is similar to the method of fluxions. The other sections treat of centripetal forces, and motions in fixed and movable orbits.

"The Second Book consists of nine sections, and treats of bodies moving in resisting media, or oscillating as pendulums.

"The Third Book consists of five sections, on the Causes of the System of the World, on the Quantity of Lunar Errors, on the Quantity of the Tides, on the Precession of the Equinoxes, and on Comets."

The great principle of the *Principia* is universal gravitation, "That every particle of matter in the universe is attracted by or gravitates to every other particle of matter, with a force inversely proportional to the squares of their distances." By the laws of gravity, Newton was enabled to calculate the quantity of matter in the sun, and in all the planets, and even to determine their density, results which Adam Smith said "were above the reach of human reason and experience." He ascer-

tained that the weight of the same body would be twenty-three times greater at the surface of the sun than at the surface of the earth, and that the density of the earth was four times greater than that of the sun. He found the true figure of the earth; he explained the phenomena of the tides.

Of the "Principia," Sir David Brewster says, in his able life of Sir Isaac Newton, it is "a work which will be memorable not only in the annals of one science or of one country, but which will form an epoch in the history of the world, and will ever be regarded as the brightest page in the records of human reason, — a work, may we not add, which would be read with delight in every planet of our system, — in every system of the universe. What a glorious privilege was it to have been the author of the 'Principia'!

"There was but one earth upon whose form, and tides, and movements, the philosopher could exercise his genius, — one moon whose perturbations and inequalities and actions he could study, — one sun whose controlling force and apparent motions he could calculate and determine, — one system of planets whose mutual disturbances could tax his highest reason, — one system of comets whose eccentric paths he could explore and rectify, — and one universe of stars to whose binary and multiple combinations he could extend the law of terrestrial gravity.

"To have been the chosen sage summoned to the study of that earth, these systems, and that

universe, the favored lawgiver to worlds unnumbered, the high priest in the temple of boundless space, — was a privilege that could be granted but one member of the human family; — and to have executed the last was an achievement which, in its magnitude, can be measured only by the infinite in space, and in the duration of its triumphs by the infinite in time. That sage, — that lawgiver, — that high priest was Newton."

The "Principia" created the greatest interest throughout Europe, but met with violent opposition. While Laplace said it would take "preeminence above all the other productions of human genius," the majority could not believe that great planets were suspended in empty space, and retained in their orbits by an invisible power in the sun.

When Newton presented copies to the heads of colleges, some of them, Dr. Babington of Trinity among the number, said, "they might study seven years before they understood anything of it."

In 1687, Newton's method of fluxions was first published, twenty years after its invention, and then because the friends of Leibnitz, the author of the "Differential Calculus," claimed priority of discovery. The quarrel aroused the scientific world, embittered the silent mathematician, and impaired his health.

In 1689, when he was forty-seven, he was chosen member of parliament, and represented Cambridge University in the House of Commons for thirteen

months. He took no active part in the debates, but was of course respected for his wonderful mind.

This same year, his beloved mother died. Anxiously he had watched through whole nights by her bedside, seeking in all ways to keep her from leaving him alone in the world.

He was now nearly fifty. His life had been laborious, with an insufficient income. His friends, John Locke among the number, tried to obtain various positions for him, but failed. They recommended him for provost of King's College, but the position could not be obtained because he had not taken priest's orders.

Seemingly unappreciated, worn with his incessant brain work, his appetite failing, and unable to sleep, with neither mother nor wife to comfort him, the sensitive organization of the great man became overstrained, and mind and body were unfitted for work. It is stated that his ill health was in part consequent upon the burning of some manuscripts on optics, by a lighted candle on the table among his papers.

When he was fifty-three, the long hard road of poverty turned into a highway of plenty, through the influence of a friend. Charles Montague, an associate of Newton at the university and also in parliament, though nineteen years his junior, — intellectual affinities are uninfluenced by age, — had been made Commissioner of the Treasury, then Privy Councillor, then Chancellor of the Exchequer, and later still, Baron of Halifax.

Lord Halifax appointed Newton to be Warden of the Mint, and then Master, with an income of between thirteen hundred and fifteen hundred pounds annually, which position he held for the remainder of his life. His home in London, where he kept six servants, with his brilliant niece, Miss Catherine Barton, for his companion, became a place of rest and comfort to the tired philosopher. Lord Halifax was a great admirer of Newton's niece Miss Catherine Barton, to whom he left, at his death, a beautiful home and about five thousand pounds, "as a token of the sincere love, affection, and esteem I have long had for her person, and as a small recompense for the pleasure and happiness I have had in her conversation."

The days of privation were over, and Newton had earned this rest and prosperity. Great people often came to dine with him. At one of his dinners, Newton proposed to drink, not to the health of kings and princes, but to all honest persons, to whatever country they belonged. "We are all friends," he added, "because we unanimously aim at the only object worthy of man, which is the knowledge of truth. We are also of the same religion, because, leading a simple life, we conform ourselves to what is right, and we endeavor sincerely to give to the Supreme Being that worship which, according to our feeble lights, we are persuaded will please him most."

Other honors now come to Newton. In 1703,

he was elected President of the Royal Society, and was annually reëlected during the remaining twenty-five years of his life. On April 16, 1705, when he was sixty-three, Queen Anne conferred the honor of knighthood upon her most illustrious subject, Sir Isaac Newton, before a distinguished company at Cambridge University. In 1704, the year previous, his great work on optics had been published, written over twenty years before.

About this time, it seems that the great philosopher would have liked to marry Lady Norris, the widow of Sir William Norris, Baronet of Speke, and Member of Parliament. Sent to Delhi as ambassador to the Great Mogul, he died in 1702, between Mauritius and St. Helena, on his homeward passage. He was the third husband to Lady Norris, and Sir Isaac, now over sixty, desired to be the fourth, as appears from the following letter: —

"Madam, — Your ladyship's great grief at the loss of Sir William shows that if he had returned safe home, your ladyship could have been glad to have lived still with a husband, and therefore your aversion at present from marrying again can proceed from nothing else than the memory of him whom you have lost. To be always thinking on the dead, is to live a melancholy life among sepulchres, and how much grief is an enemy to your health, is very manifest by the sickness it brought when you received the first news of your widow-

hood. And can your ladyship resolve to spend the rest of your days in grief and sickness?

"Can you resolve to wear a widow's habit perpetually, — a habit which is less acceptable to company, a habit which will be always putting you in mind of your lost husband, and thereby promote you grief and indisposition till you leave it off? The proper remedy for all these mischiefs is a new husband, and whether your ladyship should admit of a proper remedy for such maladies, is a question which I hope will not need much time to consider of.

"Whether your ladyship should go constantly in the melancholy dress of a widow, or flourish once more among the ladies; whether you should spend the rest of your days cheerfully or in sadness, in health or in sickness, are questions which need not much consideration to decide them. Besides that your ladyship will be better able to live according to your quality by the assistance of a husband than upon your own estate alone; and, therefore, since your ladyship likes the person proposed, I doubt not but in a little time to have notice of your ladyship's inclinations to marry, at least, that you will give him leave to discourse with you about it.

"I am, madam, your ladyship's most humble and most obedient servant."

If Lady Norris "liked the person proposed," as Sir Isaac imagined, a marriage was not the result. It is just possible that he was like Leibnitz, who

proposed to a lady when he was fifty. The lady asked for time to take the matter into consideration, and as Leibnitz thus obtained leisure to consider the matter again, he was never married.

For thirteen years Sir Isaac lived on Jermyn Street, London; then moved to Chelsea, a place dear to those who love George Eliot or admire Carlyle; and then to Martin Street, near Leicester Fields.

In his latter years he wrote much on theological subjects, especially to prove the existence of a Deity. When he was eighty-three he published a third edition of the "Principia." At eighty-five he read manuscript without spectacles. He reasoned as acutely as ever, his memory alone failing.

On March 2, 1727, he presided at a meeting of the Royal Society. He was taken ill on the following day, and, although a great sufferer for several days, never uttered a complaint. He died on Monday, March 20, and his body was laid in the Jerusalem Chamber, and thence conveyed to Westminster Abbey for burial. The pall was supported by the Lord High Chancellor and several Dukes and Earls.

On the front of his monument are sculptured youths, bearing in their hands emblematic designs of Newton's principal discoveries. One carries a prism, another a reflecting telescope, a third is weighing the sun and planets with a steelyard, a fourth is employed about a furnace, and two

others are loaded with money newly coined. The monument bears this inscription.

HERE LIES
SIR ISAAC NEWTON, KNIGHT,
Who by a vigor of mind, almost supernatural,
First demonstrated
The motions and figures of the Planets,
The Paths of the Comets, and the
Tides of the Ocean.
He diligently investigated
The different refrangibilities of the Rays of Light,
And the properties of the Colors to which
they give rise.
An Assiduous, Sagacious, and Faithful Interpreter
of Nature, Antiquity, and the Holy Scriptures,
He asserted in his Philosophy the Majesty of
God, and exhibited in his Conduct the
simplicity of the Gospel.
Let Mortals rejoice that there has existed
such and so great
AN ORNAMENT OF THE HUMAN RACE.
Born 25 Dec., 1642; Died 20 March, 1727.

A beautiful full-length, white marble statue of Sir Isaac was erected in the ante-chapel of Trinity College, where he had done his wonderful work, when scarcely more than a boy.

While he gave generously during his life, he said, "they who give nothing till they die, never give at all,"—he left a personal estate of more than

thirty thousand pounds to be divided among his nephews and nieces.

The world honored him at last, and has through all the years. Bishop Burnet said, "Newton had the *whitest* soul he ever knew." His habits were of the best. When asked to take snuff or tobacco, he declined, saying, "he would make no necessities to himself."

He was modest to the last, saying, "that whatever service he had done the public was not owing to any extraordinary sagacity, but solely to industry and patient thought." He said, a short time before his death: "I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

CARL LINNÆUS.

IT was on the 24th of July that we left Stockholm, the Venice of the North, built on her nine islands, for the famous university town of Upsala, Sweden. The ride, of about two hours by rail, lay along fine fields of wheat, blue with corn-flowers, and past comfortable-looking red farm-houses and barns.

The town, of thirteen thousand people, is quaint and quiet, yet most interesting to a stranger. We wander over the grand old Gothic cathedral, begun six hundred years ago. Here is the silver-gilt sarcophagus of King Eric IX., who died in 1160, and of John III. Here, also, that of Gustavus Vasa, the deliverer of Sweden, on a high marble pedestal supported by pillars, a recumbent figure of a wife on either side. A third wife is buried near by. The walls of the chapel where he lies are covered with frescoes, depicting scenes in that wonderful life; from the rags of the miner, to the sumptuousness of the throne.

But especially are we interested in a plain slab, underneath which sleeps the man who, more than any other, has immortalized Upsala University,

and helped to make Sweden an intellectual and studious country. Near by is the monument of dark porphyry, with the plain, shaven face in bronze, wreathed with laurel, and the words "*Carolo a Linné Botanicorum Principi Amici et Discipuli*, 1798."

Then we turn our steps to the University, the pride and hope of Sweden. Here fifteen hundred gather, not in dormitories — which were tried fifty years ago and discarded — but scattered in various homes, as in the German universities. Women are educated here on equal terms with men, and we are assured by the professors that, though admitted only a few years ago, their presence is most helpful, and the plan has proved entirely successful. No duels are allowed, these having been abolished by stringent laws two hundred years ago; a thing Germany should long since have done, and thus ended this brutal custom.

Here is the Astronomical Observatory, the Chemical Laboratory, Anatomy Building, Academic Department, and handsome library with two hundred thousand volumes and over seven thousand manuscripts. Here we look at the celebrated "Codex Argenteus," a translation of the four Gospels by Bishop Ulfila, dating from the second half of the fourth century, written on one hundred and eighty-eight leaves of parchment — gold and silver letters on a reddish ground; and the manuscript of Frithiof's Saga, by Tegnér.

Now we visit the Botanic Garden, which Linnæus

so loved and developed, and go over the two-and-a-half-story stuccoed house, cream-colored, where the great naturalist lived and entertained princes. Under these dark poplars, enormous in size, he taught the pupils who came from all parts of the world to hear him. The dark, closed blinds are as he left them, for Sweden would not change one thing about the precious home. Too little in our own country do we treasure the homes of those who give honor to the nation.

The history of Linnæus is, indeed, a romance. Few have had such great struggles with poverty; few have come off such conquerors. Few lives have given to the world such lessons of cheerfulness, of perseverance, and of untiring industry. He was born, May, 1707, at Rashult, in the south of Sweden, the son of a poor minister, and the eldest of five children. The father, Nils Linnæus, had obtained his education by the hardest toil, and, while he had only poverty to offer his family, he gave them what money could not buy, tender affection, and the inspiring influence of a cultivated mind that loved nature and studied her closely. His mother, Christina, a woman of sense, prudence, and good judgment, was his idol. He wrote of her in later years: "She possessed all the virtues of her sex, devoting the utmost attention to impressing on my mind the love of virtue, both in precept and example."

From a child he was fond of his father's garden, and gathered from the fields all kinds of wild

flowers. He says of himself in his autobiography: "He was scarcely four years old when he accompanied his father at a feast at Mökler, and in the evening, it being a very pleasant season of the year, the guests seated themselves on some flowery turf, listening to the pastor, who made various remarks on the names and properties of the plants, showing them the roots of the succisa, tormentilla, orchids, etc. The child paid the most uninterrupted attention to all he saw and heard, and from that hour never ceased harassing his father about the name, qualities, and nature of every plant he met with; indeed, he very often asked more than his father was able to answer, but, like other children, he used immediately to forget what he had learned, and especially the *names* of plants. Hence the father was sometimes put out of humor, and refused to answer him unless he would promise to remember what was told him. Nor had this harshness any bad effect, for he afterward retained with ease whatever he heard."

When he was eight, a piece of ground was assigned him, which was called "Carl's Garden." Here he gathered plants and flowers, and introduced so many rare weeds that his father had great trouble in eradicating them! So interested did Carl become, that he had nests of wild bees and wasps, not agreeable playthings usually.

But the play days with weeds and wasps came to an end, for the bright boy had to go to school. His first teacher was "a passionate and morose

man, better calculated for extinguishing a youth's talents than for improving them," and the next "pursued the same methods, preferring stripes and punishments to encouragements and admonitions." There was little time now for the precious study of flowers. At seventeen he had to go to a gymnasium or high school, where he would be taught classics, and made ready for the ministry, like his father. He had no fondness for the languages, neither for theology or metaphysics: but having obtained two books on botany, he read them day and night, committing them to memory. The teachers and scholars called him "the little botanist."

What was his father's chagrin, when he came to the school to visit him, to hear that Carl was quite unfit for the ministry, but would probably make a good tailor or shoemaker! Poor as he was, he had kept his boy at school for about twelve years. Now, well-nigh disheartened, he stopped, on his way home, to confer with his family physician, Dr. Rothmann. That good man suggested that the boy might like medicine, and accomplish great things in natural history. He offered to take him into his own home, and give him lessons in physiology, which kind proposal the father accepted, though with little faith. The doctor also taught him botany, and Carl grew happy under the new *régime.*

The next year he was sent to the University of Lund, with the following not very creditable certificate from the head master of the Gymnasium:

"Youth at school may be compared to shrubs in a garden, which will sometimes, though rarely, elude all the care of the gardener, but if transplanted into a different soil, may become fruitful trees. With this view, therefore, and no other, the bearer is sent to the University, where it is possible that he may meet with a climate propitious to his progress." Through a friend, entrance was obtained without showing the obnoxious certificate.

Carl took lodgings at the house of Dr. Stobæus, physician to the king, who gave him access to his minerals, shells, and dried plants. Delighted at this, the youth at once began to make a collection of his own, and glue them on paper. He longed to gain access to Dr. Stobæus's library, but how should it be accomplished? Finally a young German student, to whom he taught physiology, surreptitiously gained the books needed, and young Linnæus spent nearly the whole nights in reading. The doctor's aged mother did not understand why their lodger kept his light burning into the small hours, and besought her son to investigate. He did so, and found the crestfallen Carl reading his own library books. He forgave the student, took him to his own table and treated him as a son.

Advised by Dr. Rothmann to go to Upsala for better medical opportunities, he proceeded thither, and here began his bitterest poverty. His father could give him only eight pounds. As he was unknown, and without influence, he could obtain no private pupil. Starvation actually stared him in

the face. He says, "he was obliged to trust to chance for a meal, and in the article of dress, was reduced to such shifts that he was obliged, when his shoes required mending, to patch them with folded paper, instead of sending them to the cobbler." Often hungry and half clothed, there seemed nothing before the poor Swedish lad but obscurity and early death.

One day in autumn, as he was examining some plants in the Academical Garden, a venerable clergyman, Dr. Olaf Celsius, saw him, and asked him where he came from, how long he had been at the college, and what he knew about plants. He, too, was interested in botany, and was preparing a work on the plants mentioned in the Bible. Perhaps something in Carl's face or manner touched the minister's heart, for he asked him to go home with him, and soon offered him board in his own house, and gave him access to his valuable library.

The tide of adversity was beginning to turn. Some pupils were obtained, and a little money flowed into the empty pockets. At twenty-two, by a close examination of the stamens and pistils of flowers, he decided upon a new method of arrangement by the sexes of plants, which, in after years, became the basis of his great fame. This procured him the appointment of Assistant Lecturer to Dr. Rudbeck in the Botanical Garden, where, but a year before, he had asked to be the gardener!

He still had little money, but, what was equally useful, some leisure time. He began his great

works, which were not completed for seven years, "Bibliotheca Botanica," "Classes Plantarum," "Critica Botanica," and "Genera Plantarum," "letting," as he said, "not a minute pass unoccupied during his residence at Upsala. For the latter work he examined the characters of eight thousand flowers."

Scarcely had he begun this valuable labor, when the envy of one of the professors became as hard to bear as his previous poverty, and, through friends, he obtained an appointment to study the natural history of Lapland. It was a hazardous expedition for a young man of twenty-five. Now he climbed steep rocks, "which," he says, "broke loose from a spot which my late guide had just passed, and fell exactly where I had been, with such force that it struck fire as it went." Once, when floating down a river, the raft parted in the middle, and he narrowly escaped drowning. "All my food," he says, "in those fatiguing excursions, consisted, for the most part, of fish and reindeer's milk. Bread, salt, and what is found everywhere else, did but seldom recreate my palate." He travelled nearly four thousand miles, mostly on foot, often through bogs and marshes, with the water to his knees, yet always cheerful, always enthusiastic. On presenting his report to the University, on his return home, they gave him about ten pounds for his travelling expenses for five months!

A single incident shows the tender heart of the young explorer. Very few birds were visible ex-

cept the ptarmigan. He says: "The little Alpine variety of the ptarmigan was now accompanied by its young. I caught one of these, upon which the hen ran so close to me that I could easily have taken her also. She kept continually jumping round and round me, but I thought it a pity to deprive the tender brood of their mother; neither would my compassion for the mother allow me long to detain her offspring, which I returned to her in safety." Tenderness to animals seems to be a striking characteristic of great men and women.

During the journey, he found a modest little flower in the great northern forests, in the moss, and this he named *Linnæa borealis*, thinking it was so like himself, expanding in obscurity. He chose for his motto, *Tantus amor florum*, "So great is the love for flowers."

On his return to Upsala, he began courses of private lectures in medicine, but so bitter was the envy of the before-mentioned professor that the archbishop was prevailed upon to prohibit private lectures. Thus deprived of a livelihood, Linnæus turned his attention to mineralogy, visiting the Swedish mines. The Governor of Dalecarlia was so pleased with him that he engaged him to investigate the productions of his country. Here he fell in love with the daughter of John Moræus, a well-to-do physician.

Sara Elizabeth reciprocated the affections of the young man, who was told by the father that he must wait three years for a final answer; for, in

truth, Linnæus's financial prospects were not bright. The University of Upsala did not want him, and there seemed to be no hope of writing or publishing his books on botany. But a man usually achieves little, who does not fight his way at every step. Now, indeed, for love's sake he must make his mark.

After saving about fifteen pounds he decided to go to Germany, and take his doctor's degree; but first he must visit his home, out of which his beloved mother had gone at forty-five. "Alas! alas, my mother!" was all he could say as the tears fell fast upon her grave. She had witnessed his poverty and his heroism; she was not to witness his great renown.

At Hamburg he spent a month, receiving civilities from many scientific men. He showed his good sense in feeling in no wise humiliated because he was poor, a valuable lesson for poor young men and women to learn. At Leyden, good fortune came to him. Dr. Gronovius was so pleased with the manuscript of his "Systema Naturæ" that he requested to publish it at his own expense. By his advice, Carl waited upon the celebrated physician, Boerhaave, and after eight days gained admittance. So famous was this man that when the Emperor of China sent a letter to "Boerhaave, the famous physician in Europe," it easily reached him. He advised a rich banker, Mr. Clifford, to have Linnæus describe his magnificent collection of plants, and to send him to England and elsewhere,

to collect specimens for him. This was indeed a blessing. "Here in England," he says, "I lived like a prince, and had one of the finest gardens of the world under my inspection." A society in Amsterdam advanced the money to pay for the plates for his "Flora Lapponica," and fame seemed really to be coming at last.

In his visit to England, Sir Hans Sloane, who founded the British Museum, looked upon him coldly because he had suggested a different system in natural history from his own! At Oxford, Dillenius said to friends, sarcastically: "See, this is the young man who confounds all botany!" Linnæus felt hurt, and, when about to take his departure from the city, asked the scientist why he had treated him thus. After the young student had explained his work, Dillenius became his warm friend, and pressed him to stay, and even to share his salary with him. Linnæus was greatly pleased with London, and when he saw the golden furze in its green leaves, fell on his knees before it.

On his return to Germany he went to the death-bed of Boerhaave, whose parting words were: "I have lived out my time and done what I could. May God preserve thee, from whom the world expects much more! Farewell, my dear Linnæus!"

He now hastened to the idol of his heart in Sweden, and what was his amazement to find that the friend to whom he had intrusted his correspondence with Sara Elizabeth had been trying to win her for himself! Perhaps it would have been

quite as well for Linnæus had he succeeded! However, matters were amicably adjusted, and the long waiting lover became engaged.

He repaired at once to Stockholm to begin the practice of medicine, still keeping as near Upsala University as possible. And here troubles began anew. He says: "Being unknown to everybody, people were unwilling to trust their lives in my hands. Nay, they even hesitated to trust me with their dogs! Abroad, I had been honored in every place as Princeps Botanicorum; but in my own country I was looked upon as a *Klim*, newly arrived from the subterranean regions! No one cared how many sleepless nights and toilsome hours I passed. Had I not been in love I would certainly have left Sweden and gone abroad."

After a time a fortunate cure effected by him brought him speedy popularity. "No invalid could now recover without my assistance. I was busy from four in the morning till late in the evening; nor were my nights left undisturbed." He was soon chosen a member of the Upsala Academy, and at the request of the king, through his tutor, Count Tessin, gave public lectures on botany and mineralogy.

And now the rising botanist desired to claim his bride. They were accordingly married June 26, 1739, when Linnæus was thirty-two. Dr. Moræus had waited long enough to see that his daughter was making no mistake. Life now flowed on smoothly. If the "little wife," as he called her,

governed him with no very gentle sway in after years, she had great influence over him, and it is said that at her instigation he persecuted his only son. All the more is Linnæus to be admired for accomplishing such a grand work with domestic hindrances. It takes a very great man to be great when his home is not a help to him! However, he always regarded her as "one of the choicest gifts bestowed upon him."

His medical practice brought him plenty of money, but he wrote to a friend: "Once I had plants and no money: now what is money good for without plants?" Soon the desire of his heart was granted, and he was made Professor of Botany at Upsala University, also superintendent of the Botanical Garden.

Now he says: "I render thanks to the Almighty, who has ordered my lot so that I live at this day; and live, too, happier than the King of Persia. I think myself thus blessed because in this academic garden I am principal. This is my Rhodus, or, rather, my Elysium; here I enjoy the spoils of the East and the West, and, if I mistake not, that which far excels in beauty the garments of the Babylonians and the porcelain of China."

His fame grew rapidly. He published, in 1745, his "Flora Suecica," and a year later his "Fauna Suecica," a description of Swedish plants and animals. His lectures soon, by their enthusiasm and eloquence, brought listeners from all parts of Europe. The number of students in the university

grew from five hundred to fifteen hundred, young men coming even from America to hear the great botanist. During the summer he made excursions twice a week, often at the head of two hundred students, and when some rare plant was discovered, the news was announced to the others by horn or trumpet. His scholars, imbued with his spirit, went over the world in scientific investigation. Some died in the Arabian deserts; some in the swamps of Africa. From foreign students he would take no fee, as he desired to show them how he loved his work. Once he said to a German student: "Tell me, candidly, are you rich, and can you afford it? If you can, then give the money to my wife; but, if you be poor, so help me Heaven, I will not take a single farthing from you!"

Most of the scientific societies of Europe made him a member after his great works were published. The Imperial Academy called him "Dioscorides Secundus"; a gold medal was struck in his honor in 1746, and the king made him dean of the College of Physicians. He published two valuable medical books, and received the honor of the Knight of the Polar Star, never before conferred for literary merit. He was made a noble, and took for his motto, *Famam extendere factis*, adorning his crest with the little flower which he discovered in his poverty. He was made rector of the university, holding the position for several years. How different from the time when he

could obtain only a chance meal, and covered up the holes in his torn shoes!

He bought two estates, living at one of them — Hammerby — for fifteen years. In 1774, when he was sixty-seven, he suffered an attack of apoplexy in the Botanical Garden, and, two years later, another stroke made him a paralytic. When he could no longer walk, he used to be carried to his museum, and look long and earnestly at his treasures, gathered from every clime. His memory so failed him that he mixed the Greek and Latin letters, and forgot even his own name. On the 10th of January, 1778, death came to him in his sleep.

The university went into mourning, the king made a public address, and the whole nation regarded it as an irreparable loss. His herbarium and library were sold, after a time, by the wife, to Sir James E. Smith, the founder of the Linnæan Society, of London, where these treasures are now to be seen, and most of the one hundred and eighty works which he published during forty-five years. It is said that the King of Sweden, on learning that the work of Linnæus was going out of the country, sent a man-of-war to recover it, but without avail.

Linnæus was small in body, with large head, and the bright, piercing eyes which usually characterize men and women of genius.

Of his six children, the oldest soon became professor of botany, to assist, and then succeed, his father, but he lacked the parent's just and honora-

ble love of fame. The eldest daughter inherited much of his ability, being the first to discover the luminous property of the nasturtium flowers at night. Sara Elizabeth survived her noble husband many years, and now lies beside him in the cathedral.

BARON CUVIER.

IN the town of Montbéliard, France, then belonging to the Duke of Würtemberg, August 23, 1769, was born the founder of the Science of Comparative Anatomy; the greatest naturalist of his time, Georges Léopold Chrétien Frédéric Dagobert Cuvier. His father was a brave officer in a Swiss regiment, who at fifty married a young lady of unusual ability. Their first son died, and the second, Georges, was so feeble in constitution that his life was saved only by the tenderest care of his mother.

For this mother the boy cherished the most ardent affection. While she lived, there was nothing left undone that a loving nature could do for her. When she died, everything connected with her memory became sacred. When Cuvier had become honored by kings and nobles, when the great from all the world delighted to bring him offerings, nothing so touched his heart as the gift of a bouquet of red stocks, her favorite flower. Perchance the benignity that came into his face in later years was the result of these sweet remembrances.

She taught him to read at four, and, though igno-

rant of Latin, she made him repeat his lessons to her daily, so that he was the best prepared of any boy in school. She read to him history and general literature. She made him draw under her inspection. She talked with him about books till a passion for reading became the chief characteristic of his nature. No wonder that he loved such an inspiring woman. The history of most great men emphasizes the fact that the mothers cannot be too highly educated. At ten years of age he was placed in a high school, called a Gymnase, where for four years he studied Latin, Greek, history, geography, and mathematics, and was constantly at the head of his classes. Naturally enthusiastic, he played as heartily as he studied.

As is often the case, a book turned the course of his life, and made him famous. At the Gymnase he found a work of Gesner, the Swiss naturalist, and this, with its colored plates, first turned his attention to natural history. This liking was intensified by finding at the house of a relative th complete works of Buffon, the noted naturalist, wh wrote thirty-six volumes in his own brilliant and poetic style, describing the animal kingdom. The boy became intensely interested in the habits of quadrupeds and birds; their form, their color, and their homes. He copied the illustrations in the work, and colored them with paint or pieces of silk. He always carried a volume of Buffon in his pocket to read when he had a moment of leisure. At twelve, he was a well-read naturalist.

In his last year in the Gymnase, when he was fourteen, he chose a certain number of his schoolfellows, and formed an Academy. Every Thursday he gathered the lads into his room, and placing them around a table, seated himself upon his bed, and after some book had been read on natural history, philosophy, history, or travels, he asked their opinions of it, and then, being president, summed up the argument in a clear and concise manner. The mother's seed-sowing in the mind of her ardent boy was bearing fruit.

As the family were poor, and had only a soldier's pension to support them, it was decided that Georges should enter the free school at Tübingen, and prepare for the church. But the principal of the Gymnase, who had never forgiven the boy for some playful trick, placed his composition in the third rank. Georges knew that it deserved the first rank, and that this low standard would affect his position in college. He, therefore, resolved not to enter Tübingen, and, though he was thereby lost to the church, he was saved for great scientific work.

A fortunate thing now happened. A woman, a princess, who knew about the bright boy, spoke of him to her brother, Duke Charles of Würtemberg. When the duke visited Montbéliard, he sent for the lad, questioned him as to what he had learned, asked to see his drawings, and ended by sending him free of expense to the University of Stuttgart, to enter his own Academy, called the Academy Caroline. It seemed a little thing for a lady to speak of a boy's

studiousness and great love of books, but it proved a great thing for Georges Cuvier and for the scientific world. Thousands of women and men could do more of these little acts of kindness, if they only thought of it. Well said Thomas Hood: —

> "Evil is wrought by want of thought,
> As well as want of heart."

The boy of fourteen said good-by to his devoted mother, and started for Stuttgart, seated between the Chamberlain and the Secretary of the Grand Duke. Both spoke German all the way, and the lonesome boy did not understand a word. He entered the Academy May 4, 1784, and for four years studied mathematics, law, philosophy, finance, and the like.

But he lost no opportunity to study natural history. A professor gave him the works of Linnæus, and he gained inspiration from the young man who could travel four thousand miles through the marshes of Lapland, nearly barefoot and half-starved, in his study of plants. Georges now collected a herbarium. When he had leisure, he drew and colored insects, birds, and flowers with great accuracy. He kept a number of living insects in his room, constantly feeding them, and watching their habits. He said years afterward, "If I had not studied insects from choice, when I was at college, I should have done so later, from a conviction of its necessity." He declared that the wonders he

met with in the organization of insects always elevated his thoughts.

Nine months after his arrival in Germany, he won the prize at the Academy for excellence in the German language, receiving the order of Chevalerie, an honor given only to five or six out of four hundred pupils. This entitled the recipients to dine at a separate table, and to enjoy many advantages under the immediate patronage of the Grand Duke.

When the four years of college life were over, the father's pension having ceased on account of the disturbed financial condition of France, the youth of eighteen needed to find employment at once. Nothing seemed open to him but the position of tutor in a private family, a thing much deprecated by his school-fellows, who had already built many air-castles for his future.

But young Cuvier had the courage and the wisdom to do what necessity required, and to do it cheerfully. In July, 1788, he entered the family of Count d'Héricy in Caen, Normandy, and for six years taught his only son. He took with him, says a friend, "these admirable foundations for glory: a love of labor, depth of reflection, perseverance, and uprightness of character." While teaching here, he met the nobility of the surrounding country, increasing thereby his polish of manner and tact, for which he was celebrated all his life.

Living by the sea, he was led to study marine animals. The casual dissection of a calamar, a

species of cuttle-fish, influenced him to study the anatomy of mollusca, which afterward led to his great classification of the whole animal kingdom. In this obscure corner of Normandy, the young teacher observed, and committed his observations to paper. Some young men would not have found time for such work. Those only succeed who have sufficient force of character to make time for what they wish to do. To allow one's time to be wasted, is to allow one's opportunities for eminence to go by forever.

Nearly every evening Cuvier attended a small society of which he was secretary, which gathered chiefly to discuss agricultural and kindred topics. M. Tessier, living there in exile under an assumed name, the author of several valuable articles in the Encyclopedia, was often present, and between him and the young secretary a warm friendship soon existed. As the friendship of the Marquis Guidubaldo proved valuable to Galileo, so that of M. Tessier proved of great benefit to Cuvier. He led the young and comparatively unknown naturalist, though some of his articles had been published in learned journals, to correspond with Geoffroy St. Hilaire, De Lacépède, and others on scientific subjects. Through their influence he was finally called to Paris, made a member of the Commission of Arts, and professor at the Central School of the Panthéon.

He was only twenty-six, and this was but the beginning of honors. Here he composed his "Ele-

mentary Treatise on the Natural History of Animals." His great desire was to be attached to the Museum of Natural History, where he could study the collections and enlarge them. Very soon after his arrival in Paris, M. Mertrud was appointed to the newly created chair of Comparative Anatomy at the Jardin des Plantes. He was advanced in years. And now came the opportunity for friendship to do its work. Geoffroy St. Hilaire and De Lacépède were his colleagues. They urged that their friend Cuvier be appointed assistant, and Mertrud gladly consented. This was indeed an honor, since Daubenton, Buffon, Lamarck, and other European celebrities had filled this position.

Cuvier at once sent for his aged father, now nearly eighty years old, and his only brother, Frédéric, to make their home with him. The precious mother had died two years previously. She did not live to see the fame of her eldest son, but she must have been convinced of his future greatness, and been comforted by the prospect.

From the moment of entering upon his new work, Cuvier began to develop that wonderful collection in comparative anatomy which is now so celebrated. Nothing ever turned him from his purpose of making this the most extensive collection in the world; no sorrow, no legislative duties, no absence. No one who has visited Paris will ever forget the seventy-five acres in the Jardin des Plantes, with trees and flowers from all the world; with thirteen rooms filled with skele-

tons and anatomical preparations of all kinds; with eleven rooms in the gallery of anthropology containing every variety of the human species, in casts, mummies, and fossils; with the gallery of zoölogy containing over two thousand mammalia, belonging to five hundred species, as many reptiles, ten thousand birds, and over twenty-five hundred fishes; with immense geological, mineralogical, and botanical collections; all a marvel of industry and learning.

Cuvier now worked unceasingly. Sometimes his salary was in arrears, but he bore it cheerfully, as he wrote a friend: "You are not to suppose that Paris is so highly favored; for twelve months' pay are now due at the Jardin des Plantes, and all the national establishments for public instruction, in Paris as well as at Strasburg; and if we envy the elephants, it is not because they are better paid than we are, but because while living on credit, as we do, they are not aware of it, and consequently are insensible to the pain it gives. You know the saying about the French, that when they have no money they sing. We savants, who are not musicians, work at our sciences instead of singing, which comes to the same thing." He is a hero, indeed, who can breast poverty, and work and sing in the midst of hardship. When he published his "Annals of the Museum," he not only drew, but often engraved the plates himself, when he was unable, for lack of means, to hire it done.

The National Institution was founded in 1796,

and Cuvier was associated with his friends De Lacépède and Daubenton, in the section of zoölogy, holding the position of Secretary of Natural Sciences till his death.

Four years later, in 1800, the first two volumes of his "Lessons in Comparative Anatomy" were published, and met with great success. The last three volumes were issued five years later.

In this year, 1800, Cuvier received another honor, that of the professorship of Natural Philosophy in the Collège de France. He was now but thirty-one. The following year, Napoleon I., who was usually wise in his selection of men, appointed him one of the six inspectors-general of education, to establish public schools in thirty towns of France.

Every moment now seemed occupied, and yet while the brain was busy perchance the heart was lonely. The father had died two years after the mother. The wife of his brother Frédéric had died, also, and the two brothers were left alone. At thirty-four, Cuvier decided to take into his heart and home the widow of M. Duvaucel, Fermier-Général, who had perished on the scaffold in 1794. The family had lost all their money in the French Revolution, and Madame Duvaucel had four large children to be supported; but Cuvier loved her for her rare mind and sweet disposition, and she blessed the remaining years of his life. An educated man needs companionship in mind; not simply a housekeeper.

Six years later one of her sons was assassinated in Portugal, during the retreat of the French army. Another, while collecting for the Museum of Paris, died in Madras, a young man of great talent and much beloved. A daughter, Mlle. Duvaucel, lived to be the comfort of Cuvier's declining years.

Happy in his home and absorbed with his work, Cuvier went forward to new labors and new honors. M. Mertrud had died, and, instead of being assistant at the Jardin des Plantes, Cuvier was now professor. In 1808 Napoleon made him counsellor for life of the Imperial University. The next year he organized new academies in the Italian States, which were now annexed to France. In 1811 he was sent on a similar mission to Holland and the Hanseatic towns, and was made a chevalier, which rank was assured to his heirs. Though he disliked to be absent from his family, he went where duty called him, and wrote back fond letters to his wife.

"My Tender Friend, — The weather, the road, the horses, and the postilions have proved so excellent that we have reached Porte Sainte Mayence before six o'clock; and I have bitterly regretted the two or three good hours that I might still have passed with thee, without in the least delaying my journey. At least believe that I have passed them in my imagination, and that the remembrance of thy caresses and tender friendship will form the happiness of my whole way." After some words to the children, he added,

"We are quite well, my good friend; we have crossed an agreeable country; and we are in a tolerable inn. Our carriage appears to be quite able to bear the journey; thus, up to this moment, all goes well. Pray to God that this may last; thou art so good that he cannot refuse thee. Adieu. A thousand tender kisses. G. C."

This year, 1811, appeared one of his most important works — that on "Fossil Remains," which wrought a revolution in the study of geology. By comparing living and fossil animals, Cuvier showed that huger creatures had lived on the earth and become extinct before the creation of man. In the first epoch he found great reptiles, like the Ichthyosaurus, thirty feet long, and the Megalosaurus, seventy feet long. In the second epoch, he found the Paleotherium; in the third, the Mammoth, Mastodon, and gigantic sloth; and in the fourth epoch, man. So closely had he studied the relations of the organs of animals, that he could reconstruct the extinct fossil from a single bone. He had already prepared, at the request of Napoleon, a brilliant "Report on the Progress of Natural Sciences from the year 1789."

In 1813, though a Protestant, he was sent to Rome to organize a university, and was made Master of Requests in the Council of State. Napoleon also appointed him Commissaire Impérial Extraordinaire, and sent him to endeavor to raise the people on the left bank of the Rhine in favor of France, against the invading troops then march-

ing upon them. But Cuvier was stopped at Nancy by the entrance of the allied armies, and obliged to return.

He was now famous, and his company and counsel were sought by the learned and the great. And he was still a comparatively young man, forty-four.

But life had great sorrows in the midst of this prosperity. His first child, a son, had died a few weeks after his birth. His daughter Annie had died in 1812, at the age of four, and now in 1813, while he was absent in Rome, his only son, Georges, a boy of seven, had been taken from him. The blow was a terrible one. For many years he never saw a boy near that age, without being deeply affected. He would stop on the streets to watch a group of boys playing, and then go on sadly, thinking of the one he had buried.

In 1814, Cuvier was raised to the rank of Counsellor of State, and Chancellor of the University. When Napoleon was asked why he had appointed a savant to a political position, he replied, "that he may be able to rest himself sometimes," knowing that to a man like Cuvier change was the most helpful rest. When Napoleon abdicated his throne, and Louis XVIII. came to power, Cuvier was retained in office, for his rare administrative ability, and upright life.

Three years later, the first edition of his "Animal Kingdom" appeared, and is now to be seen in the British Museum, in seventeen volumes. This

work has served as the basis for subsequent zoölogical classification. Cuvier studied minutely the interior structure of animals, and based his classification on this, instead of exterior resemblance.

After this great work was published, Cuvier went with his family to London, for a rest of six weeks. Here he received distinguished attention from Sir William Herschel, and other learned men.

In 1819, he was appointed President of the Committee of the Interior, and in this position, which he held for life, it is believed ten thousand various matters passed through his hands each year, for his examination and decision. He officiated at the crowning of Charles X., as one of the presidents of the Council of State, and received from that monarch the decoration of Grand Officer of the Legion of Honor. His former sovereign, the King of Würtemberg, appointed him Commander of the Order of the Crown.

All this time in which he was doing earnest and responsible work for his country, he was writing and lecturing almost constantly. So careful was he of his time, that he always read or wrote as he was riding in his carriage through the streets of Paris. A lamp in the back of his carriage he used at night, till he found that he was injuring his eyes. Even while he was sitting for a portrait, to be used as a frontispiece for his book, "Discourse on the Revolutions of the Globe," his wife's daughter read to him the "Fortunes of Nigel." In the evenings, when he was too tired for scientific

research, his wife or daughter read to him general literature.

Every Saturday evening a reception was held at the home of Baron Cuvier, and there one was sure to meet the most brilliant and learned from all parts of Europe, whether rich or poor. . . .

Cuvier delighted everybody by his courtesy and his cordiality. Another person also was the life of these gatherings, — his beautiful daughter Clementine, his only remaining child. Never strong in body, she had been reared with the tenderest care. Devoted to all good work, reading to aged women, visiting the poor, educated, and of extreme loveliness of character, she was the idol of her family and of society. On the 25th of August, 1828, she was to have been married, but, while in the midst of the preparations, she fell ill of consumption, and died the following month, September 28.

The effect on both parents was crushing. Cuvier's light hair grew white, and lines gathered in his face. After two months he took his place again at the head of the Committee of the Interior. He listened attentively to all the discussions, but when it came his turn to speak, he burst into tears, and covered his bowed face in his hands, and sobbed bitterly. Finally he raised his head and said, "Pardon me, gentlemen, I was a father, and I have lost all!" and then with a violent effort he resumed the business of the day, with his usual calmness.

He devoted himself now more than ever to his

books, as though he must use every moment, or be prostrated with grief. This same year, 1828, the first book in a series of twenty volumes, beautifully illustrated, appeared, on the "Natural History of Fishes, containing more than five thousand species of those animals, described after nature, and distributed according to their affinities, with observations on their anatomy, and critical researches on their nomenclature, ancient as well as modern."

In 1832, he was created a Peer of France, by Louis Philippe. Every honor had come that could be asked or desired. His books were eagerly read; crowds attended his lectures; he was loved, honored, and revered; but death had robbed him of the sweetest things in life.

On Tuesday, May 8, 1832, he lectured as usual before the Collège de France, on the "History and Progress of Science in all Ages." In the evening he felt a numbness in his right arm. It was the beginning of the end. Paralysis soon developed.

He said to M. Pasquier, President of the Chamber of Peers, "Behold a very different person to the man of Tuesday — of Saturday. Nevertheless, I had great things still to do. All was ready in my head; after thirty years of labor and research, there remained but to write; and now the hands fail, and carry with them the head."

M. Pasquier tenderly expressed the universal interest felt for M. Cuvier. "I like to think so," said the dying man; "I have long labored to render myself worthy of it." He is to be

pitied, indeed, who does not care whether the world loves him.

On May 13, the nomination of Cuvier to the presidency of the whole Council of State was taken to the sovereign for his signature, but it came too late. Cuvier died that day. Four hours before his death he had asked to be taken into the room where he had met and talked with so many of the renowned of earth, and where his Clementine had charmed them by her presence. And there he died.

He was buried in Père la Chaise, by his own request, under the tombstone which covered Clementine, and whose death had virtually caused his own. His coffin was borne by the pupils of the different colleges in which he had taught, thousands following it to the cemetery. His library of nineteen thousand volumes was purchased by the government for the Jardin des Plantes. There was no child left to bear his titles.

Not only do the books of such a man live; his whole life, with its untiring energy, its promptness, its order, its unfaltering purpose, its high aims, as well as its tenderness and nobility of heart, is a constant inspiration.

SIR WILLIAM AND CAROLINE HERSCHEL.

IN Hanover, Germany, in the year 1732, Isaac Herschel and a plain, industrious girl, Anna Ilse Moritzen, began their home life together. The young man did not like the calling of his father, the cultivating of the royal gardens, and learned to play the oboe in the royal band.

He became skilled in music, and, as, one after another, ten children were born into the little home, he taught them to play on the violin and oboe, and such other branches of knowledge as he possessed. After a time his health became impaired with exposure in the Seven Years' War, and then he earned his living by lessons in music, given to scholars at his home.

The children attended the garrison school in Hanover, and learned the ordinary rudiments, besides French and German. Though the father sometimes copied music half the night to eke out his scanty living, he spared no pains to teach them all he could of his favorite art.

The fourth son, William, born November 15, 1738, not only learned French and English rapidly, but studied Latin and arithmetic with the teacher,

after hours. He became passionately fond of books, reading their own little store with avidity. The mother, who could not even write, viewed with alarm this intellectual development, feeling that her children, if they became learned, would go away from home — possibly from Germany. Poor, ignorant heart! She cooked and sewed, and prevented her daughters from learning French or drawing; but her weak hand could not stay the power of a mind like William's, bent on acquiring knowledge.

Caroline, the eighth child, born in 1750, twelve years younger than William, looked upon this brother as a marvel; and shy, plain, and silent herself, watched the boy with pride, who, perchance, would be somebody by and by. Alexander, a little older than Caroline, was skilled on the violoncello, and both the boys became members of the Hanover foot guards.

Years later, Caroline gave this picture of that early life: "My brothers were often introduced as solo performers and assistants in the orchestra of the court, and I remember that I was frequently prevented from going to sleep by the lively criticism on music, on coming from a concert; or by conversations on philosophical subjects, which lasted frequently till morning, in which my father was a lively partaker and assistant of my brother William, by contriving self-made instruments. . . .

"Often I would keep myself awake that I might listen to their animating remarks, for it made *me*

so happy to see *them so happy.* But generally their conversation would branch out on philosophical subjects, when my brother William and my father often argued with such warmth that my mother's interference became necessary; when the names Leibnitz, Newton, and Euler sounded rather too loud for the repose of her little ones, who ought to be in school by seven in the morning. But it seems that on the brothers retiring to their own room, where they shared the same bed, my brother William had still a great deal to say; and frequently it happened that when he stopped for an assent or reply, he found his hearer was gone to sleep, and I suppose it was not till then that he bethought himself to do the same.

—"The recollection of these happy scenes confirms me in the belief, that had my brother William not then been interrupted in his philosophical pursuits, we should have had much earlier proofs of his inventive genius. My father was a great admirer of astronomy, and had some knowledge of that science; for I remember his taking me, on a clear frosty night, into the street, to make me acquainted with several of the most beautiful constellations, after we had been gazing at a comet which was then visible. And I well remember with what delight he used to assist my brother William in his various contrivances in the pursuit of his philosophical studies, among which was a neatly turned four-inch globe, upon which the equator and ecliptic were engraved by my brother."

When William was seventeen, the guards went to England for a year, and on their return home he brought one precious memento of the country, Locke "On the Human Understanding." Such a boy would not remain in the foot guards forever. He was delicate in health, so that his parents removed him from the army.

At nineteen, he determined to try his fortune in England. He said good-by to the culture-loving and warm-hearted father, to the poor mother who knew "no other wants than good linen and clothing," and started out to make his way in the world. For three years nothing is known of him, save that he passed through many hardships. He played in military bands whenever and wherever he could find a situation, or at concerts, and led probably a cramped and obscure life.

There was little prospect then that he would become, as Prof. Edward S. Holden says in his admirable life, "the greatest of practical astronomers, and one of the world's most profound philosophers." What the poor German youth thought and felt in those years of trial, we do not know. He had one resource in his loneliness, the reading of useful books.

After about three years, a fortuitous circumstance occurred. It proved "fortuitous" only because young Herschel had studied music faithfully, and had made himself ready to fill a fine position, if, poor and without influence, such a position could be obtained.

As Dr. Miller, a noted organist, "was dining at Pontefract with the officers of the Durham militia, one of them, knowing his love of music, told him they had a young German in their band, as a performer on the oboe, who was also an excellent performer on the violin. The officer added that if Miller would come into another room, this German should entertain him with a solo. The invitation was gladly accepted, and Miller heard a solo of Giardini's executed in a manner that surprised him.

"He afterwards took an opportunity of having some private conversation with the young musician, and asked him whether he had engaged himself for any long period to the Durham militia. The answer was, 'Only from month to month.'

"'Leave them, then,' said the organist, 'and come and live with me. I am a single man, and think we shall be happy together; and doubtless your merit will soon entitle you to a more eligible situation.'

"The offer was accepted as frankly as it was made, and the reader may imagine with what satisfaction Dr. Miller must have remembered this act of generous feeling, when he heard that this young German was Herschel, the astronomer. 'My humble mansion,' says Miller, 'consisted at that time but of two rooms. However, poor as I was, my cottage contained a library of well chosen books.'

"He took an early opportunity of introducing

his new friend at Mr. Cropley's concerts. The first violin was resigned to him, 'and never,' says the organist, 'had I heard the concertos of Corelli, Geminiani, and Avison, or the overtures of Handel, performed more chastely, or more according to the original intention of the composers, than by Mr. Herschel.'

"'I soon lost my companion; his fame was presently spread abroad; he had the offer of pupils, and was solicited to lead the public concerts both at Wakefield and Halifax. A new organ for the parish church of Halifax was built about this time, and Herschel was one of the seven candidates for the organist's place. They drew lots how they were to perform in succession. Herschel drew the third; the second fell to Dr. Wainwright, of Manchester, whose finger was so rapid that old Snetzler, the organ-builder, ran about the church exclaiming, "*He run over te keys like one cat; he will not give my piphes room for to shpeak.*"

"'During Mr. Wainwright's performance,' says Miller, 'I was standing in the middle aisle with Herschel. "What chance have you," said I, "to follow this man?" He replied, "I don't know, I am sure fingers will not do." On which he ascended the organ loft, and produced from the organ so uncommon a fulness, such a volume of slow, solemn harmony, that I could by no means account for the effect. After this short *extempore* effusion, he finished with the Old Hundredth psalm-tune, which he played better than his opponent.

"'"*Ay, ay,*" cried old Snetzler, "*tish is very goot, very goot inteet. I will hef tish man, for he gives my piphes room for to shpeak.*" Having afterwards asked Mr. Herschel by what means, in the beginning of his performance, he produced so uncommon an effect, he replied, "I told you fingers would not do!" and, producing two pieces of lead from his waistcoat pocket, "One of these," said he, "I placed on the lowest key of the organ, and the other upon the octave above; thus, by accommodating the harmony, I produced the effect of four hands, instead of two."'"

Herschel was the successful candidate among the seven. He was now twenty-seven years old. Only once do we learn of his going home to Germany, and that in the year previous. Of this visit, Caroline, now grown to fourteen, says, "Of the joys and pleasures which all felt at this long-wished-for meeting with my, let me say my *dearest* brother, but a small portion could fall to my share; for with my constant attendance at church and school, besides the time I was employed in doing the drudgery of the scullery, it was but seldom I could make one in the group when the family were assembled together.

"In the first week, some of the orchestra were invited to a concert, at which some of my brother William's compositions — overtures, etc. — and some of my eldest brother, Jacob's, were performed, to the great delight of my dear father, who hoped and expected that they would be turned to some profit

by publishing them, but there was no printer who bid high enough."

After a year at Halifax, Herschel obtained a position as organist at the Octagon Chapel in Bath, a fashionable city of England. This was another and higher step on the road to fame. He now gave nearly forty lessons a week to pupils. He composed music, and wrote anthems, chants, and psalm-tunes for the cathedral choir where he played. He became so popular from his real ability, coupled with pleasing manners, that he was occupied in teaching from fourteen to sixteen hours daily.

But he did more than this. As his hopes brightened, he determined to devote every minute to the pursuit of knowledge, in which he found his greatest happiness. He studied Greek and Italian. He would *unbend his mind*, after he retired, with Maclaurin's "Fluxions," or Robert Smith's "Complete System of Optics," and Lalande's Astronomy.

What if he had devoted this time to ease or amusement! Would he have become learned or distinguished? Every young man and woman is obliged to decide the matter for himself and herself. We cannot idle away life and be great.

In 1767, the fond father, Isaac, died of paralysis. Caroline, who loved him tenderly, was desolate. He had taught her the violin when the prosaic mother "was either in good humor, or out of the way." It is quite possible that music, like inventions, did not bring an adequate support for ten children, and

that the practical mother wished her daughter to learn something whereby she could earn a living. She thereupon sent her two or three months to a seamstress to be taught to make household linen. After a time a delightful proposition came from the organist at Bath. He would take her to England, and see if she "could not become a useful singer for his winter concerts and oratorios." If she did not succeed, after two years, he would carry her back to Germany.

In 1772, William came to Hanover and took his sister to Bath, at 7 New Kings Street. She was now twenty-two; an untutored girl, with a bright, eager mind, and a heart that went out to her brother in the most rapt devotion. History does not show a more complete, single-hearted, subservient affection, nor a sadder picture of a woman's sorrow in later years, in consequence of it.

At once Caroline began her work of voice culture, lessons in arithmetic, English, and in keeping accounts, from her brother, and in managing the house. Alexander, now in England, boarded with William, and he and Caroline occupied the attic. The first three winter months were lonely, as she saw little of William.

"The time," she says, "when I could hope to receive a little more of my brother's instruction and attention was now drawing near; for after Easter, Bath becomes very empty, only a few of his scholars, whose families were residents in the neighborhood, remaining. But I was greatly dis-

appointed, for, in consequence of the harassing and fatiguing life he had led during the winter months, he used to retire to bed with a basin of milk or glass of water, and Smith's Harmonics and Optics, Ferguson's Astronomy, etc., and so went to sleep buried under his favorite authors; and his first thoughts on rising were how to obtain the instruments for viewing those objects himself of which he had been reading.

"There being in one of the shops a two-and-a half-foot Gregorian telescope to be let, it was for some time taken in requisition, and served not only for viewing the heavens, but for making experiments on its construction. . . . It soon appeared that my brother was not contented with knowing what former observers had seen, for he began to contrive a telescope eighteen or twenty feet long. . . . I was much hindered in my musical practice by my help being continually wanted in the execution of the various contrivances, and I had to amuse myself with making the tube of pasteboard for the glasses, which were to arrive from London, for at that time no optician had settled at Bath. But when all was finished, no one besides my brother could get a glimpse of Jupiter or Saturn, for the great length of the tube would not allow it to be kept in a straight line. This difficulty, however, was soon removed by substituting tin tubes."

Herschel had attempted to buy a telescope, but found the price far beyond his means. But he was

not discouraged. Caroline soon saw "almost every room turned into a work-shop. A cabinet-maker making a tube and stands of all descriptions in a handsomely furnished drawing-room;" this could be so occupied when the music scholars had left Bath in their vacation; "Alex putting up a huge turning machine in a bedroom, for turning patterns, grinding glasses, and turning eye-pieces, etc."

The longed-for time to see more of her brother never came to Caroline, except as she finally grew into his life-work, and became his second self.

He had one unalterable purpose, the study of the construction of the heavens. Nothing ever drew him from it. Nothing ever could draw him. And herein lay one of the elements of his great power. As an English writer has well said: "So gentle and patient a follower of science under difficulties scarcely occurs in the whole circle of biography." Yes, he was "gentle and patient," but with an untiring and never ending perseverance. Too poor to buy telescopes, he made them. With no time to read books during the day, he took the hours from sleep. With little opportunity for education, he educated himself.

In 1774, the music teacher made for himself a five-and-one-half-foot Gregorian telescope; and a year later, a Newtonian, with a four-and-a-half-inch aperture, which magnified two hundred and twenty-two times. The making of these instruments showed great mechanical skill and accurate knowl-

edge. He began now to study the heavens in earnest, but the teaching must go on to provide daily bread. He directed an orchestra of nearly one hundred pieces, and Caroline copied the scores and vocal parts. So absorbed was he in his astronomical work, however, that at the theatre, between the acts, he would run from the harpsichord to look at the stars. This boyish eagerness and naturalness he kept through life.

He soon made a seven-foot reflector, then a ten-foot reflector. The mirrors for these telescopes were all made by hand, machines for the purpose not being invented till ten or more years later. Alexander, with his mechanical skill, assisted, and Caroline was always busy at the work. She says, "My time was taken up with copying music and practising, besides attendance on my brother when polishing; since, by way of keeping him alive, I was constantly obliged to feed him, by putting his victuals by bits into his mouth. This was once the case, when, in order to finish a seven-foot mirror, he had not taken his hands from it for sixteen hours together. In general he was never unemployed at meals, but was always at those times contriving or making drawings of whatever came in his mind. Generally I was obliged to read to him while he was at the turning-lathe, or polishing mirrors, 'Don Quixote,' 'Arabian Nights' Entertainment,' the novels of Sterne, Fielding, etc.; serving tea and supper without interrupting the work with which he was engaged.". . .

So busy that he could not find time to eat or sleep! Rare devotion of a rare mind! He now began to study every star of the first, second, third, and fourth magnitudes in the sky. He carefully observed the moon, and measured the height of about one hundred of her mountains. Her extinct volcanoes, and her unpeopled solitudes, without clouds or air, were an impressive study.

He was now forty years old, — not young to begin the study of a new and illimitable science, but not too old, for one is never too old to begin a great or a noble work.

Through Dr. William Watson, Fellow of the Royal Society, who happened — if anything ever *happens* in this world — to see Herschel at his telescope, he became a member of the Philosophical Society of Bath, and soon in 1780 sent two papers to the Royal Society, the one on the periodical star in *Collo Ceti*, and the other on the mountains of the moon, which were read by Dr. William Watson, Jr.

When he was forty-three, he says, "I began to construct a thirty-foot aërial reflector, and, having made a stand for it, I cast the mirror thirty-six inches in diameter. This was cracked in cooling. I cast it a second time, and the furnace I had built in my house broke." But he persevered. This same year, 1781, after he had lived in Bath nine years, on the night of Tuesday, March 13, having removed to a larger house, 19 New King Street, he says, "In examining the small stars in

the neighborhood of *H. Geminorum* I perceived one that appeared visibly larger than the rest; being struck with its uncommon appearance, I compared it to *H. Geminorum* and the small star in the quarter between Auriga and Gemini, and, finding it so much larger than either of them, I suspected it to be a comet."

The orbit of this "comet" was computed and its distance from the sun found to be eighteen hundred million miles! The world soon awoke to the fact that a new planet had been found, the greatest astronomical discovery since Galileo invented the telescope, and the unknown musician at Bath had become famous! So little was Herschel known at this time, that one journal called him Mersthel, another Herthel, and still another Hermstel.

In December of the same year, 1781, Herschel was elected a Fellow of the Royal Society and received the Copley gold medal. He was no longer the poor German youth playing the oboe among the guards; he was the renowned discoverer. He called the planet Georgium Sidus, in honor of his sovereign, George III., but it was decided later to call it Uranus, from Urania the muse of astronomy.

Herschel went eagerly on with his work. Fame did not change his simple nature. The truly great are never ostentatious. He erected in his garden a stand for his twenty-foot telescope, and perfected his mirrors. "Though at times," says Caroline, "much harassed with business, the mir-

ror for the thirty-foot reflector was never out of his mind, and if a minute could but be spared in going from one scholar to another, or giving one the slip, he called at home to see how the men went on with the furnace, which was built in a room below, even with the garden."

The next year, 1782, Herschel went to London, and met with a gracious reception from George III. He wrote back to his devoted sister: "Dear Lina: All my papers are printing, with the postscript and all, and are allowed to be very valuable. You see, Lina, I tell you all these things. You know vanity is not my foible, therefore I need not fear your censure. Farewell.

"I am your affectionate brother,

"WM. HERSCHEL."

Again he wrote, —

"I pass my time between Greenwich and London, agreeably enough, but am rather at a loss for work that I like. Company is not always pleasing, and I would much rather be polishing a speculum. . . . I am introduced to the best company. To-morrow I dine at Lord Palmerston's, next day with Sir Joseph Banks, etc., etc. Among opticians and astronomers nothing now is talked of but *what they call* my great discoveries. Alas! this shows how far they are behind, when such trifles as I have seen and done are called *great.* Let me but get at it again! I will make such telescopes, and see such things — that is, I will endeavor to do so."

And this great ambition nerved him for action, continued and laborious, as long as he lived. He was never satisfied; always achieving. Little can be expected from those who are easily satisfied.

George III. wisely appointed Herschel Royal Astronomer, though with the too small salary of two hundred pounds yearly. He came back to Bath only to perform the last musical duty on Whit Sunday, 1782, the anthem for the day being his own composition, and to say good-by to his pupils.

He moved to Datchet in 1782, and set up his twenty-foot telescope. In 1783 he had made three reviews of the heavens. In 1784 he made a fourth review with his twenty-foot telescope. Caroline says: "My brother began his sweeps when the instrument was yet in a very unfinished state, and my feelings were not very comfortable when every moment I was alarmed by a crash or a fall, knowing him to be elevated fifteen feet or more on a temporary crossbeam, instead of a safe gallery. The ladders had not even their braces at the bottom; and one night, in a very high wind, he had hardly touched the ground before the whole apparatus came down. . . . I could give a pretty long list of accidents which were near proving fatal to my brother as well as myself."

A gentleman who visited him at Datchet wrote: "The thermometer in the garden stood at 13° Fahrenheit; but in spite of this, Herschel observes the whole night through, except that he stops every

three or four hours and goes in the room for a few moments. For some years Herschel has observed the heavens every hour when the weather is clear, and this always in the open air, because he says that the telescope only performs well when it is at the same temperature as the air. He protects himself against the weather by putting on more clothing. He has an excellent constitution, and thinks about nothing else in the world but the celestial bodies."

But, occupied as Herschel was about "celestial bodies," he yet found time to think about earthly things, for we find him at forty-five, May 8, 1783, marrying Mary, the wealthy widow of John Pitt, Esq., a lady of much intelligence and amiability.

The sad feature of the new relationship was the misery it brought to Caroline. Her whole life had centred in William. For eleven years she had devoted every moment, every wish, every thought to him. She had watched all night among the stars with him, month after month, and year after year, in cold and in heat, and superintended his home by day. His every desire was her law. She loved no other, and he was her all. Perhaps she ought to have known that another might come into his life, but she trusted blindly, and did not question the future.

When the wife came into the home, Caroline went out of it forever. For more than twenty years she lived in lodgings, always "cheerless and solitary," her only happiness found in coming day by

day to help her brother in his great work. Sometimes, when the wife was absent, Caroline came back for a few days and lived over the old unalloyed life, and then went back to her lonely lodgings.

For ten years following this marriage, she probably told her heart-aches in her journal; but before her death she destroyed the record of these years, that the feelings of those who were alive might not be pained. In later days she became more reconciled to Lady Herschel, as "a dear sister, for as such I now know you," and idolized their only son, the renowned Sir John Herschel, born nine years after their marriage.

In 1785, Herschel began to construct his great forty-foot telescope, and the next year removed to Slough, not far from Windsor. "In the whole of the apparatus," he said, "none but common workmen were employed, for I made drawings of every part of it, by which it was easy to execute the work, as I constantly inspected and directed every person's labor; though sometimes there were not less than forty different workmen employed at the same time. While the stand of the telescope was preparing, I also began the construction of the great mirror, of which I inspected the casting, grinding, and polishing; and the work was in this manner carried on with no other interruption than that occasioned by the removal of all the apparatus and materials from where I then lived, to my present situation at Slough." He had his first view through

the telescope February 19, 1787. George III. gave four thousand pounds for the building of this instrument, and two hundred pounds yearly for its maintenance.

A half-century afterwards, the woodwork having become decayed, it was taken down, the great tube laid horizontally, and, after Sir John Herschel and his family had passed through it, a poem written by Sir John having been read, it was sealed January 1, 1840, and placed on piers.

With this great telescope, Herschel discovered two satellites of Saturn, Mimas and Enceladus; one on August 27, 1789, and the other on September 17 of the same year. Two years before this, January 11, 1787, he discovered two satellites of Uranus, Oberon and Titania. Sixty years afterwards, Mr. Lassell, of England, discovered the remaining two satellites of Uranus, called Ariel and Umbriel.

From this time his work went forward grandly. He had already completed more than two hundred seven-foot, one hundred and fifty ten-foot, and eighty twenty-foot mirrors. For many of the telescopes sent abroad he made no stands, but provided the drawings. He wrote much about Saturn and its rings, and showed that its most distant satellite, Japetus, turns once on its axis in each revolution about its primary, as our moon does about the earth.

He studied carefully the nature of the sun, its probable gaseous surface, and its spots, and was the first to suspect their periodic character. What

would Herschel have said to the wonderful photographic representations of these spots given by Professor Langley, in his New Astronomy; spots which are one billion square miles in size; more than five times the surface of the land and water on the earth? He saw, as astronomers to-day see, that heat cannot be produced without expenditure of force; and that the sun is probably cooling, even though scarcely perceptibly for ages to come. He saw what science now generally concedes, the rise and fall of the solar system; its gradual fitness for the coming of man, through almost countless centuries; and its final unfitness, when his generations shall have gone forever.

He wrote much about the Milky Way, believing at first that it could be completely resolved into stars, about eighteen millions of them; but later he changed his theory, having found so much nebulous matter — in a state of condensation as though new worlds were forming, possibly to be the homes of some new race, or of man in the ages to come.

His study of the variable stars attracted wide attention. He found that the star *Mira Ceti* was for several months invisible to the naked eye; then it grew brighter and brighter, and finally disappeared for months, as before. He saw that other stars are periodic, and came to the conclusion that this is occasioned by the rotation of the star upon its axis, by which different parts of its surface are presented to us periodically.

He made a catalogue of double stars, and found by laborious calculations that such stars have a common centre of gravity; that one sun revolves about another. He found that our solar system has a motion of its own; a grand orbit round some as yet unknown centre, and that other systems have a like motion.

What this centre may be, whether a great sun like Sirius, one hundred times larger than ours, with unknown powers and unknown uses, is of course only conjecture.

Herschel gave much attention to nebulæ, discovering and describing twenty-five hundred new nebulæ and clusters. He gave his life to the study of the construction of the heavens. Concerning his statement of the general construction, Professor Holden, himself a brilliant astronomer, says: "It is the groundwork upon which we have still to build. . . . As a scientific conception it is perhaps the grandest that has ever entered into the human mind. As a study of the height to which the efforts of one man may go, it is almost without a parallel. . . . As a practical astronomer he remains without an equal. In profound philosophy he has few superiors. By a kindly chance he can be claimed as the citizen of no one country. In very truth his is one of the few names which belong to the whole world."

The distinguished man, though unassuming and gentle in manner, must have had a realizing sense of the greatness of his work, for he said, "I have

looked further into space than ever human being did before me. I have observed stars of which the light takes *two millions* of years to travel to this globe."

He gave much study to light and heat. So boundless was his knowledge believed to be, that a farmer called one day to ask the proper time for cutting his grass.

"Look at that field," said the scientist, "and when I tell you it is mine, I think you will not need another proof to convince you that I am no more weatherwise than yourself or the rest of my neighbors."

He worked earnestly till he was seventy-six, always depending upon his faithful and inseparable Caroline for aid in his labors. He made a telescope for her, with which she swept the heavens for comets, finding eight, five of which she discovered for the first time.

At seventy-six his health began to fail. He had worked incessantly from his struggling boyhood, but brain work does not wear us out; care and anxiety bring the marks of age upon us. He now took little journeys away from Slough for change of scene and air, while Caroline stayed at home to copy his papers for the Royal Society, and to arrange his manuscripts. In 1816, he was made a knight of the Royal Hanoverian Guelphic Order, by the Prince Regent, and in 1821 was the first president of the Royal Astronomical Society, his son being its first foreign secretary.

In February, 1818, Caroline spent twelve precious days with her brother, "not in idleness," she says, "but in sorrow and sadness. He is not only unwell, but low in spirits." Later he went to Bath with Lady Herschel. "The last moments before he stepped into the carriage," says the loving Caroline, "were spent in walking with me through his library and workrooms, pointing with anxious looks to every shelf and drawer, desiring me to examine all and to make memorandums of them as well as I could. He was hardly able to support himself, and his spirits were so low, that I found difficulty in commanding my voice so far as to give him the assurance he should find on his return that my time had not been misspent.

"When I was left alone I found that I had no easy task to perform, for there were packets of writings to be examined which had not been looked at for the last forty years. But I did not pass a single day without working in the library as long as I could read a letter without candle-light, and taking with me papers to copy, etc., which employed me for the *best part of the night*, and thus I was enabled to give my brother a clear account of what had been done at his return."

On the 4th of July, 1819, Herschel sent a note to his dear co-worker. "Lina,—There is a great comet. I want you to assist me. Come to dine and spend the day here. If you can come soon after one o'clock we shall have time to prepare

maps and telescopes. I saw its situation last night, — it has a long tail."

Caroline wrote on this small slip of yellow paper: "I keep this as a relic! Every line *now* traced by the hand of my dear brother becomes a treasure to me."

Every day hereafter she spent the forenoon with Sir William. On the 15th of August she went as usual and found that he was confined to his room. "I flew there immediately," she says. "As soon as he saw me, I was sent to the library to fetch one of his last papers and a plate of the forty-foot telescope. But for the universe I could not have looked twice at what I had snatched from the shelf, and when he faintly asked if the breaking up of the Milky Way was in it, I said 'Yes!' and he looked content. I cannot help remembering this circumstance, it was the last time I was sent to the library on such an occasion. That the anxious care for his papers and workroom never ended but with his life was proved by his frequent whispered inquiries if they were locked and the key safe, of which I took care to assure him that they were, and the key in Lady Herschel's hands.

"After half an hour's vain attempt to support himself, my brother was obliged to consent to be put to bed, leaving no hope ever to see him rise again. For ten days and nights we remained in the most heart-rending situation till the 25th of August, when not one comfort was left to me but that of

retiring to the chamber of death, there to ruminate without interruption on my isolated situation. Of this last solace I was robbed on the 7th of September, when the dear remains were consigned to the grave."

Faithful and devoted watcher over his dead body, to the last! When he had been buried in the little church at Upton, Windsor, at the age of eighty-four, honored by all Europe and America, Caroline could live no longer where remembrance of him made it intolerable.

She went back to Hanover, "a person," she said, sadly, "that has nothing more to do in this world," to live with her brother Dietrich. She had come to England, a girl of twenty-two; she went back an elderly woman, seventy-two. The home in Germany did not prove a happy one, but how could it without William? She lived simply, not spending half of the one hundred pounds a year left her by her dead brother.

She had already published "A Catalogue of eight hundred and sixty Stars, observed by Flamsteed, but not included in the British Catalogue," and "A General Index of Reference to every Observation of every star in the above mentioned British Catalogue." She also prepared "The Reduction and Arrangement, in the form of a Catalogue in Zones, of all the Star Clusters and Nebulæ observed by Sir William Herschel in his Sweeps," "a work," said Sir David Brewster, "of immense labor; an extraordinary monument of the unextinguished

ardor of a lady of seventy-five in the cause of abstract science."

For this the Royal Astronomical Society voted her the gold medal, and gave her the unusual distinction of honorary membership.

Sixteen years after her return to Hanover, Sir John Herschel, her nephew, who had made his wonderful review of the southern heavens, discovering as many new nebulæ as his father, took his only boy, Willie, to see her.

She was now eighty-eight. The visit was overwhelming to her affectionate heart. She watched the child with the most intense delight. Fearing the results if she knew the time of their departure for England, Sir John, with mistaken kindness, went away at four o'clock in the morning, without saying good-by. But the anguish of separation was thereby rendered greater.

The years went by slowly. On her ninety-sixth birthday the King of Prussia sent her a gold medal, Alexander von Humboldt writing her a letter from Berlin to accompany it.

January 14, 1848, at the age of almost ninety-eight, Caroline Herschel died, and was buried from the same garrison church where nearly a century before she had been christened. In her coffin was placed, by her desire, a lock of her brother's hair. Beautiful affection! great co-workers in their immortal study of unnumbered worlds!

ALEXANDER VON HUMBOLDT.

THE great Agassiz, in his eloquent address, in Boston, on the hundreth anniversary of the birth of Humboldt, said: "All the fundamental facts of popular education in physical science, beyond the merest elementary instruction, we owe to him. We are reaping daily in every school throughout the broad land, where education is the heritage of the poorest child, the intellectual harvest sown by him.

"There is not a text-book of geography, or a school atlas in the hands of our children to-day, which does not bear, however blurred and defaced, the impress of his great mind. But for him our geographies would be mere enumerations of localities and statistics. He first suggested the graphic methods of representing natural phenomena which are now universally adopted. The first geological sections, the first sections across an entire continent, the first averages of climate illustrated by lines, were his. Every school-boy is familiar with his methods now, but he does not know that Humboldt is his teacher. . . . "

Naturally we ask how such a man rose to fame,

and what incited him to stand among the few intellectual leaders of the world.

Frederick William Henry *Alexander* von Humboldt was born September 14, 1769, in Berlin, the same year as Baron Cuvier. Unlike Cuvier, he came into a home of wealth and culture. His father was a Prussian officer and chamberlain to the king. His mother, the widow of Baron von Hollwede, married Major von Humboldt when he was forty-six years old, bringing into the family much landed property. Three children were born to them, a daughter who died in infancy, and the famous brothers, William and Alexander, the former two years older than the latter.

The father, an exceedingly amiable and benevolent man, died when Alexander was but ten years old. The mother, left with her two sons, was wise enough to select superior tutors for them, deeming a good education their best preparation for a useful life.

Much of their time was spent at their summer home at Tegel, on the banks of the Havel, about eight miles from Berlin. In 1778 Goethe went there for a visit, and the two Humboldt lads, nine and eleven years of age, played and talked with the leading mind of Germany.

The children were not altogether happy there, as Alexander wrote a friend years afterward. "Vine-clad hills which here we call mountains, extensive plantations of foreign trees, the meadows surrounding the house, and lovely views of the lake with its

picturesque banks awaiting the beholder at every turn, render this place undoubtedly one of the most attractive residences in the neighborhood. If, in addition, you picture to yourself the high degree of luxury and taste that reigns in our home, you will indeed be surprised when I tell you that I never visit this place without a certain feeling of melancholy. . . . I passed most of that unhappy time (my youthful days) here at Tegel, among people who loved me, and showed me kindness, but with whom I had not the least sympathy, where I was subjected to a thousand restraints and much self-imposed solitude, and where I was often placed in circumstances that obliged me to maintain a close reserve, and to make continual self-sacrifices.

"Now that I am my own master, and living here without restraint, I am unable to yield myself to the charms of which nature is here so prodigal, because I am met at every turn by painful recollections of my childhood, which even the inanimate objects around me are continually awakening. Sad as such recollections are, however, they are interesting from the thought that it was just my residence here which exercised so powerful an influence in the formation of my character and the direction of my tastes to the study of nature."

Much which seems trying and unsatisfactory is, after all, our best discipline for life. The strongest and noblest characters are not developed in the perpetual sunshine of happiness. Rain and sun are alike necessary for growth.

Alexander early showed great fondness for natural history, collecting flowers, plants, butterflies, shells, and stones, so that he was called the "Little Apothecary." He likewise found great delight in drawing. He says of himself: "Until I reached the age of sixteen, I showed little inclination for scientific pursuits. I was of a restless disposition, and wished to be a soldier. This choice was displeasing to my family, who were desirous that I should devote myself to the study of finance, so that I had no opportunity of attending a course of botany or chemistry; I am self-taught in almost all the sciences with which I am now so occupied, and I acquired them comparatively late in life. Of the science of botany I never so much as heard till I formed the acquaintance in 1788 of Herr Willdenow, a youth of my own age, who had just been publishing a Flora of Berlin. His gentle and amiable character stimulated the interest I felt in his pursuits. I never received any lessons professedly, but I used to bring him the specimens I collected, and he gave me their classifications. I became passionately devoted to botany, and took especial interest in the study of cryptogamia. The sight of exotic plants, even when only as dried specimens in an herbarium, fired my imagination with the pleasure that would be derived from the view of a tropical vegetation in southern lands."

At sixteen, then, the boy did not know for what he was best fitted in life. How important for young men and women to study themselves, and

know their own tastes and capacities! At nineteen he had never heard of botany, and yet he became one of the most distinguished of botanists!

The boy also longed to go to sea, not an unusual desire in restless and ambitious natures. But he was frail in body, and gave little evidence that he would ever be able to accomplish any of the things for which he longed.

At nineteen he was ready for college, and with his brother entered at Frankfort-on-the-Oder. He gave his time largely to finance and political economy, by his mother's desire, that he might be able to act in some capacity under the government.

At college, as ever after in life, he had one devoted friend, who became his inseparable companion. At Frankfort, it was Wegener, a young theologian, with a warm heart, and great zeal for knowledge. Nor did this friendship cease when he went to Göttingen some months later, for better opportunities in the study of science. He wrote to Wegener: "If God only spare us, nothing can break the bond between two friends who are to each other more than brothers. . . . My fervent love and sincere friendship for you are as imperishable as the soul which gives them birth. . . . How happy, how inexpressibly happy should I be, if I had a friend like you by my side! . . . I doubt not that among eight hundred men there must be some with whom I could form a friendship, but how long is it often before we find each other out! Were not you and I acquainted for three months before we dis-

covered how completely we were made one for the other? To be without a friend, what an existence! And where can I hope to find a friend whom I could place by your side in my affections!"

These words seem like those of a lover, or an affectionate woman, but they come from a mind that now, as in after years, towered like a giant oak in the trees of a forest. Beautiful union of brain and heart! Such only makes an ideal character.

Humboldt had already met Willdenow, and begun to love botany. Again he writes to Wegener: "I have just come in from a solitary walk in the Thiergarten,"—he was for a short time in Berlin,—"where I have been seeking for mosses, lichens, and fungi, which are just now in perfection. How sad to wander about alone! And yet there is something attractive in this solitude, when occupied with nature. . . . I am collecting materials for a work on the various properties of plants, medicinal properties excepted; it is a work requiring such great research, and such a profound knowledge of botany, as to be far beyond my unassisted powers, and I am therefore endeavoring to enlist the coöperation of several of my friends. . . . Pray do not imagine that I am going to appear as an author forthwith; I do not intend that shall happen for the next ten years, and by that time I trust I shall have discovered something startlingly new and important."

Göttingen was now at the height of its glory. Humboldt attended courses of lectures on archæ-

ology, on trade and commerce, on light, heat, and electricity, on agriculture, and on ancient tragic poets, under Heyne, of whom he said, "Heyne is undoubtedly the man to whom this century is the most deeply indebted; to him we owe the spread of religious enlightenment, by means of the education and training he has instituted for young village school-masters; to him is due the introduction of a more liberal tone of thought, the establishment of a literary archæology, and the first association of the principles of æsthetics with the study of philology."

Humboldt was also fond of Greek. He said, "The more I know of the Greek language, the more am I confirmed in my preconceived opinion, that it is the true foundation for all the higher branches of learning."

With some friends, he soon founded the Philosophical Society, which, with the admirable libraries and museums at hand, became of great assistance to the students.

The next year, 1790, he had become so interested in science, that he wrote Wegener: "I was away from Göttingen for two months, spending the vacation in making a scientific tour with a Herr van Genns, a Dutchman with whom I became acquainted through his writings on botanical subjects. . . . Amid the numberless distractions of the journey, which was made sometimes on foot and sometimes by carriage, and with the incessant occupation of packing up minerals and plants,

I was not very well able to write to you." The result of this tour was a pamphlet, "Mineralogical Observations on some Basalts of the Rhine." His next works were two small treatises, "The Aqueous Origin of Basalt," and "The Metallic Seams in the Basalt at Unkel." And this youth of twenty-one was self-taught both in mineralogy and geology!

The wonder was not so great, perhaps, that a young man of his age should have written these sketches, as that, being wealthy and of the best social position, the temptations to ease and enjoyment did not draw him away from such subjects. Poverty may not be a delight, but the larger part of the world's work has been done under its stimulus. Wealth should be an incentive, because it gives leisure for careful study, but this is not always the case.

At Göttingen, Humboldt found a friend among the eight hundred. At the house of Heyne he made the acquaintance of George Foster, Heyne's son-in-law, a man who exerted a remarkable and lasting influence over him. Foster was thirty-six; Humboldt, fifteen years his junior. He had been around the world with Captain Cook in his second voyage, and had published an able book upon the subject. He was skilled in chemistry, philosophy, literature, and politics, understood Latin, Greek, French, English, Dutch, and Italian, and was somewhat conversant with the Swedish, Spanish, Portuguese, Russian, and Polish languages.

The influence of such a man can well be imagined. He became a guiding star to the young Göttingen student. If we could but estimate the value of right friendships in life! We flatter ourselves that we are too strong to be influenced, and yet we are greatly influenced for good or for evil by those with whom we associate. Humboldt always chose intellectual friends, and the natural result followed.

In the spring of 1790, he left Göttingen, and, with Foster and Van Genns, took a journey to the Lower Rhine, Holland, Belgium, England, and France, studying docks, mines, botanic gardens, manufactures, and churches, and visiting literary celebrities. Still the new friends did not take the place of the old, for he writes to Wegener: "I beseech you, dearest Wegener, by all the affection which you know I bear you, never to forget our brotherly love and friendship. You are infinitely more to me than I can ever be to you. I have now seen the most celebrated places in Germany, Holland, and England — but, believe me, I have in seeing them never been so happy as while sitting in Steinbart's arm-chair."

The influence of this journey was never lost. Sixty-eight years afterward, Humboldt said: "For the space of thirty years I have never known leisure but of an evening, and the half-century that I have spent in this ceaseless activity has been occupied in telling myself and others how much I owe my teacher and friend George Foster in the gener-

alization of my views on nature, and in the strengthening and development of that which had already dawned in me, before those happy days of intimate friendship."

In the latter part of 1790, Humboldt went to Hamburg, to enter the School of Commerce. He wished to study political economy further, and to learn practical book-keeping. He wrote to a friend: "I am contented with my mode of life at Hamburg, but not happy, less happy even than at Göttingen, where the monotony of my existence was relieved by the society of one or two friends and the vicinity of some moss-grown mountains. I am, however, always contented when I feel that I am accomplishing the purpose I have in view. . . . My leisure hours are occupied with geology and botany. . . . In addition, I have begun to learn Danish and Swedish."

To Wegener he writes: "I have made considerable progress in general information, and I am beginning to be somewhat more satisfied with my attainments. I worked very hard at Göttingen, but all I have learned makes me feel only the more keenly how much remains still to know. My health suffered severely, but improved somewhat during my journey with Foster; yet even here I continue so closely occupied that I find it difficult to spare myself. There is an eager impulse within me, which often carries me, I fear, beyond the bounds of reason; and yet such impetuosity is always necessary to insure success."

The "eager impulse" was a sure indication of something to be accomplished by and by. Success does not come with half-hearted effort; it comes only through a force and persistence that will allow no barriers between us and the goal.

At Easter, 1791, Humboldt left Hamburg and hastened to the famous School of Mines at Freiberg, to study under the celebrated Werner. Here, as ever, he attached one ardent friend to himself, Freiesleben, a student in geology. Here every moment was occupied. He studied the works of the French chemists; Guyton de Moreau, Fourcroy, Lavoisier, and Berthollet. He was daily in the mines, from six o'clock till twelve. He crowded six lectures into each afternoon. He made a study of the vegetation of that lower world, from which the sunlight is ever excluded, and the results were used later in his comprehensive work, "Flora Subterranea Fribergensis." He wrote articles for several scientific journals. A busy life, indeed, for the young man of twenty-two!

His friend Freiesleben says of Humboldt at this time: —

"The salient points of his attractive character lay in his imperturbable good-nature, his benevolence and charity, his remarkable and *unselfish amiability*, his susceptibility of friendship and appreciation of nature; simplicity, candor, and the absence of all pretension characterized his whole being; he possessed conversational powers

that made him always lively and entertaining, together with a degree of wit and humor that led him sometimes to waggishness. It was these admirable qualities which in later years enabled him to soften and attach to himself the untutored savages, among whom he dwelt for months at a time, which obtained for him in the civilized world admiration and sympathy wherever he went, and which gained for him, while a mere student, the esteem and devotion of all classes at Freiberg.

"He was kindly disposed towards every one, and knew how to make himself useful and entertaining in every circle of society; and it was only against every species of inhumanity and coarseness, against every kind of insolence, injustice, or cruelty, that he ever manifested either scorn or indignation."

How the world loves "unselfish amiability;" a person who goes through life thinking for others, not irritable, not supersensitive, not censorious!

On Humboldt's return to Berlin in 1792, he was at once made "Assessor in the Administrative Department of Mines and Smelting Works," a position for which he had previously applied. As a rule, places do not seek persons, however brilliant; they must seek places.

This was a fine opening for a young man, not yet twenty-three. He went to work with unbounded energy. He investigated the general form of mountains, collected information as to former methods of working the mines, by having three chests of mining documents, belonging to the six-

teenth century, brought to him for careful study, and made a report on the salt, alum, and vitriol works, and on the porcelain manufactory. The government authorities were so pleased with his thorough report that he was appointed superintendent of mines in the two Franconian duchies.

He wrote to Freiesleben: "I am quite intoxicated with joy. . . . Do not feel anxious about my health; I shall take care not to over-exert myself, and after the first the work will not be heavy. I cannot conclude without acknowledging that it is again to you that I am indebted for this happiness; indeed I feel it only too keenly. What knowledge have I, dear Freiesleben, that has not been taught me by you! . . . How sweet is the thought to me that it is to you that I owe all this; it seems as if it bound me closer to you, as if I carried something about me that had been planted within me and cultivated by yourself. . . ."

Thus all through life was the appreciative, warm-hearted man glad to show his gratitude for the stimulus of intellectual friends.

Who does not love to be appreciated! How many of us wait to say kind things to our friends until death makes it impossible!

Again he wrote: "I possess a certain amount of vanity, and am willing to confess it; but I know the power of my own will, and I feel that whatever I set myself to do I shall do well."

While so earnestly engaged in study, Humboldt, with his benevolent heart, could not see the chil-

dren of the miners grow up in ignorance. He therefore opened free schools for them, and paid the teachers from his own purse. Not many young men at twenty-four would have thought of so admirable a plan.

Meantime he was experiencing the first keen joy of fame. The Elector of Saxony had sent the author of "Flora Fribergensis" a gold medal. The Swedish botanist Vahl had named a magnificent species of an East Indian laurel after him, the *laurifolia Humboldtia.* It had paid to be a student; to be led by the "eager impulse" within him.

The next year he wrote to Freiesleben: —

"You are aware that I am quite mad enough to be engaged upon three books at once. . . . I have discovered several new lichens. I have also been occupied upon the history of the weaving of the ancients. . . . My head is quite distracted with all I have to attend to — mining, banking, manufacturing, and organizing; . . . the mines, however, are prospering. . . . I am promoted to be counsellor of mines at Berlin, with a salary, probably, of fifteen hundred thalers (here I have four hundred), and, after remaining there a few months, I shall most likely be appointed director of mines, either in Westphalia or Rothenburg, and receive from two thousand to three thousand thalers. I tell you everything, and open my heart to you."

In 1795, having resigned his position in the service of the state, because of his desire for travel

and scientific work, with two friends, Freiesleben, and Lieutenant Reinhard von Haften, of Westphalia, he journeyed to Venice, going through the Tyrol and the Alps into Switzerland. They visited the mountains around Schaffhausen, Zürich, and Berne, and such notable men of science as De Luc, Pictet, and Saussure. As Freiesleben said, "No subject having any reference to the physical constitution of the earth, the atmosphere, or any point of natural history, was allowed to escape his attention."

An especial bond united Humboldt and the highly educated Von Haften, since between the latter's sister Minette and the young scientist there existed a devoted affection. This was cherished for ten years, but Humboldt's life of travel and exposure prevented a union which both ardently desired. He sacrificed his affections to science, and the loneliness of his later years proved the unwisdom of his choice.

On his return home, Humboldt set himself earnestly to the writing of two books: one on geology, the disposition of strata in mountain masses; the other on the "Excitability of the Nerves and Muscles," describing over four thousand experiments. His devotion to science was shown by the painful experiments upon his own body, which brought permanent harm to his nervous system.

He wrote to a friend: "I applied two blisters to my back, each of the size of a crown-piece, and covering respectively the trapezius and deltoid

muscles. . . . When the blisters were cut, and contact made with zinc and silver, I experienced a sharp pain, which was so severe that the trapezius muscle swelled considerably, and the quivering was communicated upwards to the base of the skull and the spinous processes of the vertebræ."

He also experimented with the noxious gases in mines, inventing lamps which were the forerunner of Sir Humphrey Davy's. Sometimes he was deprived of consciousness by the gases and saved only by the timely aid of friends.

Always longing for foreign travel, he went to Weimar, to make himself more fully ready for it, especially by the study of anatomy. Here lived his brother William, who had married a brilliant and intellectual woman, the intimate friend of the wife of Schiller.

Here Humboldt and Goethe became earnest friends. Goethe says: "During Humboldt's visit, my time has been usefully and agreeably spent; his presence has had the effect of arousing from its winter sleep my taste for natural science." Years afterward Goethe said to Eckermann: "Alexander von Humboldt has been with me for some hours this morning; what an extraordinary man he is! Though I have known him for so long, I am always struck with fresh amazement in his company. He may be said to be without a rival in extent of information and acquaintance with existing sciences. He possesses, too, a versatility of genius which I have never seen equalled. Whatever may

be the subject broached, he seems quite at home in it, and showers upon us treasures in profusion from his stores of knowledge. He resembles a living fountain, whence flow many streams, yielding to all comers a quickening and refreshing draught. He will remain here a few days, and I already feel that I shall have lived through years in the time."

That Humboldt valued this friendship is shown by the dedication to Goethe of the first part of his "Travels in America."

The project of foreign travel was long delayed by sickness, war, and various disappointments. But, in life, obstacles are the common lot of mortals, and he alone is wise who breasts them cheerfully, patiently, and persistently. Humboldt said, "It is impossible not to feel the severity of this disappointment; but it is the part of a man to work, and not to yield to unavailing regrets."

> "Hard! well, and what of that?
> Didst fancy life one summer holiday,
> With lessons none to learn, and naught but play?
> Go, get thee to thy task. Conquer or die!
> It must be learned. Learn it then, patiently."

At last, in 1799, when Humboldt was thirty, the long contemplated journey to South America was about to be realized. He had already published some astronomical treatises on the determination of latitudes, trigonometrical measures of the Alpine ranges, etc.; had given lectures in Paris, before

the National Institute, on the nature of nitrous gas, and the possibility of a more exact analysis of the atmosphere; and had spent some time in Spain, with the well known botanist Bonpland, in collecting plants, and making observations in connection with meteorology, geology, and magnetism. While at Madrid, through Herr von Forell, a distinguished patron of science, Humboldt was received at court and obtained permission of the king to visit the Spanish colonies in America.

At his own expense, the best scientific instruments were procured, and June 5, 1799, at two o'clock in the afternoon, he and Bonpland, with their crew and a few others, sailed away, in the corvette Pizarro, for a five years' journey. He sent tender farewell messages back to "his family," as he called William's children, and then stifled any feelings of loneliness or homesickness which he had in his heart, by his favorite motto, "Man must ever strive after all that is good and great."

June 20, they were at the foot of the Peak of Teneriffe. He wrote to his brother: "I am quite in a state of ecstasy at finding myself at length on African soil, surrounded by cocoa-nut palms and bananas. . . . I returned last night from an excursion up the peak. What an amazing scene! What a gratification! We descended some way into the crater, perhaps farther than any previous scientific traveller. . . . What a remarkable spectacle was presented to us at this height of eleven thousand five hundred feet. . . . At two in the morning we were

already on our way towards the last cone. The heavens were bright with stars, and the moon shone with a gentle radiance; but this calm was soon to be disturbed. The storm raged violently round the summit; we were obliged to cling fast to the edge of the crater. The wind rushed through the rifts with a noise like thunder, while a veil of cloud separated us from the world below."

After a voyage of nineteen days, the ship entered the harbor of Cumana, on the north coast of South America. Here they enjoyed the new and strange scenes; the houses built of satin-wood; the copper-colored Indians outside the town, living in bamboo huts, covered with the leaves of the cocoa-nut palm; these great trees from fifty to sixty feet high, with large red bunches of flowers. "Even the crabs," said Humboldt, "are sky-blue and gold!"

By November they had dried more than sixteen hundred plants, and described about six hundred new varieties. He had taken observations of the solar eclipse of October 28, and so severely burnt his face that he was obliged to remain in bed for two days.

Going to Caracas, they spent two months and a half climbing mountains, visiting hot springs, and forming an intimate acquaintance with tigers, crocodiles, monkeys, and boa constrictors. Here they discovered the singular cow-tree, with dry and tough leaves, but which gives out a sweet nourishing milk when an incision is made in its stem. "At sunrise this vegetable spring is the richest: then the

negroes and the natives come from all sides, provided with large vessels to collect the milk, which turns yellow and thickens on the surface."

In February, 1800, the travellers traced the water system of the Orinoco, often in the midst of danger. Once, in a severe storm, their boat was two-thirds full of water. "Our position," says Humboldt, "was truly appalling; the shore was distant from us more than a mile, where a number of crocodiles could be discerned lying half out of the water. Even if we had gained the shore against the fury of the waves and the voracity of the crocodiles, we should infallibly have either perished from hunger or been torn in pieces by the tigers, for the woods upon these shores are so dense and so intertwined with lianas as to be absolutely impenetrable. The strongest man, axe in hand, could hardly make his way in twenty days for the distance of a league. The river too is so little frequented that even an Indian canoe scarcely passes oftener than once in two months. At this most momentous and perilous crisis a gust of wind filled the sails of our little vessel and effected in a marvellous manner our deliverance."

To his botanist friend, Willdenow, he writes: — "During four months of this journey we passed the night in forests, surrounded by crocodiles, boa constrictors, and tigers, which are here bold enough to attack a canoe, while for food we had nothing better than rice, ants, bananas, and occasionally the flesh of monkeys, with only the waters of the

Orinoco wherewith to quench our thirst. Thus have we with difficulty toiled, our hands and faces swollen with mosquito bites, from Mondvaca to the volcano of Duida, from the limits of Quito to the frontier of Surinam — through tracts of country extending over twenty thousand square miles, in which no Indian is to be met with, and where the traveller encounters only apes or serpents.

"In Guiana the mosquitoes abound in such clouds as to darken the air, and, as it is absolutely necessary to keep head and hands constantly covered, no writing can be done by daylight; the intolerable pain produced by the attacks of these insects renders it impossible to hold the pen steadily. All our work had therefore to be carried on by the light of a fire, in an Indian hut, where no ray of sunlight could penetrate, and into which we had to creep on our hands and knees. Here, if we escaped the torment of the mosquitoes, we were almost choked by the smoke. At Maypures, we and the Indians took refuge in the midst of the cascade, where the spray from the foaming stream kept off the insects. At Higuerote, the people are accustomed at night to lie buried three or four inches deep in sand, with only the head exposed."

Sometimes twenty-four Indians were in Humboldt's employ for months together, and fourteen mules were required to carry his instruments and plants.

After a year and a half spent in South America, Humboldt sailed for Cuba, where he remained for

several months, collecting material for his "Political Essay on the Island of Cuba." From there he went to Quito, in Ecuador, crossing one of the most difficult passes in the Andes, "the path so narrow that it rarely exceeds twelve or sixteen inches in width, and for the most part resembles an open gallery cut in the rock," and the Paramos of Pasto, "desert regions where, at a height of about twelve thousand feet above the sea, all vegetation ceases, and the cold is so intense as to penetrate to the very bones."

In June, 1802, they reached Quito, where, five years previously, an earthquake had destroyed forty thousand people. This month they made the ascent of Chimborazo, at that time regarded as the highest mountain in the world. "At certain places," he says, "where it was very steep, we were obliged to use both hands and feet, and the edges of the rock were so sharp that we were painfully cut, especially on our hands." As they climbed on, "one after another, we all began to feel indisposed, and experienced a feeling of nausea accompanied by giddiness, which was far more distressing than the difficulty of breathing. . . . Blood exuded from the lips and gums, and the eyes became bloodshot. . . . A few rock-lichens were to be observed above the line of perpetual snow, at a height of sixteen thousand nine hundred and twenty feet; the last green moss we noticed was growing about twenty-six hundred feet lower. A butterfly was captured by M. Bonpland, at a

height of fifteen thousand feet, and a fly was observed sixteen hundred feet higher. . . . When we were at a height of about seventeen thousand four hundred feet we encountered a violent hailstorm." The height of the mountain is over twenty-one thousand feet.

The intrepid Humboldt four times crossed the Andes; he travelled over Peru; he called attention to the fertilizing properties of guano, and then he sailed for Mexico, where he remained for a year. Here he met a lady greatly esteemed in that country, called the "fair Rodriguez," the most beautiful woman he had seen in his journeys, but whom he admired more "for her graces of mind than her beauty of person." He regarded her as an American Madame de Staël. It is asserted that the grave man of science was deeply interested, but it was too late — she was already the wife of another, and had two children. Humboldt, like most other great men, all his life enjoyed the society of intellectual women, who were a constant inspiration.

After two months passed at Havana, Humboldt came to the United States, spending three weeks with President Jefferson, at his home at Monticello. He never failed to speak in grateful terms of the courtesy he received from Americans. He studied carefully their institutions, and greatly admired the republic; slavery alone saddened him.

On July 9, 1804, after five years of absence, he set sail for France. Europe received him with

universal joy. He had been reported dead. He was thirty-five, handsome, and famous. He had travelled over forty thousand miles, and brought back over sixty thousand specimens of plants. He was made a member of the Royal Academy of Sciences in Berlin, and later a member of the Legion of Honor, and of about one hundred and fifty other societies; indeed, of all the great associations of the land.

And now the result of his travels must be given to the world in books. While he was preparing them, he yet found time to spend months together in the École Polytechnique, experimenting in chemistry with his devoted friend Gay-Lussac; with Biot, he made investigations in magnetism; with Arago, in astronomy; with Cuvier, in anatomy.

Most of the time from 1808 to 1827, nineteen years, he remained in Paris, devoting his time to his great work. In the forenoons he usually studied and experimented; from twelve to seven he wrote, and then, if his evenings were spent socially, he wrote again from midnight till half-past two, usually allowing himself only four hours for sleep. So popular was he that he often went to five receptions in an evening.

Year after year his works on America appeared, till twenty-nine volumes were published! The first part was entitled, "Voyage in the Equatorial Regions of the New Continent." This described a portion of his journey in three volumes; views of the Cordil-

leras and the native peoples of America, one volume with sixty plates; an atlas of the new continent, with thirty-nine maps; a critical examination of the history of the geography of the middle ages, in five volumes. The second part related largely to zoölogy and comparative anatomy in the new regions; the third part related chiefly to Mexico; the fourth part to astronomical observations, measurement with the barometer, etc.; the fifth part, geology, and the geography of plants; the sixth part, plants in Mexico, Cuba, and South America, in two volumes, with nearly one hundred and fifty engravings; two volumes more, with one hundred and twenty colored plates; seven volumes of new species, with seven hundred engravings, and several other books. The expense of bringing out these works was enormous; the copper-plate illustrations cost in printing and paper alone about thirty-four thousand pounds.

As the price of the volumes was about five hundred and fifty pounds, the number of purchasers was comparatively limited. Humboldt had used all his fortune in his journeys and in publishing his books, and was now a poor man, dependent upon a pension from his king. But he was the pride of his nation, and beloved in France as well.

Humboldt and Guizot were like brothers, and for forty years corresponded affectionately with each other. Arago he held "dearest in this life." His last letter to Arago, "small in size but so full

of matter," was the greatest comfort to the dying astronomer.

During all these busy twenty years he had honors heaped upon him. He was offered the position of Ambassador to Vienna, but declined. He accompanied the King of Prussia to England in 1814, and was with him at the peace of Aix-la-Chapelle and at the Congress of Verona.

Busy as he was, he seemed to find time to befriend everybody, especially young men. Liebig says in the preface of his work dedicated to Humboldt: "During my residence in Paris, I gave a course of lectures at the Academy in the winter of 1823–4, upon an analytic investigation of Howard's fulminating mercury and silver — my first effort in the field of science.

"At the close of the sitting of March 22, 1824, while busy packing up my apparatus, a gentleman came up to me from among a group of academicians, and entered into conversation. In the most winning manner, he made inquiry as to the objects of my study, my present occupations, and the plans I had laid for the future. We separated without my knowing to whom I was indebted for this kind expression of interest, for my shyness and inexperience had not allowed me to make the inquiry.

"This conversation laid the foundation of my future career, for I thus acquired a kind friend and a powerful patron in my scientific undertakings. . . .

"From that time all doors were thrown open to me, I had access to every institution and every laboratory: the great interest you took in me procured the love and intimate friendship of my instructors, Gay-Lussac, Dulong, and Thénard, to all of whom I became deeply attached. The confidence which you accorded me was the means of my introduction into a sphere of labor which during the last sixteen years it has ever been my ambition worthily to occupy."

When Agassiz was a poor medical student in Paris, Humboldt visited him. Agassiz says: —

"After a cordial greeting, he walked straight to what was then my library — a small book-shelf containing a few classics, the meanest editions, bought for a trifle, along the quays, some works on philosophy and history, chemistry and physics, his own 'Aspects of Nature,' 'Aristotle's Zoölogy,' 'Linnæus' Systèma Naturæ,' in several editions, 'Cuvier's Règne Animal,' and quite a number of manuscript quartos, copies which, with the assistance of my brother, I had made of works I was too poor to buy, though they cost but a few francs a volume. . . .

"It was no doubt apparent to him that I was not over-familiar with the good things of this world, for I shortly afterward received an invitation to meet him at six o'clock in the Galerie Vitrée of the Palais Royal, whence he led me into one of those restaurants the tempting windows of which I had occasionally passed by. When we were seated, he

half laughingly, half inquiringly, asked me whether I would order the dinner. I declined the invitation, saying that we should fare better if he would take the trouble. And for three hours, which passed like a dream, I had him all to myself. How he examined me, and how much I learned in that short time! How to work, what to do, and what to avoid; how to live; how to distribute my time; what methods of study to pursue; these were the things of which he talked to me on that delightful evening."

Noble Humboldt! so great that everybody honored and looked up to him; so kindly interested in others that everybody loved him!

In 1827, at the request of his king, Humboldt returned to Berlin, and became chamberlain, with a yearly salary of five thousand thalers. He gave this year, before the university, a course of free, public lectures upon physical geography, sixty-nine in all, which afterwards formed the basis of his grandest work, "Cosmos." The first four lectures were a general description of nature; then astronomy, the principal outlines of geology and meteorology, the distribution of plants and animals, the history of the study of our globe, volcanoes, the ocean, the atmosphere, and the human race.

The lectures were crowded and the applause unexampled. A second course, of sixteen lectures, was given to the public in the music hall, the royal family coming with the thousands who gathered each evening.

A grand way to educate the people! Would that at the expense of some philanthropist such a course might be given in every city.

In 1829, at the request of Emperor Nicholas, Humboldt made a scientific expedition to eastern Russia, travelling over nine thousand miles in twenty-five weeks. He was now in his sixtieth year, but he climbed high mountains with no apparent fatigue.

The emperor was delighted with the results of the expedition, which were published in several volumes. He said, "Your sojourn in Russia has been the cause of immense progress to my country; you spread a life-giving influence wherever you go." He presented Humboldt with a sable cloak worth five thousand rubles, and a malachite vase seven feet high, worth nearly forty thousand rubles.

The death of friends saddened this busy year, 1829. William's wife had died, and left him utterly desolate. In his ministry to several countries, she had honored and graced his diplomatic positions. He did not long survive her. "Wholly given up to grief," said Alexander, "he seeks in the depth of his misery the only consolation that can render life supportable, while he occupies himself with intellectual pursuits as with the drudgery of a task."

He died four years later, tenderly watched over by his illustrious brother, to whom he said in dying, "Think of me often, but always with cheer-

fulness. I have been very happy, and even to-day has been a glorious day with me, for there is nothing more beautiful than love. I shall soon be with *the mother*, and enter upon a higher order of being."

This death was a great blow to Alexander. He said, "I am quite bereft of hope. I did not think that my old eyes could have shed so many tears. . . . I am the unhappiest of men. . . . I have lost half of myself." A few months later William's eldest daughter, Caroline, died, to whom Alexander was tenderly attached. From henceforth his life was devoted to his sovereign Frederick William IV., to "Cosmos," and to his ever widening circle of friends. Two thousand letters or more came to him yearly, and till late in life he answered each one, and answered it promptly, showing thereby how truly well bred he was in manner, and how truly kind in heart.

In 1834, when he was sixty-five, he began the publication of "Cosmos," in five volumes, the "most comprehensive compendium of modern science." It was soon translated into English, meeting with a cordial reception in that country, and into French, Dutch, and Italian.

Even at the age of sixty-five, so eager was he to know more that he attended courses of lectures on Grecian antiquities and literature, and upon chemistry, taking notes among the young university students. He now lived with the king, at Sans-Souci, spending every evening with him, and becoming the confidential friend of both king and

queen. When Humboldt was ill, the king would read to him by the hour.

Frederick William IV. conferred on him the decoration of the Star of the Red Eagle, the Order of the Black Eagle, the highest honor in the royal power to confer, and the Order of Merit, given to those "who throughout Europe have won for themselves a name either in the arts or sciences."

Till the last years of his life Humboldt showed the same marvellous energy and industry. At eighty he said, "I am more than ever filled with a zest for work and literary distinction." When he wrote to friends for information in finishing "Cosmos," he asked for speedy answers, saying, "The dead ride fast." On the fortieth anniversary of his return to Europe, a fête was given in his honor, by the Berlin Academy. Later his bust was placed in the French Institute. The freedom of the city of Berlin was presented to him. America sent him in 1858, on his eighty-ninth birthday, an album of nine maps, showing the scores of towns, counties, rivers, bays, and mountains which had received his name. Letters came from all parts of the world, breathing love and admiration. Yet, with all this honor, he was often lonely, and spoke of the *ennui* of life. After the regency, Humboldt lived at Berlin, in an unostentatious home, with his attendant, Seifert.

On May 6, 1859, at half-past two in the afternoon, death came to Alexander von Humboldt, at the age of ninety. His mind was clear to the last.

All ranks gathered at the public funeral, for all, from king to peasant, had lost a friend. With uncovered head, the Prince Regent received the procession at the door of the cathedral, amid the tolling of the bells, and then they buried him at the summer home of his childhood, Tegel, by the side of William.

A new edition of his select works, including "Cosmos," was published in Stuttgart, in 1874, in thirty-six volumes.

Great in learning, great in achievement, great in will-power; unwise sometimes in utterance, as in the Varnhagen letters — how seldom is it safe or wise to express our inmost thoughts; — sarcastic sometimes in his language — a dangerous power, to be used sparingly, if indeed ever, — and yet withal a noble, unselfish, marvellous-minded man, who, as Agassiz says, "exerted upon science a personal influence which is incalculable."

SIR HUMPHREY DAVY.

COLERIDGE said, "Had not Davy been the first chemist, he probably would have been the first poet of his age."

Said Professor Silliman's "American Journal of Science and Arts:" "His reputation is too intimately associated with the eternal laws of nature to suffer decay; and the name of Davy, like those of Archimedes, Galileo, and Newton, which grow greener by time, will descend to the latest posterity."

Davy was poor and self-taught, but he triumphed over obstacles, and died universally lamented.

The eldest son in a family of five children, Humphrey Davy was born at Penzance, Cornwall, England, December 17, 1778, the year in which Carl Linnæus died. He was a bright, active child, making rhymes when he was five years old, and reciting them at the Christmas gatherings. In consequence of his retentive memory, he could repeat a great part of "Pilgrim's Progress" before he could read it. This book and "Æsop's Fables" were his favorites.

When Humphrey was six, he was sent to a grammar school kept by Rev. Mr. Coryton, a man who

had the vicious habit of punishing by pulling the pupils' ears. On one occasion, Humphrey came to school with a large plaster on each ear. Upon being asked what was the matter, he said, with a grave face, that he had "put the plasters on to prevent a mortification!"

As he grew older, he composed Latin and English verses easily, and was in great demand among the boys as a writer of valentines and love-letters. Though shy in manner, with his vivid imagination and flow of language, he told stories remarkably well, and might have been seen, often, in a cart at the Star Inn, addressing a most attentive audience.

Says his brother, Dr. John Davy, "Humphrey, when a boy, was fond of declaiming, and indulged in it in his solitary walks and rambles. On one occasion it is recorded of him, that, on his way to visit a poor patient in the country (during his apprenticeship), in the fever of declamation, he threw out of his hand a vial of medicine which he had to administer, and that when he arrived at the bedside of the poor woman he was surprised at the loss of it. The potion was found the next day in a hay-field adjoining the path."

When Humphrey was fourteen he attended the Truro Grammar School for a year, where he was greatly liked for his good-humor, affectionate disposition, and originality. Says Mr. Nicholls, a school friend, "I can never forget that as boys we knew and loved each other. I recollect a visit he paid in company with his aunt at my father's,

who then resided at Lanarth. He was a great favorite; but there was even then an original mode of thinking and acting observable in him, — one instance of which I well remember; — it was on rather a hot day, when my father, mother, your aunt, Humphrey, and myself, were to walk to a place a mile or two distant, I forget for what purpose. Whilst others complained of the heat, and whilst I unbuttoned my waistcoat, Humphrey appeared with his great-coat close-buttoned up to his chin, for the purpose, as he declared, of keeping *out* the heat. This was laughed at at the time, but it struck me then, as it appears to me now, as evincing originality of thought and an indisposition to be led by the example of others."

At fifteen his school education was considered complete. The next year he studied French, gave a good deal of time to fishing, of which he was always fond, and apparently had little definite purpose. About this time his father died, and the straitened circumstances of the family now seemed to awaken all the energy and nobility of his nature. Seeing his mother in deep affliction, he begged her not to grieve, saying that "*he would do all he could for his brothers and sisters.*" And he never forgot this promise.

The following year he was apprenticed to Mr. Bingham Borlase, practising surgeon and apothecary in Penzance. Young Davy now seemed destined to become a physician, but his note-books show that he intended to know other things besides

medicine. He laid out a plan for study: theology, logic, astronomy, mathematics, Latin, Greek, Italian, Spanish, and Hebrew.

He said later, "Almost all great deeds arise from a plenitude of hope or desire. No man ever had genius who did not aim to execute more than he was able." And all his life he planned to do twice as much as he was ever able to do. And yet he knew that he must bind himself to a *few* things, if he would succeed. He said, "In minds of great power, there is usually a disposition to variety of pursuits, and they often attempt all branches of letters and science, and even the imitative arts; but if they become truly eminent, it is by devotion to one object at a time, or at most two objects. This sort of general power is like a profusion of blossoms on a fruit tree, a symptom of health and strength; but if all are suffered to become fruit, all are feeble and bad; if the greater portion is destroyed by accident or art, the remainder, being properly nourished, become healthy, large, and good." In these early note-books, he began to show an unusual and mature mind. He wrote essays: "On the Immortality and the Immateriality of the Soul," "On Governments," "On Moral Obligation," and the like. Of Friendship, he wrote at seventeen: "It is a composition of the noblest passions of the mind; a just taste and love of virtue, good-sense, a thorough candor and benignity of heart, and a generous sympathy of sentiment and affections, are the essential ingredients of this

nobler passion. When it originates from love and esteem, is strengthened by habit, and mellowed by time, it yields infinite pleasure, ever new and ever growing. It is the best support amongst the numerous trials and vicissitudes of life, and gives a relish to most of our enjoyments. What can be imagined more comfortable than to have a friend to console us in afflictions, to advise with us in doubtful cases, and share our felicity? . . . It exalts our nobler passions, and weakens our evil inclinations; it assists us to run the race of virtue with a steady and undeviating course. From loving, esteeming, and endeavoring to felicitate particular people, a more general passion will arise for the whole of mankind."

He finishes this essay with an allegory. God is described as deliberating with the angels on the propriety of creating woman. Justice, Peace, and Virtue plead against her creation, as through her Adam will be driven out of Paradise. Then Divine Love stands before Jehovah, her countenance covered with smiles. "Create her," she says, "for Paradise itself will afford no delight to man without woman. She will be the cause of his misery, but she will likewise be the cause of all his happiness. She will console him in affliction; she will comfort and harmonize his soul; she will wipe the tears from his eyes, and compose the fury of his passions. Her friendship shall make him virtuous, and her love shall make him happy; and, lastly, the tree of their transgression, and the plant of immortality, nour-

ished by the blood of her son, shall flourish, and grow out of Paradise, and overspread the earth: man shall eat of their fruit, and be immortal and happy."

All through these early note-books are scattered his poems, showing a passion for the blue sea at Penzance, and an unbounded love of nature.

Just as he was entering his nineteenth year, young Davy began the study of chemistry, as a branch of his profession. He read "Lavoisier's Elements of Chemistry," and "Nicholson's Dictionary of Chemistry." Suddenly a new world seemed to open before him. He began to think for himself, and to make experiments. As his means were limited, his apparatus consisted of vials, wine-glasses, tea-cups, tobacco-pipes, and earthen crucibles.

His first experiments were the effects of acids and alkalies on vegetable colors, the kind of air in the vesicles of common seaweed, and the solution and precipitation of metals. These were made in his bedroom in Mr. Tonkin's house, or in the kitchen, when he required fire. This old gentleman had brought up his mother and her two orphan sisters, and now was like a father to Humphrey. He said, "This boy, Humphrey, is incorrigible. Was there ever so idle a dog! He will blow us all into the air." He was at this time probably making a detonating composition, which he called "thunder power," his sister Kitty being his assistant.

At this time, a young man came to board at the house of Mrs. Davy, Gregory Watt, the only child of James Watt, the inventor of the steam-engine. He was the idol of his parents; possessed of a mind so unusual in its passionate love for knowledge, and a nature so companionable, that everybody loved him. He was twenty-one, and Humphrey nineteen.

Between these two young men there grew a most ardent and lasting friendship; lasting because it had the only sure foundation, moral and mental worth. They were always together. They visited the neighboring mines and mountains, and came home with their pockets filled with minerals.

The brilliant Gregory died at twenty-eight, but Davy lived to show the fruits of one of the most beautiful things in life, the affinity of two noble and intellectual souls, with similar tastes and aspirations. This death was a great loss to Humphrey. He wrote to a friend: "Poor Watt! He ought not to have died. I could not persuade myself that he would die: and until the very moment when I was assured of his fate, I would not believe he was in any danger.

"His letters to me only three or four months ago were full of spirit, and spoke not of any infirmity of body, but of an increased strength of mind. Why is this in the order of nature, that there is such a difference in the duration and destruction of her works? If the mere stone decays, it is to produce a soil which is capable of nourishing

the moss and the lichen; when the moss and the lichen die, and decompose, they produce a mould, which becomes the bed of life to grasses, and to more exalted species of vegetables. Vegetables are the food of animals; the less perfect animals of the more perfect; but in man the faculties and intellect are perfected. He rises, exists for a little while in disease and misery; and then would seem to disappear, without an end, and without producing any effect.

"We are deceived, my dear Clayfield, if we suppose that the human being, who has formed himself for action, but who has been unable to act, is lost in the mass of being; there is some arrangement of things which we can never comprehend, but in which his faculties will be applied. . . . Gregory was a noble fellow, and would have been a great man. Oh! there was no reason for his dying — he ought not to have died."

This death broke the spirit of James Watt, the father, who ever after kept beside him, in the attic at Heathfield, the little, old-fashioned hair trunk of his beloved Gregory, full of his school-books, letters, and childish toys. It stands to-day, where it did eighty years ago, beside the mouldering beams of the sculpture machine. That life is not short, however few the years, which leaves such an undying influence and such beautiful memories.

Humphrey was now twenty-six, and much had come into his young life. He had applied himself

with zeal to his professional studies, had read Locke, and Rollin, and Gibbon, and Shakspeare, and at twenty had been appointed to take charge of the Pneumatic Institution at Clifton, established by Dr. Beddoes. It had been founded to give an opportunity of trying the medicinal effects of various gases, and was supported by liberal men of science. So distressed was his old friend, Mr. Tonkin, that he should give up the idea of being a surgeon in Penzance, that he revoked a legacy he had made him in his will!

Davy's life was now an extremely busy one. He published, when he was twenty-one, his "Essays on Heat and Light," beginning his work, like Sir Isaac Newton, when but a youth. He discovered silica in the epidermis of the stems of weeds, corn, and grasses. He found the intoxicating effects of breathing nitrous oxide, April 9, 1799, and his experiments on this subject were published the following year. He spent ten months of incessant labor in them, often endangering and once nearly losing his life from breathing carburetted hydrogen. He made experiments on galvanic electricity, increasing the powers of the Galvanic Pile of Volta. He also planned and partly wrote an epic poem on the deliverance of the Israelites from Egypt.

Worn with overwork, he returned to see his widowed mother at Penzance. He had been absent a year. How glad were all to greet the rising young scientist! Not least glad was Davy's water spaniel,

Chloe. When very small, and about to be drowned, he begged her as a gift, and with great care reared her to be his hunting and fishing companion. At first she did not know him, but when, with his peculiarly musical voice, he called her by name, "she was in a transport of joy."

Davy never forgot his early life at Penzance. In his will he left a sum of money to be paid annually to the master of the grammar school, "*on condition that the boys may have a holiday on his birthday.*"

One secret of Davy's early success was, no doubt, his ambition. He used to say that he had been kept largely from the temptations of youth by "an active mind, a deep ideal feeling of good, and *a look towards future greatness.*" The young man or woman who definitely plans to be somebody seldom finds any obstacles along the road too great to be overcome.

He wrote in his note-book: "I have neither riches, nor power, nor birth to recommend me; yet, if I live, I trust I shall not be of less service to mankind, and to my friends, than if I had been born with these advantages."

At the Pneumatic Institution he found in Mrs. Beddoes "the best and most amiable woman in the world," a helper in the development of his genius. Like the wife of William Humboldt, and like any other woman who combines heart and intellect, Mrs. Beddoes gathered about her, in her home, Coleridge and Southey, and other bright minds of Clifton. Here Davy, scarcely more than a boy, with his soft

brown curling hair, his beautiful smile, and his "wonderfully bright eyes, which seemed almost to emit a soft light, when animated," in the midst of congenial friends, was stimulated to do his best.

Years after this, Wordsworth gave Dr. John Davy a letter to Coleridge, on the back of which he had written: "This from Davy, the great chemist. It is an affectionate letter."

"My dear Coleridge, — My mind is disturbed, and my body harassed by many labors; yet I cannot suffer you to depart, without endeavoring to express to you some of the unbroken and higher feelings of my spirit, which have you at once for their cause and object.

"Years have passed away since we first met; and your presence, and recollections with regard to you, have afforded me continued sources of enjoyment. Some of the better feelings of my nature have been elevated by your converse, and thoughts which you have nursed have been to me an eternal source of consolation.

"In whatever part of the world you are, you will often live with me, not as a fleeting idea, but as a recollection possessed of creative energy, — as an imagination winged with fire, inspiring and rejoicing. . . .

"May blessings attend you, my dear friend! Do not forget me: we live for different ends, and with different habits and pursuits; but our feelings with regard to each other have, I believe, never altered. They must continue; they can have no natural

death; and I trust they can never be destroyed by fortune, chance, or accident."

Thus his sweet, kindly nature was an inspiration to others. He believed in amiability. He said, later, of temper in the marriage state: "Upon points of affection it is only for the parties themselves to form just opinions of what is really necessary to ensure the felicity of the marriage state. Riches appear to me not at all necessary; but competence, I think, is; and after this more depends upon the *temper* of the individual than upon personal or even intellectual circumstances. The finest spirits, the most exquisite wines, the nectars and ambrosias of modern tables, will be all spoilt by a few drops of bitter extract; and a bad temper has the same effect in life, which is made up, not of great sacrifices or duties, but of little things, in which smiles and kindness, and small obligations given habitually, are what win and preserve the heart and secure comfort."

When Davy was twenty-three, a brilliant opening came to him; came as it did to Cuvier, Newton, and others, through the influence of a friend. Count Rumford had been instrumental in founding the Royal Philosophical Institution for the diffusion of a knowledge of science. Through his works on heat, nitrous oxide, and galvanic electricity, Davy had made the acquaintance of Dr. Hope, the distinguished professor of chemistry in the University of Edinburgh. He recommended Davy to Count Rumford, as fitted for the professorship of chemis-

try in the Royal Institution, an appointment, Davy wrote to his mother, "as honorable as any scientific appointment in the kingdom, with an income of at least five hundred pounds a year." He had evidently kept the "look towards future greatness" in his heart.

Six weeks after his arrival in London, in the spring of 1801, Davy gave his first lecture, upon the history of galvanism, and the different modes of accumulating galvanic influence. "The sensation created by his first course of lectures at the Institution," says the *Philosophical Magazine*, "and the enthusiastic admiration which they obtained, is at this period hardly to be imagined. Men of the first rank and talent, — the literary and the scientific, the practical and the theoretical, — blue-stockings and women of fashion, the old and the young, all crowded, eagerly crowded, the lecture-room. His youth, his simplicity, his natural eloquence, his chemical knowledge, his happy illustrations and well conducted experiments, excited universal attention and unbounded applause. Compliments, invitations, and presents were showered upon him in abundance from all quarters; his society was courted by all, and all appeared proud of his acquaintance." He usually wrote his lecture the day before he delivered it, on this day dining in his own room, generally on fish. His manner in speaking was very animated, but natural. He believed in enthusiasm. He said, "Great powers have never been exerted independent of strong feelings. The

rapid arrangement of ideas from their various analogies to the equally rapid comparisons of these analogies, with facts uniformly occurring during the progress of discovery, have existed only in those minds where the agency of strong and various motives is perceived — of motives modifying each other, mingling with each other, and producing that *fever of emotion* which is the joy of existence and the consciousness of life."

Coleridge used to say, "I attend Davy's lectures to increase my stock of metaphors."

In the spacious and well supplied laboratory of the Institution, in making his experiments, says his brother, "his zeal amounted to enthusiasm, which he more or less imparted to those around him. With cheerful voice and countenance, and a hand as ready to manipulate as his mind was quick to contrive, he was indefatigable in his exertions. He was delighted with success, but not discouraged by failure; and he bore failures and accidents in experiments with a patience and forbearance, even when owing to the awkwardness of assistants, which could hardly have been expected from a person of his ardent temperament."

He was very happy in these years of work. Says his brother: "In going to bed, and rising, and sometimes in the dead of night, I used to hear him, in a loud voice, reciting favorite passages in prose or verse, or declaiming some composition of his own, or humming some angler's song."

He spent his evenings often in society, but wrote

to a friend concerning himself: "Be not alarmed, my dear friend, as to the effect of worldly society on my mind. . . . There are in the intellectual being of all men paramount elements, — certain habits and passions that cannot change. I am a lover of nature with an ungratified imagination. I shall continue to search for untasted charms, for hidden beauties. My *real*, my *waking* existence is amongst the objects of scientific research. Common amusements and enjoyments are necessary to me only as dreams to interrupt the flow of thoughts too nearly analogous to enlighten and vivify."

During his vacations he explored most parts of Great Britain, the Hebrides, and Ireland, studying the geological structure, collecting agricultural knowledge, and making sketches. He never hesitated to ask questions, and often the miners and farmers thought they had never seen a person so inquisitive.

In his early years at the Institution he was asked to investigate astringent vegetables in connection with tanning. He entered the work with his usual ardor; visited tan-yards, and made the acquaintance of practical farmers. In 1802 he began to deliver, at the request of the Board of Agriculture, a course of lectures, "On the Connection of Chemistry with Vegetable Physiology." He had made himself acquainted with the different kinds of soil and the various methods of agriculture. For ten years he delivered these lectures at the meetings of the Board. They were published in

book form, and translated into almost every European language.

"We feel grateful," said the *Edinburgh Review*, "for his having thus suspended for a time the labors of original investigation, in order to apply the principles and discoveries of his favorite science to the illustration and improvement of an art which, above all others, ministers to the wants and comforts of man."

He now continued his work with the voltaic pile or battery. If water could be decomposed by it, why not some substances heretofore regarded as simple or elementary bodies?

In October, 1806, he discovered that potash and soda can be decomposed, with potassium and sodium as resultant bases.

When he saw the minute globules of potassium burst through the crust of potash, and take fire as they entered the atmosphere, he is said to have bounded about the room in ecstatic delight, some time elapsing before he could compose himself sufficiently to go on with his experiment.

He had worked so constantly that he became very ill, and for several weeks his life was despaired of. All London was agitated over the expected death of the young chemist. Bulletins were prepared by the physicians morning, noon, and night, for the scores who came to ask concerning him.

When he had recovered and returned to his work, the Royal Institution provided him with a voltaic battery of six hundred double plates of four inches

square, four times as powerful as any that had been constructed, and not long after, one of two thousand plates. Scientific papers were constantly coming from his pen. He soon decomposed boracic acid with the battery. By heating boron in oxygen, it burnt, and was reconverted into boracic acid. In his experiments with muriatic acid gas he found chlorine to be a simple substance, and discovered euchlorine, a compound of chlorine and oxygen.

He had already been made a fellow of the Royal Society at twenty-five, and at twenty-nine one of the secretaries. His lectures were crowded, as ever, by a thousand people. The Dublin Society now invited him to give courses of lectures in 1810 and 1811, which he did, ticket-holders each paying two guineas for a course. So difficult was it to gain admission to the lectures that many offered from ten to twenty pounds for a course ticket!

He writes these facts to his mother, and adds, "This is merely for your eye: it may please you to know that your son is not unpopular or useless. Every person here, from the highest to the lowest, shows me every attention and kindness.

"I shall come to see you as soon as I can. I hear with infinite delight of your health, and I hope Heaven will continue to preserve and bless a mother who deserves so well of her children."

Trinity College, Dublin, conferred upon him the degree of Doctor of Civil Law. Cuvier said of him: "Davy, not yet thirty-two, in the opinion of all who could judge of such labors, held the first rank

among the chemists of this or of any other age." The National Institute of France had awarded him the prize given by Napoleon to the greatest discovery by the means of galvanism.

And yet all this fame and honor had been won by incessant labor. He writes to his mother: "At present, except when I resolve to be idle for health's sake, I devote every moment to labors which I hope will not be wholly ineffectual in benefiting society, and which will not be wholly inglorious for my country hereafter; and the feeling of this is the *reward* which will continue to keep me employed."

His brother John, who had been for three years at the Royal Institution, now went to Edinburgh to study medicine. Davy writes him: "Let no difficulties alarm you, you may be what you please. Trust me, I know what your powers are. Preserve the dignity of your mind, and the purity of your moral conduct. You set sail with a fair wind on the ocean of life. You have great talents, good feelings, and an unbroken and an uncorrupted spirit. Move straight forward on to moral and intellectual excellence. Let no example induce you to violate decorum, — no ridicule prevent you from guarding against sensuality or vice. Live in such a way that you can always say, the whole world may know what I am doing."

In 1812 Davy was knighted by the Prince Regent. Only thirty-three, and he had come to great renown!

And now an important change was to come into

his life. During the preceding year he had become acquainted with Mrs. Appreece, towards whom esteem gradually ripened into affection. When their marriage had been decided upon, he wrote his mother: "I am the happiest of men, in the hope of a union with a woman equally distinguished for virtues, talents, and accomplishments. . . . You, I am sure, will sympathize in my happiness. I believe I should never have married but for this charming woman, whose views and whose tastes coincide with my own, and who is eminently qualified to promote my best efforts and objects in life."

To his brother he writes: "I have been very miserable. The lady whom I love best of any human beings has been very ill. She is now well, and I am happy. Mrs. Appreece has consented to marry me: and when the event takes place I shall not envy kings, princes, or potentates. . . . I am going to be married to-morrow; and I have a fair prospect of happiness, with the most amiable and intellectual woman I have ever known." How love idealizes all things, makes a new heaven and a new earth for us! He found in her the two needed qualities for happiness; amiability, without which the life of a man is usually made wretched, and intellectuality, without which a cultivated man can have little companionship in a wife.

The marriage seems to have been a happy one, for he writes to John later: "Lady D. is a noble creature, and every day adds to my contentment by

the powers of her understanding, and her amiable and delightful tones of feeling."

Like the wife of Herschel, she was a wealthy widow, so that after his marriage Davy was enabled to travel, and devote himself wholly to original investigation. He resigned his professorship at the Royal Institution after twelve most useful years.

His "Elements of Chemical Philosophy" was now published, and dedicated to Lady Davy. After a pleasure trip with his wife to the highlands of Scotland, taking his portable chemical apparatus with him for study, they took a journey to France, Italy, Sicily, and Germany, accompanied by Mr. Michael Faraday, afterward so celebrated, then "his assistant in experiments and writing."

In Paris, where he spent two months, he discovered that iodine is a simple substance, analogous to chlorine. Here he became the intimate friend of many distinguished men. "Humboldt," he said, "was one of the most agreeable men I have ever known; social, modest, full of intelligence, with facilities of every kind; almost *too fluent* in conversation. His travels display his spirit of enterprise. His works are monuments of the variety of his knowledge and resources."

Gay-Lussac he placed "at the head of the living chemists of France."

At Fontainebleau, on the banks of the Rhone, at Mont Blanc, at Vaucluse, Sir Humphrey's artistic nature voiced itself in song. He had the poet's

temperament, intense, quick, earnest, ardent, aspiring. He loved science, and paid her homage; he loved poetry, and made her his rest and solace and soul-companion.

At Florence he studied the diamond, and found it merely crystallized carbon. At Rome he met Canova, who showed him great attention, and to whom he wrote this sonnet: —

"Thou wast a light of brightness in an age
When Italy was in the night of art:
She was thy country; but the world thy stage,
On which thou actedst thy creative part.
Blameless thy life — thy manners, playful, mild,
Master in art, but Nature's simplest child.
Phidias of Rome! like him thou stand'st sublime:
And after artists shall essay to climb
To that high temple where thou dwell'st alone,
Amidst the trophies thou from time hast won.
Generous to all, but most to rising merit;
By nobler praise awakening the spirit;
Yet all unconscious of the eternal fame,
The light of glory circling round thy name!"

At Milan he met Volta, nearly seventy years old. "His conversation was not brilliant," he said; "his views rather limited, but marking great ingenuity. His manners were perfectly simple."

Around Naples he investigated the phenomena of volcanic eruptions. On his return to London they bought a house in Grosvenor Square. He now published several papers: "Experiments and Observations on the Colors used in Painting by the Ancients"; "Experiments on a Solid Compound of

Iodine and Oxygen, and on its Chemical Agencies"; "Action of Acids on the Salts usually called the Hyper-oxymuriates, and on the Gases produced from them."

All his life, besides his ambition to be great, he desired to aid his fellow-men, and in the year 1815 he made a discovery which placed him among the benefactors of the race. In 1812 a terrible explosion of gas had taken place in a mine, causing the death of nearly a hundred men. The mine was on fire, and the mouth had to be closed, thus bringing sure death to the poor creatures within. Such accidents were so frequent, that a committee of mine proprietors visited the great chemist, to see if science could suggest a remedy.

He at once visited several mines, investigated fire-damp, and found it to be light carburetted hydrogen. After a long and careful series of experiments through several months, he invented the safety-lamp, "a cage of wire gauze, which actually made prisoner the flame of the fire-damp, and in its prison consumed it; and whilst it confined the dangerous explosive flame, it permitted air to pass and light to escape; and though, from the combustion of the fire-damp, the cage might become red hot, yet still it acted the part of a safety-lamp."

Sir Humphrey at thirty-seven had immortalized himself. At a public dinner given in his honor at Newcastle, a service of plate worth over two thousand pounds was presented to him. After his death this service was given to the Royal Society

by his widow, to be sold, and the proceeds applied to the encouragement of science. Emperor Alexander of Russia sent him a splendid silver-gilt vase, with a personal letter; his own sovereign conferred a baronetcy upon him.

When Davy was urged by some friends to take out a patent upon the safety-lamp, and thus make five or ten thousand a year for himself, he said, "I never thought of such a thing: my sole object was to serve the cause of humanity; and if I have succeeded, I am amply rewarded in the gratifying reflection of having done so. I have enough for all my views and purposes; more wealth could not increase either my fame or my happiness. It might undoubtedly enable me to put four horses to my carriage; but what would it avail me to have it said that Sir Humphrey drives his carriage and four?"

He said later of his discovery of the safety-lamp: "I value it more than anything I ever did: it was the result of a great deal of investigation and labor; but if my directions be attended to, it will save the lives of thousands of poor men. I was never more affected than by a written address which I received from the working colliers when I was in the North, thanking me on behalf of themselves and their families for the preservation of their lives."

Sir Humphrey used to say: "Whoever wishes to enjoy *peace*, and is gifted with great talents, must labor for posterity. In doing this he enjoys all the pleasures of intellectual labor, and all the desire

arising from protracted hope. He feels no envy nor jealousy; his mark is too far distant to be seen by short-sighted malevolence, and therefore it is never aimed at. . . . To raise a chestnut on the mountain, or a palm in the plain, which may afford shade, shelter, and fruit for generations yet unborn, and which, if they have once fixed their roots, require no culture, is better than to raise annual flowers in a garden, which must be watered daily, and in which a cold wind may chill or too ardent a sunshine may dry. . . . The best faculties of man are employed for futurity: speaking is better than acting, writing is better than speaking."

In the spring of 1818 he took his second continental journey with his wife, going through Austria, Germany, and Italy. Commissioned by his king, he made some researches on Herculaneum manuscripts.

On his return to England he was made President of the Royal Society, the position so ably filled by Sir Isaac Newton. Every Saturday evening, poets, artists, and men of science gathered at his receptions. This office he held for seven years, till his declining health compelled his resignation.

In December, 1821, Davy paid a visit to his old home in Penzance, and saw his mother for the last time before her death. A public dinner was given him by his townsmen, which honor he greatly appreciated. He was no longer the poor lad among them. "Every heart, tongue, and eye were as one to do honor to him who had not only rendered the

name of their *town* famous and imperishable as science itself, but who had added lustre to the intellectual character of their *country.*"

From year to year he continued his experiments. Urged by the commissioners of the navy to remedy the corrosion of copper sheathing on vessels by sea water, he succeeded in rendering the copper negatively electrical by small pieces of tin, zinc, or iron nails. Shells and seaweeds adhered to the non-corroded surface, but the principle of galvanic protection has been applied to various important uses.

In 1824, Sir Humphrey took a journey to Norway, Sweden, and Denmark, visiting Berzelius of Sweden, "one of the great ornaments of the age," he said, and Oersted of Denmark, distinguished for his discovery of electro-magnetism.

Towards the close of 1826, when he was only forty-eight, Davy was attacked by paralysis in the right side, having suffered for a year with numbness and pain in his right arm. During his confinement in his room, he corrected the proof sheets of his "Discourses to the Royal Society," published in January, 1827.

In this year, having improved, he went through France, Italy, and Switzerland, hunting and fishing as in his boyhood, and writing "Salmonia, or Days of Fly Fishing," giving descriptions of his journey and his observations on natural history.

In the spring of 1828, he made another journey, to Southern Austria, spending the winter in Italy,

and writing his "Consolation in Travel," which Cuvier called the work of a dying Plato. "I was desirous," he says, "of again passing some time in these scenes, in the hope of reëstablishing a broken constitution; and though this hope was a feeble one, yet, at least, I expected to spend a few of the last days of life more tranquilly and more agreeably than in the metropolis of my own country. Nature never deceives us. The rocks, the mountains, the streams, always speak the same language. A shower of snow may hide the verdant woods in spring; a thunder storm may render the blue limpid streams foul and turbulent: but these effects are rare and transient; in a few hours, or at least days, all the sources of beauty are renovated; and Nature affords no continued trains of misfortunes and miseries, such as depend upon the constitution of humanity, — no hopes forever blighted in the bud, — no beings full of life, beauty, and promise, taken from us in the prime of youth. Her fruits are all balmy, bright, and sweet; she affords none of those blighted ones so common in the life of man, and so like the fabled apples of the Dead Sea, — fresh and beautiful to the sight, but, when tasted, full of bitterness and ashes."

From Rome he writes to a friend, a year later, in the spring of 1829: "I am here *wearing away* the winter, — a ruin amongst ruins! . . . I fight against sickness and fate, believing I have still duties to perform, and that even my illness is con-

nected in some way with my being made useful to my fellow-creatures. I have this conviction full on my mind, that intellectual beings spring from the same breath of infinite intelligence, and return to it again, but by different courses. Like rivers born amidst the clouds of heaven, and lost in the deep and eternal ocean, — some in youth, rapid and short-lived torrents; some in manhood, powerful and copious rivers; and some in age, by a winding and slow course, half lost in their career, and making their exit by many sandy and shallow mouths."

Davy was destined to go back to the Infinite Intelligence in manhood, "a powerful and copious river," however much he "fought against sickness and fate."

On February 23, 1829, he dictated a letter to his brother John: "I am dying from a severe attack of palsy, which has seized the whole body, with the exception of the intellectual organ." He added in his own hand, just legible, "Come as quickly as possible."

When the brother arrived, and was overcome with grief, Sir Humphrey received him with a cheerful smile, and bade him not to grieve, but consider the event like a philosopher. He talked more earnestly than ever, and his mind seemed all aglow as with the brilliancy of a setting sun.

At one time he was so near death, that he said "he had gone through the whole process of dying, and that when he awoke he had difficulty in convincing himself that he was in his earthly exist-

ence." Reviving somewhat, they journeyed from Italy to Geneva, by slow and easy travel, arriving May 28, 1829. In the night, at half-past two, Sir Humphrey was taken very ill, and died almost immediately.

He was buried June 1, in the cemetery outside the walls of the city, having requested to be interred where he died, without any display. The grave is marked by a simple monument erected by his wife. She also founded a prize in his honor, to be given every two years, for the most original and important discovery in chemical science. Only fifty, and his work finished, — no not finished, — for his books and his discoveries, his character, with its earnest perseverance, its tenderness, its sympathy, its noble aspirations, and its helpfulness to mankind, will live forever!

JOHN JAMES AUDUBON.

THE problem why certain men and women come to eminence, and why others, with apparently as much ability, remain forever in obscurity, is an interesting one to solve. Most persons desire fame; most persons desire wealth; but, for one reason or another, thousands fail to achieve what they desire. They lack either singleness of aim, or adequate perseverance, or determined will, or sound judgment, or, instead of mastering circumstances, they permit circumstances to master them.

It is so easy to be turned aside in life by trivial matters; to be interested in our neighbor's wedding, or our neighbor's profits and losses. Those who oversee the affairs of others rarely oversee their own. Men become very busy over clubs and pastimes; women, over social gatherings and appearance, and die with little accomplished.

Audubon's life furnishes a unique illustration of the result of having a definite purpose, and bending all one's energies to it, till success is attained.

John James Audubon was born at New Orleans, May 4, 1780, in the land of orange groves and

magnolias, of birds and sunshine. His grandfather was a poor fisherman of La Vendée, France, with twenty-one children. Unable to support them, they made their way in life as best they could.

When John's father was twelve years old, the fisherman gave him "a shirt, a dress of warm clothing, his blessing, and a cane, and sent him out to seek his fortune." He went to Nantes, shipped before the mast; at twenty-one commanded a vessel, and at twenty-five was owner and captain of a small craft.

Going to St. Domingo, West Indies, he purchased a small estate. Ambitious, as are all persons who succeed, he soon secured an appointment from the Governor of St. Domingo, returned to France, made the acquaintance of influential men, and obtained an appointment in the Imperial navy, with the command of a small vessel of war.

He had what all persons need, true self-appreciation; quite another quality from self-conceit. To believe that we can do things, having kept our characters such that we respect ourselves, is a strong indication that we shall prosper if we make the attempt.

Frequently visiting America in his ship, Audubon purchased land in Louisiana, Virginia, and Pennsylvania. In the former State he married a lady of Spanish extraction, Anne Moynette, both beautiful and wealthy. Of their three sons and one daughter, John James was the youngest son.

The mother was not spared to rear the distin-

guished naturalist, but perished a few years after his birth, in the insurrection of the colored people of St. Domingo. The father, having purchased a beautiful estate on the Loire, nine miles from Nantes, married a second time, a woman who proved a most indulgent mother to her husband's children. Having none of her own, she humored John in every way, and allowed him to gather moss, curious stones, birds' nests, — indeed, everything which belongs to natural history, — to his heart's content.

On the return of Commodore Audubon to France, finding that the boy was following the bent of his own mind, to the neglect of a solid education, in spite of the tears and entreaties of his wife, he sent him away to school. For a year John was obliged to apply himself closely to mathematics, taking a ramble to collect specimens whenever it was possible. He studied drawing under the celebrated painter David, and learned to play well on the violin, flute, flageolet, and guitar.

His father had hoped that he would become a soldier under Napoleon, but a lad who could lie on his back under a tree for three weeks, and watch with a telescope the habits of some little gray birds of the color of the bark of the tree, would not care much for the smoke and din of battle. He was therefore sent to America, to look after his father's property.

With a heavy heart the youth said good-by to France, where he had already sketched two

hundred varieties of birds from life. Arriving in New York, he became ill of yellow fever, and was carried to the home of two Quaker ladies in Morristown, whose kindness doubtless saved his life.

When he had recovered, he went to his father's farm at Mill Grove, near the Schuylkill Falls, Pennsylvania, and found, as he said, "a blessed spot." He was free, now, to study natural history; no more mathematics; no more urging to become a soldier. He was delighted with the mill attached to the property, and with the pewees who built their nests near by. "Hunting, fishing, and drawing occupied my every moment," he says; "cares I knew not, and cared nothing for them."

An English gentleman, William Bakewell, descended from the Peverils of Derbyshire, rendered historical by Scott's novel "Peveril of the Peak," owned the adjoining property. Audubon, being French, did not court the acquaintance of the Englishman, indeed avoided him, till one day, as he was following some grouse down the creek in winter, he met Mr. Bakewell.

"I was struck with the kind politeness of his manners," says Audubon, "and found him a most expert marksman, and entered into conversation. I admired the beauty of his well trained dogs, and finally promised to call upon him and his family. Well do I recollect the morning, and may it please God may I never forget it, when for the first time I entered the Bakewell household. It happened

that Mr. Bakewell was from home. I was shown into a parlor, where only one young lady was snugly seated at work, with her back turned towards the fire. She rose on my entrance, offered me a seat, and assured me of the gratification her father would feel on his return; which, she added with a smile, would be in a few minutes, as she would send a servant after him. Other ruddy cheeks made their appearance, but, like spirits gay, vanished from my sight. Talking and working, the young lady who remained made the time pass pleasantly enough, and to me especially so. It was she, my dear Lucy Bakewell, who afterwards became my wife, and the mother of my children."

Mr. Bakewell soon returned, and lunch was provided before leaving on a shooting expedition. "Lucy rose from her seat a second time, and her form, to which I had before paid little attention, seemed radiant with beauty, and my heart and eyes followed her every step. The repast being over, guns and dogs were provided, and as we left I was pleased to believe that Lucy looked upon me as a not very strange animal. Bowing to her, I felt, I knew not why, that I was at least not indifferent to her."

Thus was begun a beautiful affection that ran like a thread of gold through the darkness and light of two struggling lives. The friendship increased as the months went by, for the youth, alone in a strange country, devoted to his foster-mother, needed a woman's love and tenderness to

cheer him. Lucy Bakewell taught Audubon English, and he in return gave her drawing lessons.

At Mill Grove the weeks passed pleasantly, — is not the world always beautiful when we love somebody? Audubon says in his journal: "I had no vices; but was thoughtless, pensive, loving, fond of shooting, fishing, and riding, and had a passion for raising all sorts of fowls, which sources of interest and amusement fully occupied my time. . . . I ate no butcher's meat, lived chiefly on fruits, vegetables, and fish, and never drank a glass of spirits or wine until my wedding day. To this I attribute my continual good health, endurance, and an iron constitution."

Here at Mill Grove, while yet a boy, he planned his great work, the "Birds of America," their habits, and a description of them. This one idea dominated Audubon's life. Through poverty and suffering, this one desire was ever before him. It is well to plan early in life what we wish to do, and then *do it.*

One writer has well said of Audubon: "For sixty years or more he followed, with more than religious devotion, a beautiful and devoted pursuit, enlarging its boundaries by his discoveries, and illustrating its objects by his art. In all climates and in all weathers; scorched by burning suns, drenched by piercing rains, frozen by the fiercest colds: now diving fearlessly into the densest forest, now wandering alone over the most savage regions; in perils, in difficulties, and in doubts;

with no companion to cheer his way, far from the smiles and applause of society; listening only to the sweet music of birds, or to the sweeter music of his own thoughts, he faithfully kept his path.

"The records of man's life contain few nobler examples of strength of purpose and indefatigable energy. Led on solely by his pure, lofty, kindling enthusiasm, no thirst for wealth, no desire of distinction, no restless ambition of eccentric character, could have induced him to undergo as many sacrifices, or sustained him under so many trials. Higher principles and worthier motives alone enabled him to meet such discouragements and accomplish such miracles of achievement. He has enlarged and enriched the domains of a pleasing and useful science; he has revealed to us the existence of many species of birds before unknown; he has given us more accurate information of the forms and habits of those that were known; he has corrected the blunders of his predecessors; and he has imparted to the study of natural history the grace and fascination of romance."

At Mill Grove he came near losing his life, on a duck-shooting expedition, by falling through an air hole in the ice. It was three months before he recovered.

At this time "a partner, tutor, and monitor," Da Costa, whom Audubon's father had sent over to superintend a lead-mine enterprise at Mill Grove, refused to give money to the son and objected to his marrying Lucy Bakewell. Resenting the dic-

tation of Da Costa, young Audubon determined to go to France and lay the matter before his father. Da Costa would give him no money, but a letter of credit upon an agent in New York. The youth, nothing daunted, walked all the way to New York, was refused the money by the agent, who hinted that the lad should be seized and shipped to China, borrowed his passage money, went to France, caused the removal of Da Costa, and obtained his father's consent to his marriage. For a year he resided at Nantes, shooting, stuffing birds, and drawing for his beloved book. Then all Frenchmen being liable to conscription under Napoleon, the Commodore obtained leave for his son to return to America.

Once again he was at his dear Mill Grove. In his room "the walls were festooned with all sorts of birds' eggs, carefully blown out and strung on a thread. The chimney piece was covered with stuffed squirrels, raccoons, and opossums, and the shelves around were likewise crowded with specimens, among which were fishes, frogs, snakes, lizards and other reptiles."

Lucy's father, concluding that the study of natural history might not bring pecuniary support for his daughter, suggested to Audubon that he obtain some knowledge of commercial pursuits. Love seldom asks about ways and means; too seldom, in fact, for subsequent happiness. Audubon entered the counting-house of Mr. Benjamin Bakewell of New York, and soon lost some hundreds of pounds

by a bad speculation in indigo. The drying of bird's skins in his rooms was so disagreeable to his neighbors that a message was sent him, through a constable, insisting on his abating the *nuisance!*

Finance did not seem the specialty of the young man, and he returned to Mill Grove.

Dear as the place was to him, he sold it, invested the capital in goods, married Lucy Bakewell, April 8, 1808, when he was twenty-eight years old, and started for the West. They were twelve days in sailing down the Ohio River in a flat-bottomed float, called an ark. He engaged in trade at Louisville, and the young couple were extremely happy. Fortunate it was that they had these few months of comfort, for hardship was soon to test their affection.

The war of 1812 so crippled business that he and his partner decided to go to Hendersonville, while Lucy and her infant son went home to her father for a year. If Mr. Bakewell ever regretted the choice which his daughter had made, she did not, and never failed, when days were darkest, to encourage him to write and win renown. When all others bemoaned his lack of business success, and his devotion to a non-paying pursuit, she alone was his comforter, and was willing to suffer poverty if thus his great work might be done.

There was no success at Hendersonville, and the goods were taken to St. Geneviève. Here the partner married, and Audubon sold his interest to him, purchased a horse, and started across the country

to see his wife, who had meantime come back from Pennsylvania to Hendersonville, Ky. In this trip he came near losing his life. He says: "I found myself obliged to cross one of the wild prairies which, in that portion of the United States, vary the appearance of the country. The weather was fine, all around me was as fresh and blooming as if it had just issued from the bosom of nature. My knapsack, my gun, and my dog were all I had for baggage and company. But although well moccasined, I moved slowly along, attracted by the brilliancy of the flowers, and the gambols of the fawns around their dams, to all appearance as thoughtless of danger as I felt myself."

After travelling all day, he reached a log cabin. "Presenting myself at the door, I asked the tall figure, which proved to be a woman, if I might take shelter under her roof for the night. Her voice was gruff, and her dress negligently thrown about her. She answered in the affirmative. I walked in, took a wooden stool, and quietly seated myself by the fire. The next object that attracted my notice was a finely formed young Indian, resting his head between his hands, with his elbows on his knees. A long bow rested against the log wall near him, while a quantity of arrows and two or three raccoon skins lay at his feet. He moved not; he apparently breathed not. Accustomed to the habits of the Indians, and knowing that they pay little attention to the approach of civilized strangers, I addressed him in French, — a language not

unfrequently partially known to the people of that neighborhood. He raised his head, pointed to one of his eyes with his finger, and gave me a significant glance with the other; his face was covered with blood.

"The fact was, that an hour before this, as he was in the act of discharging an arrow at a raccoon in the top of a tree, the arrow had split upon the cord, and sprung back with such violence into his right eye as to destroy it forever.

"Feeling hungry, I inquired what sort of fare I might expect. Such a thing as a bed was not to be seen; but many large, untanned buffalo hides lay piled in a corner. I drew a time-piece from my pocket, and told the woman that it was late, and that I was fatigued. She espied my watch, the richness of which seemed to operate on her feelings with electric quickness. She told me there was plenty of venison and jerked buffalo meat, and that on removing the ashes I should find a cake. But my watch had struck her fancy, and her curiosity had to be gratified by an immediate sight of it. I took off the gold chain which secured it around my neck, and presented it to her. She was all ecstasy, spoke of its beauty, asked me its value, and put the chain round her brawny neck, saying how happy the possession of such a watch would make her. Thoughtless, and, as I fancied myself, in so retired a spot, secure, I paid little attention to her talk or her movements. I helped my dog to a good supper of venison, and

was not long in satisfying the demands of my own appetite.

"The Indian rose from his seat as if in extreme suffering. He passed and repassed me several times, and once pinched me on the side so violently, that the pain nearly brought forth an exclamation of anger. I looked at him; his eye met mine, but his look was so forbidding that it struck a chill into the more nervous part of my system. He again seated himself, drew his butcher-knife from its greasy scabbard, examined its edge, as I would do that of a razor suspected dull, replaced it, and, again taking his tomahawk from his back filled the pipe of it with tobacco, and sent me expressive glances whenever our hostess chanced to have her back towards us."

Audubon now perceived his danger. "I asked the woman for my watch, wound it up, and, under the pretence of wishing to see how the weather might probably be on the morrow, took up my gun, and walked out of the cabin. I slipped a ball into each barrel, scraped the edges of my flints, renewed the primings, and, returning to the hut, gave a favorable account of my observations. I took a few bear-skins, made a pallet of them, and, calling my faithful dog to my side, lay down, with my gun close to my body, and in a few minutes was, to all appearance, fast asleep."

Soon two young, stalwart Indians arrived at the cabin, bearing a dead stag on a pole. These were the Indian woman's sons. She and they drank

whiskey, and then took a large carving-knife to a grindstone, and sharpened it. "I saw her pour the water on the turning machine," says Audubon, "and watched her working away with the dangerous instrument, until the cold sweat covered every part of my body, in despite of my determination to defend myself to the last. Her task finished, she walked to her reeling sons, and said, 'There, that'll soon settle him! Boys, kill you — and then for the watch!'"

Just at this moment the door suddenly opened, and two travellers entered. The mother and her sons were bound, and Audubon's life was saved.

He arrived at last at Hendersonville, and soon went into business with a brother-in-law at New Orleans. He embarked all the fortune at his disposal, and lost it all.

His father had already died, leaving Audubon an estate in France, and over three thousand pounds deposited with a merchant in Richmond, Va. The merchant died insolvent, and Audubon never received a pound. He made no effort to possess the property in France, and years afterwards it was transferred to his sister Rosa. He now began to feel anxious about the future. A second son, John, had been born to him, and he must try once more to earn in business. Gathering a few hundred dollars, he purchased some goods in Louisville, and returned to Hendersonville. A former partner joined him, advised erecting a steam mill, which was done. Several men invested capital in

the enterprise, and a complete failure resulted. Audubon gave up all the property he possessed to his creditors, and left Hendersonville with his sick wife, his gun, his dog, and his drawings.

They reached Louisville, and were kindly received by a relative. How could he support his family? The outlook was not hopeful. He would try making crayon portraits. He succeeded so well that a farmer came in the middle of the night to request a picture of his mother before she died, and the work was done by candle-light.

Invited to Cincinnati to become curator of the museum, Audubon accepted, and opened a drawing-school in that city. But very little money resulted, and he resolved to seek a new field of labor. Getting letters of recommendation from General, afterwards President, Harrison, and from Henry Clay, he started, October 12, 1820, for New Orleans. Stopping for a time at Natchez, he and a companion found themselves destitute of shoes. Going to a shoemaker, he asked to sketch a crayon portrait of himself and his wife in return for two pairs of boots. The offer was accepted, and Audubon and his friend found themselves again in suitable condition for travelling. How different all this from the former easy life at Mill Grove!

Arriving at New Orleans, what little money he possessed was stolen, he could find no work, and he was obliged to live on the boat in which he had come thither. He writes in his journal: "Time passed sadly in seeking ineffectually for employ-

ment. I was fortunate in making a hit with the portrait of a well known citizen of New Orleans. I showed it to the public; it made a favorable impression, and I obtained several patrons. A few orders for portraits relieved my necessities, and, continuing my work of painting birds, the time passed more pleasantly."

He was always planning for wider opportunities to study birds for his book. In the midst of his dire poverty, he did not forget this. Now he hoped to join the expedition which surveyed the boundary line of the territory ceded to the United States by Spain, and he says, "Saw nothing but hundreds of new birds in imagination within range of my gun." But this, like other plans, came to naught, for poverty binds with strong cords, and it requires almost superhuman strength to break them.

At last, in the family of Mrs. Perrie, who owned a plantation at Bayou Sara, in Louisiana, he obtained a situation. He was to teach drawing to her daughter for twelve pounds a month, having his afternoons for his work. Her desire was, under the guise of employment, to help the poor naturalist.

After fourteen months since leaving Cincinnati, during which time, he says, "I have finished sixty-two drawing of birds and plants, three quadrupeds, two snakes, fifty portraits of all sorts, and have subsisted by my humble talents, not having had a dollar when I started," he sent for his family to come to him. A house was rented on Dauphine Street, at seventeen dollars a month. Now if they

starved, they would starve together. Being asked to join in painting a panorama of the city, he said, "My birds, my beloved birds of America, occupy all my time, and nearly all my thoughts, and I do not wish to see any other perspective than the last specimen of these drawings." He was now forty-two, and life was none too long, at the best. No wonder he was anxious about his book.

During the first months of 1822, after his family came, there are no records of his life. He was too poor to buy a journal. Mrs. Audubon had found a situation as governess in a family. Audubon was depressed in spirits, and poor health was the result. If some person with wealth had only been wise enough to have helped the man of talent! We build colleges and churches, and this is well; but often neglect the brilliant man or woman near our own door, who might bless the world. Brains do not always win pecuniary success. We sometimes go to extremes in America by advocating self-dependence, and let a refined and sensitive soul break because it cannot breast the world. We forget that on earth we are to be our brother's keeper. Perchance we shall remember it beyond!

Finally Audubon left New Orleans, procuring passage on a boat to Natchez, by a crayon portrait of the captain and his wife. In the family of a Portuguese gentleman in that city, he taught drawing, music, and French, and also drawing in a college nine miles from Natchez, but he was still depressed. "While work flowed in upon me," he

says, "the hope of my completing my book upon the birds of America became less clear; and, full of despair, I feared my hopes of becoming known to Europe as a naturalist were destined to be blasted."

To feel within one's breast the aspiration which is God-given, and know that one has genius, and yet be bound hand and foot by circumstances, — what is harder?

Poor Audubon! with his lessening hope of "becoming known to Europe." His wife had come to Natchez and obtained a position as teacher, similar to the one she had held in New Orleans. Poverty had tested their love, but it had stood the test. Audubon had made a copy of the "Death of Montgomery;" and for this friends raffled, and gave him the proceeds, three hundred dollars, and the picture also.

Mrs. Audubon now made an engagement with a lady at Bayou Sara, to teach her children with her own, and a limited number of pupils. Seeing that his family would now be provided for, "I determined," he says, "to break through all bonds, and pursue my ornithological pursuits. My best friends solemnly regarded me as a madman, and my wife and family alone gave me encouragement. My wife determined that my genius should prevail, and that my final success as an ornithologist should be triumphant."

Blessed faith of woman! Giving a love that knows only self-sacrifice; that braves all, bears all, and finally wins all for its beloved object.

The oldest son, Victor, was placed in the counting-house of a friend at Louisville, and Audubon sought Philadelphia, "as a desperate venture," he says, to see if means could not be obtained to further his work. He took a room, and began to give lessons in drawing. He said plaintively in his journal, "I have now been twenty-five years pursuing my ornithological studies," and yet the book was not written. Fortunately he obtained a letter of introduction to the portrait-painter Sully, "a man after my own heart, and who showed me great kindnesses." He gave Audubon instruction in oil, and would take no pay for it, and the naturalist was "overwhelmed with his goodness." Audubon found another warm-hearted friend, — Edward Harris, — a young ornithologist, who, as he was bidding Audubon good-by, squeezed a hundred-dollar bill into his hand, saying, "Mr. Audubon, accept this from me; men like you ought not to want for money." "I could only express my gratitude," says Audubon, "by insisting on his receiving the drawings of all my French birds, which he did, and I was relieved."

A friend now took him to visit Mill Grove. "As we entered the avenue leading to Mill Grove," he says, "every step brought to my mind the memory of past years, and I was bewildered by the recollections until we reached the door of the house, which had once been the residence of my father as well as myself. . . . After resting a few moments, I abruptly took my hat, and ran wildly towards the

woods, to the grotto where I first heard from my wife the acknowledgment that she was not indifferent to me. It had been torn down, and some stones carted away; but, raising my eyes toward heaven, I repeated the promise we had mutually made. We dined at Mill Grove, and as I entered the parlor I stood motionless, for a moment, on the spot where my wife and myself were forever joined."

He then went to New York, and a friend took him to the Lyceum. "My portfolio was examined by the members of the Institute," he says, "among whom I felt awkward and uncomfortable. After living among such people, I feel clouded and depressed; remember that I have done nothing, and fear I may die unknown. I feel I am strange to all but the birds of America. In a few days I shall be in the woods, and quite forgotten." The next day, he writes in his journal: "My spirits low, and I long for the woods again; but the prospect of becoming known prompts me to remain another day."

From this city he journeyed West. "All trembling I reached the Falls of Niagara, and oh, what a scene! My blood shudders still, although I am not a coward, at the grandeur of the Creator's power; and I gazed motionless on this new display of the irresistible force of one of his elements."

At Buffalo, he took a deck-passage on board a schooner bound for Erie, using his buffalo-robe and blanket to sleep on. At Pittsburg, he spent a

month scouring the country for birds, and continued his drawings. Arriving at Cincinnati, he says, "I was beset by claims for the payment of articles which years before had been ordered for the Museum, but from which I got no benefit. Without money, or the means of making it, I applied to Messrs. Keating and Bell for the loan of fifteen dollars; but had not the courage to do so until I had walked past their house several times, unable to make up my mind how to ask the favor. I got the loan cheerfully, and took a deck-passage to Louisville. I was allowed to take my meals in the cabin, and at night slept among some shavings I managed to scrape together. The spirit of contentment which I now feel is strange; it borders on the sublime; and, enthusiast or lunatic, as some of my relatives will have me, I am glad to possess such a spirit."

At last he reached Bayou Sara, and saw his wife; "and, holding and kissing her, I was once more happy, and all my toils and trials were forgotten."

Mrs. Audubon had been extremely fortunate. She was earning nearly six hundred pounds a year. This she offered to her husband to help the publication of the book. He was invited to teach dancing, and a class of sixty was soon organised. From this source he received about four hundred pounds. The tide of fortune had turned at last, and he began to prepare for a trip to England. He was forty-six. Life had been indeed a struggle. He had wandered over the country, with scanty

food and poor attire, always in debt, but he had drawn his birds; and now the money was actually in his hands, whereby he could, perhaps, "be known in Europe." And Lucy Audubon had made it possible!

He had gained much by his trials. He had learned what most of us take a life-time to learn, patience; not to speak harshly when others are harsh. He said, "To repay evils with kindness is the religion I was taught to practise, and this will forever be my rule." He had learned that much in life is trivial, that most things are "not matters of life and death;" little worries come to all, and can be borne — the momentous things of life are really few.

April 26, 1826, Audubon sailed for England. Arriving at Liverpool, he was able to arrange for the display of his drawings at the Liverpool Exhibition. The entrance fee was one shilling, and the receipts were from three to four pounds a day. Surely fame was coming at last. Lord Stanley spent five hours in examining the collection, and said, "This work is unique, and deserves the patronage of the Crown." He invited Audubon to visit him at his town house in Grosvenor Square. The naturalist made portraits of various friends who were desirous of obtaining specimens of his drawing. From the exhibition of his pictures in Liverpool he realised one hundred pounds.

From this city he went to Manchester, and from

thence to Edinburgh. Here he met the naturalist Professor Jameson, who promised to introduce his book to the public in his "Natural History Magazine." Professor Wilson (Christopher North) volunteered to introduce Audubon to Sir Walter Scott. Audubon was asked to sit for his portrait. The Royal Institution offered their rooms for the exhibition of his drawings, and the receipts were from five to fifteen pounds a day.

Truly things had changed since those desolate days in America, when he slept on the deck of a steamboat, because unable to pay for a bed, and could not summon the courage to ask the loan of three pounds.

Invited to dine with the Antiquarian Society, he met Lord Elgin, who presided, and was obliged to respond to a flattering toast, which made him "feel very faint and chill. I was expected to make a speech," he says, "but could not, and never had tried. Being called on for a reply, I said, 'Gentlemen, my incapacity for words to respond to your flattering notice is hardly exceeded by that of the birds now hanging on the walls of your institution. I am truly obliged to you for your favors, and can only say, God bless you all, and may your society prosper.' I sat down with the perspiration running over me."

Professor Wilson prepared an article upon Audubon and his work for "Blackwood's Magazine." His picture was hung in the Exhibition room. He was made a member of the Wernerian

Natural History Society, and of the Royal Society. He was pleased, and said, "So, poor Audubon, if not rich, thou wilt be honored at least, and held in high esteem among men."

No wonder he wrote to his wife: "My success in Edinburgh borders on the miraculous. My book is to be published in numbers, containing four birds in each, the size of life, in a style surpassing anything now existing, at two guineas a number. The engravings are truly beautiful; some of them have been colored, and are now on exhibition. . . . I expect to visit the Duke of Northumberland, who has promised to subscribe for my work. . . . One hundred subscribers for my book will pay all expenses. Some persons are terrified at the sum of one hundred and eighty guineas for a work," — nearly a thousand dollars, — "but this amount is to be spread over eight years, during which time the volumes will be gradually completed. I am fêted, feasted; elected honorary member of societies, making money by my exhibition and by my paintings. It is Mr. Audubon here, and Mr. Audubon there, and I can only hope that Mr. Audubon will not be made a conceited fool at last." There was no fear of this. He always remained the modest, earnest, devoted student of nature.

He read before the Natural History Society a paper on the habits of the wild pigeon. He says, "I began that paper on Wednesday, wrote all day, and sat up until half-past three the next morning; and so absorbed was my whole soul and spirit in

the work, that I felt as if I were in the woods of America among the pigeons, and my ears were filled with the sound of their rustling wings. After sleeping a few hours, I rose and corrected it. . . . Captain Hall expressed some doubts as to my views respecting the affection and love of pigeons, as if I made it human, and raised the possessors quite above the brutes. I presume the love of the mothers for their young is much the same as the love of woman for her offspring. There is but one kind of love; God is love, and all his creatures derive theirs from his: only it is modified by the different degrees of intelligence in different beings and creatures."

With all this attention, his heart was never callous to suffering. "I was sauntering along the streets," he says, "thinking of the beautiful aspects of nature, meditating on the power of the great Creator, on the beauty and majesty of his works, and on the skill he had given man to study them, when the whole train of my thoughts was suddenly arrested by a ragged, sickly-looking beggar boy. His face told of hunger and hardship, and I gave him a shilling and passed on. But turning again, the child was looking after me, and I beckoned to him to return. Taking him back to my lodgings, I gave him all the garments I had which were worn, added five shillings more in money, gave him my blessing, and sent him away rejoicing, and feeling myself as if God had smiled on me."

There is no sympathy so sweet as that born of

experience. Noble-hearted Audubon! God had indeed "smiled on him." Hereafter he was to walk in the sunlight of that smile. He was to work, of course, for there is no approbation for idleness, but he was to know want no more.

March 17, 1827, he issued the prospectus of his book, which was to cost him over twenty-one thousand pounds. Here was courage, but he had been fighting obstacles all his life, and he believed he could succeed. In this he said, "The author has not contented himself, as others have done, with single profile views, but in very many instances has grouped his figures so as to represent the originals at their natural avocations, and has placed them on branches of trees, decorated with foliage, blossoms, and fruits, or amidst plants of numerous species. Some are seen pursuing their prey through the air, searching for food amongst the leaves and herbage, sitting in their nests, or feeding their young; whilst others, of a different nature, swim, wade, or glide in or over their allotted element."

Leaving Edinburgh, Audubon visited Newcastle, Leeds, York, Shrewsbury, and Manchester, securing a few subscribers to his work, at two hundred pounds each. It seemed difficult enough to spend a lifetime in preparing the book, without being obliged to perform the irksome and trying task of selling it; but fame asks Herculean labors of its votaries.

Often he was pained by ill-mannered refusals.

How few are like Longfellow, who could say "no" so kindly, that it almost seemed like "yes." Audubon tells, in his journal, of an interview with the great banker Rothschild. On opening the letter brought by the naturalist, the baron said, "This is only a letter of introduction, and I expect from its contents that you are the publisher of some book or other, and need my subscription."

No man can be truly great who knows how to be uncivil!

"Sir," he added, "I never sign my name to any subscription list, but you may send in your work and I will pay for a copy of it. I am busy, I wish you good-morning."

When the book was sent, the baron exclaimed, "What, two hundred pounds for birds! Why, sir, I will give you five pounds, and not a farthing more!" This offer was "declined with thanks," and the book taken back to the publishers.

Very different from Rothschild was Sir Thomas Lawrence, the painter. Overwhelmed with work, he insisted on Audubon's remaining to his simple breakfast of boiled eggs and coffee, called at his rooms later, examined his drawings, and said he would bring a few purchasers, that very day. "In about two hours," says Audubon, "he returned with two gentlemen, to whom he did not introduce me, but who were pleased with my work, and one purchased the 'Otter Caught in a Trap,' for which he gave me twenty pounds sterling, and the other, 'A Group of Common Rabbits,' for fifteen sover-

eigns. I took the pictures to the carriage which stood at the door, and they departed, leaving me more amazed than I had been by their coming.

"The second visit was much of the same nature, differing, however, chiefly in the number of persons he brought with him, which was three instead of two; each one of whom purchased a picture, at seven, ten, and thirty-five pounds respectively; and, as before, the party and the pictures left together in a splendid carriage with liveried footmen. I longed to know their names, but, as Sir Thomas was silent respecting them, I imitated his reticence in restraining my curiosity, and remained in mute astonishment. . . .

"Without the sale of these pictures, I was a bankrupt, when my work was scarcely begun, and in two days more I should have seen all my hopes of the publication blasted; for Mr. Havell, the engraver, had already called to say that on Saturday I must pay him sixty pounds. I was then not only not worth a penny, but had actually borrowed five pounds a few days before, to purchase materials for my pictures. But these pictures which Sir Thomas sold for me enabled me to pay my borrowed money, and to appear full-handed when Mr. Havell called. Thus I passed the Rubicon!"

Blessings on thee, Sir Thomas Lawrence, carrying out Emerson's divine motto, "Help somebody!"

But Audubon did something more than try to obtain subscribers for his book. He says: "At

that time I painted all day, and sold my work during the dusky hours of evening, as I walked through the Strand and other streets where the Jews reigned; popping in and out of Jew shops or any others, and never refusing the offers made me for the pictures I carried fresh from the easel. Startling and surprising as this may seem, it is nevertheless true, and one of the curious events of my most extraordinary life. Let me add here, that I sold seven copies of the 'Entrapped Otter,' in London, Manchester, and Liverpool, besides one copy presented to my friend Mr. Richard Rathbone. In other pictures, also, I have sold from seven to ten copies, merely by changing the course of my rambles; and strange to say, that when, in after years and better times, I called on the different owners to whom I had sold the copies, I never found a single one in their hands."

Painting all day, and selling his pictures at night along the streets of London, all to bring out the "Birds of America"! What a life history is between the leaves of that great work!

Sometimes, in his wanderings, he met poverty that made him "sick of London;" an artist making caricatures, while his wife and six little children begged; but he always gave part of what he had, and went back to his work, more than ever determined to win.

September 1, 1828, Audubon went to Paris, going first to Baron Cuvier. He was busy — who is not that accomplishes anything? — and, while he

cordially invited Audubon to dine, went on studying a small lizard. "Great men show politeness in a particular way," says Audubon; "they receive you without much demonstration; a smile suffices to assure you that you are welcome, and keep about their avocations as if you were a member of the family."

Cuvier made a report of Audubon's work to the Academy of Sciences. He said, "It may be described in a few words as the most magnificent monument which has yet been erected to ornithology. . . . Formerly the European naturalists were obliged to make known to America the riches she possessed. . . . If that of Mr. Audubon should be completed, we shall be obliged to acknowledge that America, in magnificence of execution, has surpassed the world."

Audubon also made the acquaintance of Baron Humboldt, Geoffroy Saint-Hilaire, and of Gérard, the painter, who said, "You are the king of ornithological painters. We are all children in France or Europe. Who would have expected such things from the woods of America!"

After two months in Paris, he returned to London, and soon sailed for America. Once on his native soil, he says, "My heart swelled with joy, and all seemed like a pleasant dream at first; but as soon as the reality was fairly impressed on my mind, tears of joy rolled down my cheeks. I clasped my hands, and fell on my knees, and, raising my eyes to heaven, I offered my thanks to

our God, that he had preserved and prospered me in my long absence, and once more permitted me to approach these shores so dear to me, and which hold my heart's best earthly treasures."

He soon reached the Bayou Sara, and "came suddenly on my dear wife: we were both overcome with emotion, which found relief in tears."

He remained with his wife three months, collecting birds and making drawings, and then both sailed together for England.

During his absence he had been made a fellow of the Royal Society of London, much to his delight. Now that his "Birds of America" was coming out, he began earnestly upon a new work, "Ornithological Biography of the Birds of America," containing nearly three thousand pages, and published for him by Mr. Black of Edinburgh. Two publishers refused this famous work, and Audubon published at his own expense. The first volume was finished in three months, and Mrs. Audubon copied it entire to send to America to secure copyright.

Audubon worked untiringly. He wrote all day long, and "so full was my mind of birds and their habits, that in my sleep I continually dreamed of birds."

The "Birds of America" received good reviews in "Blackwood's Magazine," and elsewhere. Audubon said, "I have balanced my accounts with the 'Birds of America,' and the whole business is really wonderful; eight thousand pounds have passed

through my hands for the completion of the first volume. Who would believe that a lonely individual, who landed in England without a friend in the whole country, and with only sufficient pecuniary means to travel through it as a visitor, could have accomplished such a task as this publication! Who would believe that once, in London, Audubon had only one sovereign left in his pocket, and did not know of a single individual to whom he could apply to borrow another, when he was on the verge of failure in the very beginning of his undertaking! And, above all, who would believe that he extricated himself from all his difficulties, not by borrowing money, but by rising at four o'clock in the morning, working hard all day, and disposing of his works at a price which a common laborer would have thought little more than sufficient remuneration for his work!"

In the four years required to bring out the work, fifty-six of his subscribers, representing the sum of eleven thousand pounds, abandoned him, and he was obliged to leave London, and go into the provinces to supply their places.

September 3, 1831, Audubon returned to America, spent the winter in Eastern Florida, searching for birds and animals, and then some months in Labrador, having sent Victor to England to superintend the engraving of the drawings. In Labrador he collected one hundred and seventy-three skins of birds, and studied carefully the habits of the eider-duck, loons, wild geese, and other birds. Some-

times he was so weary from drawing that "my neck and shoulders, and most of all my fingers, have ached from the fatigue. The fact is, I am growing old too fast, alas! I feel it, and yet work I will, and may God grant me life to see the last plate of my mammoth work finished.

"Labrador is so grandly wild and desolate," he said, "that I am charmed by its wonderful dreariness. . . . And yet how beautiful it is now, when your eye sees the wild bee, moving from one flower to another in search of food, which doubtless is as sweet to her as the essence of the orange and magnolia is to her more favored sister in Louisiana. The little ring-plover rearing its delicate and tender young; the eider-duck swimming man-of-war-like amid her floating brood, like the guardship of a most valuable convoy; the white-crowned bunting's sonorous note reaching your ears ever and anon; the crowds of sea-birds in search of places wherein to repose or to feed."

On his return from Labrador, he went to Philadelphia, where he was arrested for one of his old partnership debts, and would have been taken to prison except for a friend who kindly offered bail. From here he went to the house of an old friend, Rev. John Bachman of Charleston, S. C., whose two daughters subsequently married the two sons of Audubon, Victor and John. He returned to London, and in 1834 and 1835 published the second and third volumes of the "Ornithological Biography."

In 1836 he came back to America for further research, and received a warm welcome from distinguished men. Daniel Webster and Washington Irving became his earnest friends. The latter said that his work "was highly creditable to the nation," and deserved "national patronage." He dined with Andrew Jackson at the White House. On his return to England he wrote the fourth volume of the "Ornithological Biography," and the fifth the following year.

This year, 1839, he returned to America to spend the rest of his life, purchased a home on the banks of the Hudson in upper New York, which he called "Minnie's Land," the Scotch word for mother, this being the name by which he generally addressed his wife, to whom he left the whole of it at his death.

He was now sixty, but his work was not done. He immediately began to bring out his "Birds of America" in seven octavo volumes, with the figures reduced and lithographed. He exhibited in New York his wonderful collection of drawings, several thousands of birds and animals, all the size of life, by his own hands.

In 1843, taking his son Victor, he started on an expedition to the Yellowstone River, to collect animals and drawings for another great work, the "Quadrupeds of North America." After nearly a year he returned, and began his book. In two years the first volume was ready; but after this he could do no more. The rest of the great work was finished by his sons after his death.

In 1848 the quick, active mind failed. His wife read to him, led him like a child, and at the last fed him. One, at least, had never failed him, since the day when she gave the money she earned to send him to Europe to win renown.

On Thursday morning, January 27, 1851, the eyes dulled for so long once more showed their former lustre and beauty. Audubon did not speak, but he seemed to know that the time had come for the last journey. He reached out his arms, clasped the hands of his wife and children, and died.

Four days later, surrounded by distinguished friends, he was buried in Trinity Church cemetery, where his sons now rest beside him. A singularly guileless, sweet-natured man, who willed to do all this great work when a boy, and achieved it when a man, because he had willed it.

Well says General James Grant Wilson, in the life of Audubon so admirably prepared by his wife, "Long after the bronze statue of the naturalist, that we hope soon to see erected in the Central Park, shall have been wasted and worn beyond recognition by the winds and rains of Heaven, while the towering and snow-covered peak of the Rocky Mountains known as Mount Audubon shall rear its lofty head among the clouds, while the little wren chirps about our homes and the robin and reed-bird sing in the green meadows, while the melody of the mocking-bird is heard in the cypress swamps of Louisiana, or the shrill scream of the

eagle on the frozen shores of the Northern seas, the name of John James Audubon, the gifted artist, the ardent lover of nature, and the admirable writer, will live in the hearts of his grateful countrymen."

SAMUEL FINLEY BREESE MORSE.

SAMUEL F. B. MORSE was born at the foot of Breed's Hill, Charlestown, Mass., April 27, 1791. He was the eighth child in a family of eleven children, all of whom, except three sons, Samuel, Richard, and Sidney, died in their infancy.

The father, Jedediah Morse, was a doctor of divinity, having studied under Jonathan Edwards, and was also a journalist and writer of books. He helped to establish the "Boston Recorder," now the "Congregationalist," and with others laid the foundations of the Theological Seminary at Andover, the American Board of Foreign Missions, the American Bible Society, and the American Tract Society. He was an impulsive, hopeful man of wonderful energy, and, as Daniel Webster said, he was "always thinking, always writing, always talking, always acting."

His wife, Elizabeth Ann Breese, was the granddaughter of Samuel Finley, President of Princeton College, a woman of strong will, excellent judgment, and extremely pleasant manners. From the one, the boy Finley inherited energy and hope; from the other, agreeable manners and indomitable perseverance.

At four years of age Finley was sent to a school near the parsonage, kept by "Old Ma'am Rand." Being an invalid, she governed with a long rattan which reached from her chair across the schoolroom. Finley, early developing artistic tastes, sketched the teacher's face with a pin on a chest of drawers. Probably the picture was not handsome, for the offender was punished by being pinned to her dress. Breaking away, and carrying part of the dress with him, the rattan did its appropriate work!

At seven he was sent to a school at Andover, and fitted for Phillips Academy. He received helpful letters from his father. At ten, Dr. Morse writes him: "Your natural disposition, my dear son, renders it proper for me earnestly to recommend to you to *attend to one thing at a time;* it is impossible that you can do two things well at the same time, and I would therefore never have you attempt it. Never undertake to do what ought not to be done, and then, whatever you undertake, endeavor to do it in the best manner. It is said of DeWitt, a celebrated statesman in Holland, who was torn to pieces in the year 1672, that he did the whole business of the republic, and yet had time left to go to assemblies in the evening, and sup in company.

"Being asked how he could possibly find time to go through so much business, and yet amuse himself in the evenings as he did, he answered: 'There was nothing so easy, for that it was only

doing one thing at a time, and never putting off anything till to-morrow that could be done to-day.' This steady and undissipated attention to one object is a sure mark of a superior genius, as hurry, bustle, and agitation are the never-failing symptoms of a weak and frivolous mind."

At this early age Finley pored over Plutarch's "Lives of Illustrious Men," and resolved, as many another boy from reading these volumes, to be somebody. There is scarcely a more important thing for a child than that parents should put into his or her hands stimulating and helpful books. When Finley was thirteen, he wrote a sketch of the "Life of Demosthenes," and sent it to his father.

At fourteen he was admitted to the Freshman class at Yale, but did not attend college till the following year. He was a good scholar in geometry and history, but was especially fond of natural philosophy and chemistry. Under Professor Jeremiah Day he began to study electricity, and witnessed the following experiments with great interest: "Let the fluid pass through a chain, or through any metallic bodies placed at small distances from each other, the fluid in a dark room will be visible between the links of the chain, or between the metallic bodies. . . . If the circuit be interrupted by several folds of paper, a perforation will be made through it, and each of the leaves will be protruded by the stroke from the middle to the outward leaves."

Writing upon this subject sixty years afterward,

Morse said, "The fact that the presence of electricity can be made visible in any desired part of the circuit was the crude seed which took root in my mind, and grew up into form, and ripened into the invention of the telegraph."

Under Professor Benjamin Silliman, a name greatly honored in science, Morse found great delight and profit. He wrote to his parents, that he should bring home "a chemical trough, gun-barrels, retorts, etc."

With this fondness for science, Morse showed a decided ability in art. He took pictures of his classmates, at one dollar each, and miniatures on ivory at five dollars each, thus helping to pay his expenses. The price charged was very low, but possibly it was all the pictures were worth, for as yet he had never taken a lesson.

Long before his college course was at an end, he had decided to become a painter, probably much against the unspoken wishes of his parents, who must have felt that poverty would be his companion, for some years, at best.

On going home to Charlestown, he attended a course of anatomical and surgical lectures in Boston. Washington Allston, then at the head of his profession in America, had spent two years in Boston, and was about to return to Europe. Morse went with him and took lodgings in London. At once he wrote home, "I only wish you had this letter now to relieve your minds from anxiety, for while I am writing I can imagine mother wishing

that she could hear of my arrival, and thinking of thousands of accidents which may have befallen me. I *wish that in an instant I could communicate the information; but three thousand miles are not passed over in an instant, and we must wait four long weeks before we can hear from each other.*"

On the outside of this letter, yellow with age, he wrote toward the end of his life, "LONGING FOR A TELEGRAPH EVEN IN THIS LETTER."

In London he soon met Benjamin West, born in Springfield, Penn., then at the head of the Royal Academy in England. He had been poor and obscure; now he was distinguished, and courted even by royalty. Morse, ever ambitious, soon arranged to study under West, and became his devoted admirer. He wrote home: "Mr. West is in his seventy-fourth year, but to see him you would suppose him only about five-and-forty. . . . He expressed great attachment to his native country, and he told me, as a proof of it, he presented them with this large picture ('Christ Healing the Sick'). I walked through his gallery of paintings of his own production. There were upwards of two hundred, consisting principally of the original sketches of his large pieces. He has painted in all upward of six hundred pictures, which is more than any artist ever did, with the exception of Rubens. Mr. West is so industrious now that it is hard to get access to him, and then only between the hours of nine and ten in the morning. He is

working on eight or nine different pieces at present, and seems to be more enthusiastic than he ever was before. . . . No man, perhaps, ever passed through so much abuse, and I am confident no one ever bore up against its insolence with more nobleness of spirit. With a steady perseverance in the pursuit of the sublimest profession, he has travelled on, heedless of his enemies, till he is sure of immortality.

"Excuse my fervor in the praise of this extraordinary man. . . . I think there can be no stronger proof that human nature is the same always, than that men of genius in all ages have been compelled to undergo the same disappointments, and to pass through the same storms of calumny and abuse, doomed in their lifetime to endure the ridicule or neglect of the world, and to wait for justice till they were dead."

How well, unknowingly, Morse foretold his own career; disappointments, abuse, ridicule!

Stimulated by the industry and renown of West, he worked at his drawing from half-past seven in the forenoon until five in the afternoon, and then again in the evening. He learned what all persons learn, sooner or later, that there is no easy road to fame.

West encouraged the young artist, and this added fuel to the flame of ambition. Desiring admission to the Royal Academy, he spent two weeks in making a drawing from a small cast of the Farnese Hercules. Showing it to Mr. West for

his criticism, West said, "Very well, sir, very well; go on and finish it."

"It *is* finished," replied Morse.

"Oh, no," said Mr. West; "look here, and here, and here."

Morse drew a week longer, and again presented it. "Very well, indeed, sir," he said; "go on and finish it."

"Is it not finished?" asked Morse, half discouraged.

"Not yet," said West; "see, you have not marked that muscle, nor the articulations of the finger-joints."

A third time he presented the drawing, and received the same advice as before. "I cannot finish it," said Morse, despairingly.

"Well," said West, "I have tried you long enough. Now, sir, you have learned more by this drawing than you would have accomplished in double the time by a dozen half-finished beginnings. It is not numerous drawings, but the *character of one*, which makes a thorough draughtsman. *Finish* one picture, sir, and you are a painter."

Morse was now admitted to the Royal Academy, and had visions of becoming great. He writes home: "I have just finished a model in clay of a figure ('The Dying Hercules'), my first attempt at sculpture. Mr. Allston is extremely pleased with it; he says it is better than all the things I have done since I have been in England, put together, and says I must send a cast of it home to you, and

that it will convince you that I shall make a painter. . . . Mr. West also was extremely delighted with it. He said it was not merely an academical figure, but displayed *thought.* He could not have paid me a higher compliment. . . . My passion for my art is so firmly rooted that I am confident no human power could destroy it. The more I study, the greater I think is its claim to the appellation of *divine,* and I never shall be able sufficiently to show my gratitude to my parents for enabling me to pursue that profession without which I am sure I should be miserable. And if it is my destiny to become GREAT, and *worthy of a biographical memoir,* my biographer will never be *able to charge* upon my parents that bigoted attachment to any individual profession, the exercise of which spirit by parents toward their children has been the ruin of some of the greatest geniuses."

The model of the "Dying Hercules" was sent to the Society of Arts at the Adelphi, and Morse received the *gold medal* given for the *best* work in painting, sculpture, and architecture.

Morse had taken letters of introduction to several prominent persons, like Wilberforce and Zachary Macaulay, the father of the historian, but he was too busy to use them. He gives another reason also — poverty. He says, "With regard to my expenses, I got through the first year with two hundred pounds, and hope the same sum will carry me through the second. If you knew the manner in which we live, you would wonder how

it was possible I could have made so great a change in my habits. I am obliged to screw and pinch myself in a thousand things in which I used to indulge myself at home. . . . I breakfast on simple bread and butter, and two cups of coffee; I dine on either beef, mutton, or pork (*veal* being out of the question, as it is one shilling and six pence per pound), baked, with potatoes, warm perhaps twice a week, all the rest of the week cold; at tea, bread and butter, with two cups of tea. This is my daily round.

"I have had no new clothes for nearly a year; my best are threadbare, and my shoes are out at the toes; my stockings all want to see my *mother*, and my hat is growing hoary with age. . . . 'But,' you will say, 'what do you do with the money, if you live thus sparingly?' Why, I will tell you the whole. When I first came to London, I was told, if I meant to support the character of a gentleman, I must take especial care of my personal appearance; so I thought it a matter of course that I must spare no expense in order to appear well. So, this being first in my mind, I (supposing very wisely that London folks had nothing else to do but to see how I was dressed) laid out a considerable part of my money on myself; meanwhile, picture-galleries and collections, with many other places which I ought constantly to have visited, and which cost some money, were neglected. And why? Because *I could not afford it.*

"Well, in process of time, I found no very par-

ticular advantage to be gained by supporting the character of a gentleman, for these reasons: in the first place, *nobody saw me;* in the second place, if they *had seen me,* they would not *have known me;* and, thirdly, if they had *known* me, they would not have *cared* a farthing about me. So I thought within myself what I came to England for, and I found that it was not to please English folks, but to study painting; and, as I found I must sacrifice painting to dress and visiting, or dress and visiting to painting, I determined on the latter, and ever since have lived accordingly, and now the tables are turned. I visit galleries and collections, purchase prints, etc.; and when I am asked why I don't pay more attention to my dress, I reply that I *cannot* afford it."

Morse had now painted the "Death of Hercules," a large picture, eight feet by six feet and a half. The painting was received at the exhibition at Somerset House, though six hundred other works were refused. It was adjudged by the press to be one of the best *nine* among a thousand pictures; many of them by such men as Turner, Lawrence, and Wilkie. Surely, he had reason to be encouraged.

What little leisure Morse could obtain he spent in reading the old poets, — Spenser, Chaucer, Dante, and Tasso. He now made the acquaintance of Rogers, Coleridge, and others. Once, as he was going into the country with Coleridge, he took in the carriage Irving's "History of New York." On

retiring, Coleridge took the book and began to read. Morse fell asleep, and in the morning was surprised to find the lights burning, and his friend still reading. It was now ten o'clock, and Coleridge was so absorbed that he did not know that the whole night had passed. Later, Irving and Coleridge became warm friends.

In need of money, Morse repaired to Bristol, where he spent several months, having had the promise of work; but not a single person called to look at his pictures, and not one came for a portrait. He had already been abroad four years, and now stern necessity called him home. He had just finished a large picture, "The Judgment of Jupiter in the Case of Apollo, Marpessa, and Ida," to compete for the highest prize offered by the Royal Academy for historical composition; but as he could not be present to receive the premium, he was not allowed to enter the picture. He accordingly brought it home with him, arriving in Boston October 18, 1815.

Dr. Morse had engaged a studio for his son in Boston, and the "Judgment of Jupiter" was opened for exhibition. People came, and saw, and praised, and went away without leaving any orders for pictures. A year went by, and not one person offered to buy the "Judgment of Jupiter," and not one person ordered a historical work. This was indeed discouraging to an enthusiastic artist. He began now to turn his mind toward invention, for which he had a natural tendency; and during the

evenings he thought out an improvement in the common pump, one that could be adapted to the forcing-pump in the fire-engine. The pump and the "Judgment of Jupiter" certainly had not very much in common.

The patent pump was put on exhibition on Gray's Wharf in Charlestown, but it did not cause money to flow into the pockets of its inventor.

Disappointed in his art work, Morse took letters of introduction from his father to several ministers in the neighboring towns, and started out to paint portraits at fifteen dollars apiece. This was not very much better than the five-dollar miniatures on ivory while in college, especially as he had been to the expense of four years in Europe.

At Concord, N. H., he had good success, writing home that he had "painted five portraits, had two more engaged, and many more talked of." While in London he had written to his parents, "I came very near being at my old game of falling in love; but I find that *love* and *painting* are quarrelsome companions, and that the house of my heart was too small for both of them, so I have turned *Mrs. Love* out-of-doors. 'Time enough,' thought I (with true old-bachelor complacency), 'time enough for you these ten years to come.'"

But Morse did not wait ten years, for at twenty-four he fell in love with Lucretia P. Walker of Concord, and was engaged to her. She was not only beautiful, but of the same lovable and intellectual type as Grace Webster, who held the heart

of Daniel Webster while he lived. She combined sound judgment with much tenderness of feeling. Morse was a tall, graceful, handsome young man, with blue eyes and winsome manners.

Dr. Morse and his wife at once sent for their prospective daughter to visit them. She came, and, as she pleased a mother who idolized Finley, it is safe to conclude that she was indeed lovely.

In January, 1818, having been assured that he would find work in Charleston, S. C., he sailed from New York, and met with a pleasant reception in the home of his uncle, Dr. Finley. He found the society agreeable, but month after month passed, and there was not a single request for a portrait. At last, as he was about to return to New England, he begged his uncle to sit for a painting, as a small return for his kindness. He did so, and an admirable picture resulted.

Friends came to see it. At once Charleston perceived that a real artist was in the city. He soon had one hundred and fifty orders at twelve pounds each! Hope came again to his heart; after a few months he returned to Boston, and October 1, 1818, he married Lucretia Walker.

At the request of the Common Council of Charleston, he now painted the portrait of James Monroe, then President of the United States, and a year later went again to South Carolina, leaving his wife and an infant daughter in Concord, with her parents. On his return, Dr. Morse having resigned his pastorate at Charlestown, and moved to

New Haven, Ct., Finley also moved thither. Here he found delight in renewing his studies of galvanism and electricity under Professor Silliman.

Tiring of portraits, and longing for preëminence in art, he conceived the idea of a historical piece, the "House of Representatives," with eighty portraits of individual members. For this purpose he went to Washington, and began his work in earnest. He writes to his young wife: "I am up at daylight, have my breakfast and prayers over, and commence the labors of the day long before the workmen are called to work on the Capitol by the bell. This I continue unremittingly till one o'clock, when I dine in about fifteen minutes, and then pursue my labors until tea, which scarcely interrupts me, as I often have my cup of tea in one hand and pencil in the other. Between ten and eleven o'clock I retire to rest. This has been my course every day (Sundays, of course, excepted) since I have been here, making about fourteen hours study out of the twenty-four. This, you will say, is too hard, and that I shall injure my health. I can say that I never enjoyed better health, and my body, by the simple fare I live on, is disciplined to this course. . . . I have had a great deal of difficulty with the perspective of my picture. But I have conquered, and have accomplished my purpose. After having drawn in the greater part three times, I have as many times rubbed it all out again. I have been, several

times, from daylight until eleven o'clock at night, solving a simple problem.

"How I do long to see that dear little girl of mine, and to hear her sweet prattle! Instruct her early, my dear wife, in the most important of all concerns; teach her that there is a great Father above, her obligations to Him and to her Saviour. Kiss her often for papa, and tell her he will come back one of these days."

So absorbed did he become in this picture, that once he arose in the night, mistaking the light of the moon for the day, and went to his work, and another time attempted to enter the hall on Sunday, forgetting even the days of the week. When the work was finished and exhibited, everybody was too much interested in his own affairs to care about congressmen, and the picture failed to attract the public. It proved a loss pecuniarily, and was purchased by an Englishman and taken to England. Twenty-five years afterward, it was found in the third story of a store in New York, nailed against a board partition, and covered with dust. It had been sent over from London by a house which had advanced a sum of money upon it while in England. The picture afterward became the property of the artist Daniel Huntington.

Morse now went to Albany, hoping to obtain some patronage from public men. After long waiting, he writes to his wife: "I have not as yet received any application for a portrait. Many tell me I have come at the wrong time — the same tune

that has been rung in my ears so long! I hope the right time will come by and by. The winter, it is said, is the proper season; but, as it is better in the South in that season, and it will be more profitable to be there, I shall give Albany a thorough trial and do my best. If I should not find enough to employ me here, I think I shall return to New York and settle there. This I had rather not do at present, but it may be the best that I can do. Roaming becomes more and more irksome. Imperious necessity alone drives me to this course. Don't think by this I am faint-hearted. I shall persevere in this course, painful as is the separation from my family, until Providence clearly points out my duty to return."

Morse now turned his attention to the invention of a machine for carving marble, from which he hoped for pecuniary success, but success did not result from it. He now went to New York to try his fortune. But things were no brighter.

He wrote to Lucretia: "My last two letters have held out to you some encouraging prospects of success here, but now they seem darkened again. I have had nothing to do this week thus far but to wait patiently. I have advertised in both of the city papers that I should remain one week to receive applications, but as yet it has produced no effect. . . . I sleep in my room on the floor, and put my bed out of sight during the day, as at Washington. . . . I have been active in calling on my friends and inviting them to my room; they

have promised to come, but as yet few have called. As far as human foresight can perceive, my prospects seem gloomy indeed. The only gleam of hope — and I cannot underrate it — is from confidence in God. When I look upward, it calms my apprehensions for the future, and I seem to hear a voice saying: 'If I clothe the lilies of the field, shall I not also clothe you?' Here is my strong confidence, and I will wait patiently for the direction of Providence."

Again he writes to his wife: "My cash is almost gone, and I begin to feel some anxiety and perplexity to know what to do. I have advertised, and visited, and hinted, and pleaded, and even asked one man to sit, but all to no purpose. . . . My expenses, with the most rigid economy too, are necessarily great; my rent to-morrow will amount to thirty-three dollars, and I have nothing to pay it with. What can I do? I have been here five weeks, and there is not the smallest prospect *now* of any difference as to business."

He now attempted to obtain a situation in the legation about to be sent to Mexico. The place was promised, and Morse went to Washington, only to find that the expedition had been abandoned.

There was an occasional rift in the clouds, as when the corporation of the city of New York commissioned Morse to paint for them a portrait of General Lafayette, then in Washington, the price to be about one thousand dollars. As Sully, Peale,

Inman, and other prominent artists were competitors in the application for this picture, to receive the commission was indeed an honor.

Morse now wrote cheerfully to his wife: "When I consider how wonderfully things are working for the promotion of the great and *long desired* event, — that of being constantly with my dear family, — all unpleasant feelings are absorbed in this joyful anticipation, and I look forward to the spring of the year with delightful prospects of seeing my dear family permanently settled with me in our own hired house here."

February 8, 1825, he wrote his wife that he had met Lafayette, "the man whose beloved name has rung from one end of this continent to the other, whom all flock to see, whom all delight to honor."

That very day a letter was penned him, not this time by the wife, but by his father. "My affectionately beloved son: Mysterious are the ways of Providence. My heart is in pain and deeply sorrowful, while I announce to you the sudden and unexpected death of your dear and deservedly loved wife. Her death proved to be an *affection of the heart, incurable* had it been known. . . . I wrote you yesterday that she was *convalescent.* So she then appeared and so the doctor pronounced. She was up about five o'clock yesterday afternoon, to have her bed made, as usual; was unusually cheerful and social; spoke of the pleasure of being with her dear husband in New York ere long;

stepped into bed herself, fell back, with a momentary struggle, on her pillow; her eyes were immediately fixed, the paleness of death overspread her countenance, and in five minutes more, without the slightest motion, her mortal life terminated.

"It happened that, just at this moment, I was entering her chamber-door, with Charles in my arms, to pay her my usual visit, and to pray with her. The nurse met me affrighted, calling for help. Your mother, the family, and neighbors, full of the tenderest sympathy and kindness, and the doctor, thronged the house in a few minutes; everything was done that could be done, to save her life. But her appointed time had come, and no earthly skill or power could stay the hand of death. It was the Lord who gave her to you, the chiefest of all your earthly blessings, and it is he that has taken her away; and may you be enabled, my son, from the heart to say, 'Blessed be the name of the Lord!'"

The heart of Morse was well nigh broken. The woman he had idolized had gone from him in a moment. He wrote back to his father: "Oh, is it possible? is it possible? Shall I never see my dear wife again? But I cannot trust myself to write on the subject. I need your prayers, and those of Christian friends, to God for support. I fear I shall sink under it.

"Oh, take good care of her dear children!

"Your agonized son,

"FINLEY."

Travelling by stage, he did not reach New Haven till his wife had been buried a week. A month later he wrote to a friend: "I dare not yet give myself up to the full survey of its desolating effects; every day brings to my mind a thousand new and fond connections with dear Lucretia, all now ruptured. I feel a dreadful void, a heart-sickness, which time does not seem to heal, but rather to aggravate. You know the intensity of the attachment which existed between dear L. and me, never for a moment interrupted by the smallest cloud; an attachment founded, I trust, in the purest love, and daily strengthening by all the motives which the ties of *nature* and more especially of *religion* furnish.

"I found in dear L. everything that I could wish. Such ardor of affection, so uniform, so unaffected, I never saw nor read of, but in her. My fear with regard to the measure of my affection toward her, was not that I might fail of 'loving her as my own flesh,' but that I should put her in the place of Him who has said, 'Thou shalt have no other gods but me.' I felt this to be my greatest danger, and to be saved from this *idolatry* was often the subject of my earnest prayers. If I had desired anything in my dear L. different from what she was, it would have been that she had been *less lovely.* My whole soul seemed wrapped up in her; with her was connected all that I expected of happiness on earth."

She was but twenty-five, and had shared only the

sorrows and privations of her young husband. How pitiful it seemed that she could not live to share his grand success. Whatever may come into a man's life afterwards, he never forgets an affection like this. It blossoms in the warm sunlight of his youth; it never withers, even though other flowers take root in the heart.

Truly says George Eliot: "There is no despair so absolute as that which comes with the first moments of our first great sorrow, when we have not yet known what it is to have suffered and be healed, to have despaired and to have recovered hope."

This despair seemed to have settled upon Morse. He went back to New York, and now had plenty of work, but he said, "After being fatigued at night, and having my thoughts turned to my irreparable loss, I am ready almost to give up. The thought of seeing my dear Lucretia, and returning home to her, served always to give me fresh courage and spirits whenever I felt worn down by the labors of the day, and now I hardly know what to substitute in her place."

Hard, indeed, it seemed, that this "plenty of work" did not come in Lucretia's life-time. Why are so many of the best and sweetest things in this world a little too late in their coming? Is it because perfection attained is not best for mortals?

About this time the National Academy of Design was organized, and Morse was made president,

holding this position for eighteen years, till his work on the telegraph required his whole attention. These years were extremely busy years. So numerous were his sitters, that he was obliged to send many to his artist friends. In his evenings he prepared a series of lectures on the Fine Arts, which he delivered to large and fashionable audiences at the New York Athenæum. He also wrote at this time a life of Lucretia Maria Davidson, a young poet who died at Plattsburg, N. Y., when she was seventeen, and several pamphlets against the growing power of the Romish Church.

Four years after the death of his wife he sailed for Italy, still further to study his beloved art. In London he again met Rogers, the poet, — "he has not the proverbial lot of the poet, — he is not poor, for he is one of the wealthiest bankers, and lives in splendid style," said Morse, — Turner, "the best landscape-painter living," Irving, our secretary of legation, and other distinguished men.

For three years Morse remained in Europe, in Rome becoming the friend of Thorwaldsen, whose portrait he painted; in Florence, of Horatio Greenough, the sculptor, of James Fenimore Cooper, and many others. In Paris, Morse painted the "Gallery of the Louvre," working from nine till four daily, meeting Baron Humboldt, and receiving the cordial hospitality of General Lafayette.

October 1, 1832, he sailed from Havre, on the packet ship Sully, for New York. That passage marked an epoch not only in the life of S. F. B.

Morse, but an epoch in American progress. At the dinner-table the conversation turned upon recent discoveries in electro-magnetism, and the experiments of Ampère with the electro-magnet. Morse said, "If the presence of electricity can be made visible in any part of the circuit," and he had seen that it could years before in the class-room at Yale College, "I see no reason why intelligence may not be transmitted instantaneously by electricity."

He thought the subject over as he walked upon the deck, and as he lay in his berth, too deeply interested to sleep. If intelligence could be transmitted, it could be recorded. He took from his pocket a note-book, and thought out his alphabet of dots and lines. He showed his sketches to his fellow-passengers, — not a wise thing, as it proved, when, later, one of the persons on board laid claim to the invention, causing some years of litigation.

When the vessel reached New York, Morse said, "Well, captain, should you hear of the telegraph one of these days as the wonder of the world, remember the discovery was made on board the good ship Sully."

Electricity had been known and studied since early times. It had been ascertained that the electric force could be stored up, as in the Leyden jar, and that it could be conducted through long metallic wires. The discovery of the Voltaic pile, or battery, in 1800, gave a great impetus to the study. Oersted of Copenhagen found that the position of the magnetic needle may be changed

by the electric current, and that a magnet will induce electricity in a coil of wire. Schweigger of Halle discovered that "the deflection of the needle may be increased by coiling an insulated wire in a series of ovals or flat rings, compactly disposed, in a loop, and conducting the current around the needle from end to end." Ampère developed the theory of electro-magnetism, and proposed to the French Academy in 1820 a plan for a telegraph, in which there was to be a needle for each letter.

In 1827 Morse had listened to a course of lectures, given by Prof. James Freeman Dana, upon these matters, so that the subject was still fresh in his mind when he crossed the ocean in the Sully. Prof. Joseph Henry's important discoveries were also well known.

Says Prof. E. N. Horsford of Cambridge, Mass., in the admirable life of Morse written by Dr. Samuel Irenæus Prime: "He knew generally, when he stepped on board the Sully, in 1832, that a soft-iron horseshoe-shaped bar of iron could be rendered magnetic while a current of galvanic electricity was passing through a wire wound round it; and he knew that electricity had been transmitted, apparently instantaneously, through wires of great length, by Franklin and others. . . . In the leisure of ship-life the idea of a *recording* electric telegraph seized Professor Morse's mind, and he gave expression to his conviction that it was *possible*. As it was possible to *dispatch* and to

arrest the current, he conceived that some device could be found for compelling it to manifest itself by this intermittent action, and produce a record.

"He knew, for he had witnessed it years before, that by means of a battery and an electro-magnet reciprocal motion could be produced. He knew that the force which produced it could be transmitted along a wire. He *believed* that the battery current could be made, through an electro-magnet, to produce physical effects at a *distance*. He saw in his mind's eye the existence of an agent and a medium by which reciprocal motion could be not only produced, but *controlled*, at a *distance*. The question that addressed itself to him at the outset was naturally this: 'How can I make use of the simple up-and-down motion of opening and closing a circuit to write an intelligible message at one end of a wire, and at the same time print it at the other?' . . .

"Like many a kindred work of genius, it was in nothing more wonderful than in its simplicity. First, he caused a continuous ribbon or strip of paper to move under a pencil by clock-work, that could be wound up. The paper moved horizontally. The pencil moved only up and down; when resting on the paper it made a mark — if for an instant only, a dot; if for a longer time, a line. When lifted from the paper it left a blank. . . . The grandeur of this wonderful alphabet of dots, lines, and spaces has not been fully appreciated. . . .

"Not one of all the brilliant scientific men who have attached their names to the history of electro-magnetism had brought the means to produce the practical registering telegraph. Some of them had ascended the tower that looked out on the field of conquest. Some of them brought keener vision than others. Some of them stood higher than others; but the genius of invention had not recognized them. There was needed an inventor."

As soon as Morse left the ship Sully, and met his brothers Richard and Sidney, he told them that he had made an important invention, "one that would astonish the world, and of the success of which he was perfectly sanguine." He became an inmate of Richard's house, living there several months.

From this time onward for twelve years he labored to give his telegraph to mankind; labored in the midst of distressing poverty, the ridicule of acquaintances, and the indifference of the world. Three motherless children were dependent upon him, but he could do little for them.

On the corner of Nassau and Beekman Streets, in the newspaper building erected by his brothers, —they were the editors and proprietors of the "New York Observer,"—in the fifth story, a room was assigned to him which he used for studio, sleeping-room, kitchen, and workshop. On one side was his cot, on the other his tools and crude machine. He whittled the models, and then made the moulds and castings. Here, from day to day,

the simplest food was brought him, he preparing his own tea.

In the year 1835, having been appointed professor of the Literature of the Arts of Design in the New York City University, he took rooms in the third story of the university building. "There," he says, "I immediately commenced, with very limited means, to experiment upon my invention. My first instrument was made up of an old picture or canvas frame fastened to a table; the wheels of an old wooden clock, moved by a weight to carry the paper forward; three wooden drums, upon one of which the paper was wound and passed over the other two; a wooden pendulum suspended to the top piece of the picture or stretching-frame, and vibrating across the paper as it passes over the centre wooden drum; a pencil at the lower end of the pendulum, in contact with the paper; an electro-magnet fastened to a shelf across the picture or stretching-frame, opposite to an armature made fast to the pendulum; a type rule, and type for breaking the circuit, resting on an endless band, composed of carpet-binding, which passed over two wooden rollers, moved by a wooden crank, and carried forward by points projecting from the bottom of the rule downward into the carpet-binding; a lever, with a small weight on the upper side; and a tooth, projecting downward at one end, operated on by the type; and a metallic fork, also projecting downward over two mercury-cups; and a short circuit of wire, embracing the helices of the electro-

magnet connected with the positive and negative poles of the battery, and terminating in the mercury-cups."

Morse was now so poor that he bought his food in small quantities from some grocery, and prepared it himself. He says, "To conceal from my friends the stinted manner in which I lived, I was in the habit of bringing my food to my room in the evenings, and this was my mode of life for many years."

In this year, 1835, says Professor Horsford, "Morse made his discovery of the *relay*, the most brilliant of all the achievements to which his name must be forever attached. It was the discovery of a means by which the current, which through distance from its source had become feeble, could be reënforced or renewed. This discovery, according to the different objects for which it is employed, is variously known as the registering magnet, the local circuit, the marginal circuit, the repeater, etc. It made transmission from one point on a main line through indefinitely great distances, and through an indefinite number of branch lines, and to an indefinite number of way-stations, and registration at all, possible and practicable, from a single act of a single operator."

Poor, longing for money to carry forward his plans, despondent lest some one think out a kindred machine and supplant him, Morse was also suffering from injustice in his art work. Our government having offered to American artists

commissions to paint pictures for the panels in the Rotunda of the Capitol, the friends of Morse urged that he, as the president of the National Academy of Design, be one of the artists chosen by the committee. John Quincy Adams, ex-President of the United States, and one of the committee, urged that foreign artists be allowed to compete, stating that no American artists were competent for the work. This, of course, gave offence, and James Fenimore Cooper wrote a severe article, in the "New York Evening Post," upon Mr. Adams's remarks. The article was attributed to Morse, and his name was rejected by the committee. This was a great disappointment.

He said, years afterward, "The blow I received from Congress . . . has almost destroyed my enthusiasm for my art. . . . I have not painted a picture since that decision. . . . When I applied to paint one of the Rotunda pictures, I was in my full vigor. I had just returned from three years' hard study in Italy, . . . and felt a consciousness of ability to execute a work creditable to my country. I hazarded everything almost for this single object. When so unexpectedly I was repelled, I staggered under the blow. I have endeavored in every way to prevent its effects upon my mind; but it is a thorn which perpetually obtrudes its point, and would goad me to death were it not for its aspect in the light of God's overruling providence. Then all is right."

From time to time prominent men came to the

university, to see the telegraph. They saw, thought it wonderful, doubted its practicability, and did not offer to invest any money in the enterprise. Finally, in 1837, Mr. Alfred Vail, a young graduate of the University of the City of New York, became interested, helped to construct an improved machine at his father's brass-works at Speedwell, N. J., for Morse to take to Washington for exhibition, and provided the means for his going.

After five long years, Morse had finally found some one ready to help. Arriving at Washington, he obtained the use of the room of the Committee on Commerce, to show his telegraph. Congressmen came, wondered, and went away doubting.

He now caused a respectful memorial to be presented to Congress, asking an appropriation of thirty thousand dollars, to test the telegraph between two cities. The petition was referred to a committee, quietly ignored, and Morse heard no more concerning it.

He sailed for Europe in 1838, to take out a patent for his work, but could obtain none in England, as Wheatstone and Cooke had already patented a magnetic-needle telegraph, entirely unlike that of Morse, invented four years later, says Professor Horsford, but brought before the public about the same time, 1837. In point of active use, Wheatstone's preceded Morse's telegraph by six years, on account of the indifference of Congress in helping the inventor.

In Paris, Morse submitted his telegraph to the

Institute, and Arago, Humboldt, and others were delighted with it. As Morse was sending a word from one room to the other, Robert Walsh said to him, "The next word you may write is 'IMMORTALITY,' for the sublimity of this invention is of surpassing grandeur. I see now that all physical obstacles, which may for a while hinder, will inevitably be overcome. The problem is solved; MAN MAY INSTANTLY CONVERSE WITH HIS FELLOW-MAN IN ANY PART OF THE WORLD."

Morse returned to New York after eleven months, disappointed that Congress had done nothing, "without," as he said, "a farthing in my pocket, and have to borrow even for my meals." In Paris, having learned from M. Daguerre, the inventor of the daguerreotype, the process, Morse introduced it in this country, and earned enough by taking pictures to reimburse him for his European journey. Many crowded to his rooms to be taught, and he cheerfully imparted the knowledge he possessed.

As the months went by and Congress did nothing, Morse became despondent. He had not the means even to pay postage on letters. He said, "I am sick at heart. . . . I feel at times almost ready to cast the whole matter to the winds, and turn my attention forever from the subject." The Vails were unable to help the enterprise further, at present. Morse was still teaching a few pupils at the university. Gen. Strother, of Virginia, "Porte Crayon," thus tells of Morse's pecuniary

condition: "He was very poor. I remember that when my second quarter's pay was due, my remittance from home did not come as expected; and one day the professor came in, and said, courteously:

"'Well, Strother, my boy, how are we off for money?'

"'Why, professor,' I answered, 'I am sorry to say I have been disappointed; but I expect a remittance next week.'

"'Next week,' he repeated, sadly; 'I shall be dead by that time.'

"'Dead, sir?'

"'Yes, dead by starvation!'

"I was distressed and astonished. I said, hurriedly: 'Would ten dollars be of any service?'

"'Ten dollars would save my life; that is all it would do.'

"I paid the money, all that I had, and we dined together. It was a modest meal, but good, and, after he had finished, he said: 'This is my first meal in twenty-four hours. Strother, don't be an artist. It means beggary. Your life depends upon people who know nothing of your art, and care nothing for you. A house-dog lives better, and the very sensitiveness that stimulates an artist to work keeps him alive to suffering.'"

Even the janitor of the University building said to a young man who was looking for a studio for himself: "You will have an artist for your neighbor, though he is not here much of late; he seems

to be getting rather shiftless, he is wasting his time over some silly invention, a machine by which he expects to send messages from one place to another. He is a very good painter, and might do well if he would only stick to his business; but, Lord!" he added, with a sneer of contempt, "the idea of telling by a little streak of lightning what a body is saying at the other end of it!"

"Judge of my astonishment," says the young man, "when he informed me that the 'shiftless individual, whose foolish waste of time so much excited his commiseration, was none other than the president of the National Academy of Design, — the most exalted position, in my youthful artistic fancy, it was possible for mortal to attain."

Once more, in some way, Morse obtained the money to go to Washington, and make another effort. December 30, 1842, a bill was at last submitted, asking for the thirty-thousand-dollar appropriation. It received much ridicule from some of the members. One suggested that there should be an appropriation for mesmeric experiments; another suggested the same for Millerism. At last the vote was taken in the House, Morse sitting in the gallery watching the result with feverish anxiety. The vote stood 89 yeas to 83 nays. IT WAS CARRIED.

Would it pass the Senate? The amount of business to be transacted made its coming up improbable. The last day of the session came. Morse sat all the day and evening in the gallery,

and finally went to his hotel, nearly prostrated from disappointment.

In the morning, as he came down to breakfast, Annie G. Ellsworth, the daughter of his old friend, the Commissioner of Patents, came toward him with a bright smile, saying: "I have come to congratulate you!"

"For what, my dear friend?"

"On the passage of your bill."

Morse could scarcely believe the good news, that the bill had passed, in the last moments of the session, without opposition. He was nearly overcome with joy, and told the young lady that she should send the first message over the first line.

He at once proceeded to construct the first line of his electric telegraph between Washington and Baltimore. Ezra Cornell, later one of the most successful constructors and largest proprietors of telegraphs, and the founder of Cornell University, was employed at a salary of one thousand dollars a year.

After many perplexities, the line was completed. On May 24, 1844, Morse invited his friends to assemble in the chamber of the United States Supreme Court, where he had his instrument in connection with Baltimore. Annie Ellsworth's mother had suggested to her these words from the Bible, for the first message: "What hath God wrought!" No words could have been more in accordance with Morse's feelings. Taking his seat at the instrument, he spelled out the words, and

instantly they were received by Mr. Vail in Baltimore, who resent them the same moment to Washington. The strip of paper on which this message is printed is now in the Athenæum at Hartford, Conn.

What must have been Professor Morse's feelings at that moment. The day of triumph had come — the twelve weary years of poverty were over. Hereafter he was to be like one of the princes of the world.

A telegraph company was formed which offered to sell the telegraph to the government for one hundred thousand dollars. Congress refused to buy, much to the subsequent profit of the Morse company. In less than thirty years, the Morse telegraph was used in America upon two hundred and fifty thousand miles of wire, and in foreign countries upon six hundred thousand miles of wire, while the telegraph receipts throughout the world were about eight million pounds yearly.

There were many amusing incidents in connection with this early telegraph. "A pretty little girl tripped into the Washington City termination, and, after a great deal of hesitation and blushing, asked how long it would take to send to Baltimore. The interesting appearance of the little questioner attracted Mr. Morse's attention, and he very blandly replied, '*One second!*'

"'Oh, how delightful, how delightful!' ejaculated the little beauty, her eyes glistening with delight. 'One second only; here, send this even

quicker if you can.' And Mr. Morse found in his hand a neatly folded, gilt-edged note, the very perfume and shape of which told a volume of love.

"'I cannot send this note,' said Mr. Morse, with some feeling; 'it is impossible.'

"'Oh, do, *do!*' implored the distracted girl. 'William and I have had a quarrel, and I shall die if he don't know that I forgive him in a second. I know I shall.'

"Mr. Morse still objected to sending the note, when the fair one, brightening up, asked, 'You will, then, send *me* on, won't you?'

"'Perhaps,' said one of the clerks, 'it would take your breath away to travel forty miles in a second.'

"'Oh, no, it won't! no, it won't, if it carries me to William! The cars in the morning go *so slow* I can't wait for them.'

"Mr. Morse now comprehended the mistake which the petitioner was laboring under, and attempted to explain the process of conveying important information along the wires. The letter-writer listened a few moments, impatiently, and then rolled her burning epistle into a ball, in the excitement under which she labored, and thrust it into her bosom.

"'It's too slow!' she finally exclaimed; 'it's too slow! and my heart will break before William knows I forgive him; and you are a cruel man, Mr. Morse,' said the fair creature, the tears coming into her eyes, 'that you won't let me travel by the

telegraph to see William.' And, full of emotion, she left the office."

All these years Morse was longing for a home. In 1845 he wrote his daughter, who was now married and living in Porto Rico, in the West Indies, "I do long for the time, if it shall be permitted, to have you, with your husband and little Charles, around me; I feel my loneliness more and more keenly every day. Fame and money are, in themselves, a poor substitute for domestic happiness: as means to that end, I value them. Yesterday was the sad anniversary (the twentieth) of your dear mother's death, and I spent the most of it in thinking of her."

Two years later he purchased two hundred acres on the Hudson River, near Poughkeepsie, calling it "Locust Grove," and built a handsome and spacious Italian villa for his residence. With the telegraph in his library, he could now converse with men in all parts of the world. Here he gathered his children and grandchildren around him. He was now fifty-six years old. Fame and money had come late in life. The next year he married Miss Sarah E. Griswold, the daughter of his cousin, a lady thirty years his junior.

His life here was peaceful and happy, most of the day being spent in reading and writing. He was very fond of nature. One of his daughters writes: "He loved flowers. He would take one in his hand, and talk for hours about its beauty, its wonderful construction, and the wisdom and love of

God in making so many varied forms of life and color to please our eyes. In his later years he became deeply interested in the microscope, and purchased one of great excellence and power. For whole hours, all the afternoon or evening, he would sit over it, examining flowers, or the animalcula in different fluids. Then he would gather his children about him, and give us a sort of *extempore* lecture on the wonders of creation, invisible to the naked eye, but so clearly brought to view by the magnifying power of the microscope.

"He was very fond of animals, cats and birds in particular. He tamed a little flying-squirrel, and it became so fond of him that it would sit on his shoulder while he was at his studies, and would eat out of his hand, and sleep in his pocket. To this little animal he became so much attached that we took it with us to Europe, where it came to an untimely end, in Paris, by running into an open fire."

In New York he bought a large house, No. 5 West Twenty-second Street, for his winter residence, and, on a vacant lot adjoining, erected an elegant building for his library and study. What a contrast between this and the time when "Porte Crayon" gave him ten dollars, which Morse said would save his life!

Honors now poured in upon him. In 1835 he had been elected a member of the Historical Institute of France.

In 1837, a member of the Royal Academy of Fine Arts of Belgium.

In 1839 the Great Silver Medal of the Academy of Industry of Paris was voted him.

In 1841, a corresponding member of the National Institution for the Promotion of Science at Washington.

In 1842, the gold medal of the American Institute.

In 1845, a corresponding member of the Archæological Society of Belgium.

In 1846, Doctor of Laws by Yale College.

In 1848, the first decoration ever bestowed by the Sultan of Turkey upon a citizen of the United States, *Nishan Iftikar,* in diamonds; he was also made a member of the American Philosophical Society, Philadelphia.

In 1849, a Fellow of the American Academy of Arts and Sciences, Boston.

In 1851, a golden snuff-box containing the Prussian golden medal for scientific merit.

In 1852, the Great Gold Medal of Arts and Sciences from the King of Würtemberg.

In 1855, the Great Gold Medal of Science and Art from the Emperor of Austria.

In 1856, the brevet and decoration as Chevalier of the Imperial Order of the Legion of Honor, from the Emperor of France.

In 1856, the Cross of the Order of Dannebrog from the King of Denmark.

In 1858, a member of the Royal Academy of Sciences in Sweden.

In 1859, the order of knighthood and Commander of the First Class of the Royal Order

of Isabella the Catholic, from Isabella II. of Spain.

In 1860, Knight of the Tower and Sword, from the King of Portugal.

In 1864, Chevalier of the Royal Order of Saints Lazaro and Mauritio, from Victor Emmanuel II., King of Italy.

In 1866, honorary member of the Société de Physique et d'Histoire Naturelle of Geneva, Switzerland.

In 1857, Morse aided in the attempt to lay the Atlantic cable, being made electrician of the company. This was eminently fitting, as he had laid the first submarine cable, in 1842, October 18; one moonlight night in the harbor of New York City, between Castle Garden and Governor's Island.

In 1858, France, Austria, Belgium, the Netherlands, Piedmont, Russia, the Holy See, Sweden, Tuscany, and Turkey presented Mr. Morse with an honorary gratuity of four hundred thousand francs, "as a reward, altogether personal, of your useful labors."

During an extended trip in Europe, he was presented at the Court of Alexander III. in Russia, and met Baron Humboldt at Potsdam, from whom he received a large photograph of himself, on which he wrote in French: "To Mr. S. F. B. Morse, whose philosophic and useful labors have rendered his name illustrious in two worlds. The homage of the high and affectionate esteem of Alexander Humboldt." After also visiting his

daughter in the West Indies, his return to Poughkeepsie in 1859 was made by the people a time of rejoicing. Crowds flocked to the station to welcome him. The children of the public schools joined in the procession, while bells rung, flags waved, and bands played, as they followed the carriage of Professor Morse to the gateway of his residence, which had been festooned with flowers and evergreens. Was ever a man more honored? The world loves heroes, though it takes very little pains to help men or women to achieve greatness.

In 1866, Morse crossed the ocean again to give his children the opportunity of study abroad. He was now seventy-five years old, yet seemingly as vigorous as ever. At the Paris Exposition he was one of the committee upon telegraphic instruments. At Düsseldorf, he was received with great enthusiasm by the artists of the city. He purchased there five valuable pictures, as he was now in circumstances to be a patron of art. He also purchased Allston's celebrated painting of "Jeremiah," for fourteen hundred pounds, and gave it to Yale College; a portrait of Allston, at one hundred pounds, he presented to the Academy of Design. Thus did he remember the man who had been his friend in his young manhood.

Morse also gave to the Union Theological Seminary, in the city of New York, ten thousand dollars, endowing a lectureship on the "Relation of the Bible to the Sciences," named in honor of his father.

In 1868, a public dinner was given Professor Morse in New York, by the distinguished men of the day. Chief Justice Chase presided, and made an able address. After recounting the discoveries of others in electricity, "not least illustrious among these illustrious men, our countryman Henry," he said: "And it is the providential distinction and splendid honor of the eminent American who is our guest to-night that, happily prepared by previous acquirements and pursuits, he was quick to seize the opportunity, and give to the world the first recording telegraph. Fortunate man! thus to link his name forever with the greatest wonder and the greatest benefit of the age!" Other addresses were made by Bryant, Evarts, and many prominent men.

In 1871, June 10, a bronze statue of Professor Morse was unveiled in Central Park, the money for it being raised, in small amounts, from telegraphic operatives all over the country. In the evening, a brilliant reception was tendered him in the Academy of Music, the following despatch being sent on his ORIGINAL register: "GREETING AND THANKS TO THE TELEGRAPHIC FRATERNITY THROUGHOUT THE LAND. GLORY TO GOD IN THE HIGHEST, ON EARTH PEACE, GOOD-WILL TO MEN."

And then the white-haired Morse, now eighty years old, took his seat at the instrument, and signed his name to his message — "S. F. B. Morse." The entire audience rose and cheered, and many eyes filled with tears, as he gave his farewell address.

The last time Mr. Morse appeared in public was when he unveiled the statue of Benjamin Franklin in Printing-House Square, in front of the City Hall, January 17, 1872.

Death came in a few weeks. To his pastor, Rev. Dr. Adams, he said in response to a remark concerning the goodness of God to him in the past, "The best is yet to come."

Near the last, when the physicians were inspecting his lungs, and tapping upon his breast, one said, "This is the way we doctors telegraph."

"Very good," said the dying man, and passed away, April 2, 1872.

He was buried with distinguished honors from Madison Square Presbyterian Church, New York. Scientific, philanthropic, and religious institutions everywhere adopted resolutions of respect for his memory. A solemn service was held in the hall of the House of the Representatives at Washington, April 16, with appropriate addresses from Garfield and others. An oil painting of Professor Morse hung in front of the main gallery, surrounded by the historic words, "What hath God wrought!" Telegraphic messages were sent from Europe, Asia, and Africa, to this memorial meeting. Did any of those present remember how Congress allowed him nearly to die of despair and want, only a few years before? Truly a life that reads like a romance, in its misfortunes and its fortunes! Through all the days of poverty, as well as prosperity, Morse preserved his earnest Christian char-

acter, and his childlike, tender, loving nature. Trials did not embitter him, as they sometimes do, and honors did not exalt him above his fellows. American history does not furnish a more sublime illustration of faith in God and indomitable perseverance.

SIR CHARLES LYELL.

GALILEO studied and found out the truth that the earth moves around the sun, and died recanting it.

Buffon, the great French naturalist, studied, and ascertained that the earth has been subject to changes which must have required millions of years. He wrote: "The waters of the sea have produced the mountains and valleys of the land — the waters of the heavens, reducing all to a level, will at last deliver the whole land over to the sea, and the sea, successively prevailing over the land, will leave dry new continents like those which we inhabit."

He was at once summoned before the Faculty of Theology in Paris to recant his opinions, saying, "I declare that I had no intention to contradict the text of Scripture; that I believe most firmly all therein related about the creation, both as to order of time and matter of fact; *I abandon everything in my book respecting the formation of the earth*, and, generally, all which may be contrary to the narration of Moses."

A little more than a century later, at Kinnordy, Forfarshire, Scotland, a boy was born, Charles

Lyell, who was destined not only to make geology as fascinating to the world as a novel, but to prove more fully and conclusively than any one had previously done that the world is not only six thousand years old, but perhaps six thousand million years old; and that man has lived here not for a few centuries only, but for thousands of centuries. Lyell knew and felt what the Christian world has come to feel, that truth must and will stand, and that there is no real conflict between science and religion.

Charles Lyell, the eldest of ten children, having two brothers and seven sisters, was born November 14, 1797. He had the early training of an educated and refined father, a man who had devoted himself to the study of botany, and written several works on Dante. The mother was a woman of practical common-sense, and from her, doubtless, Charles inherited that good judgment which characterized all his work and life.

At seven the child was sent to Ringwood, to a school kept by Rev. R. S. Davies. Here, being the youngest, and one of the gentlest, he was spared the roughness too often found in boys' schools. At ten he and his brother Tom were sent to a school in Salisbury, sixteen miles from Bartley Lodge, whither the family had moved from Kinnordy.

Though they missed their favorite sport of haymaking, they enjoyed walks to Old Sarum, a famous camp of Roman times. Here the boys

amused themselves by heaping up piles of chalk flints on the opposite ridges, and letting them roll down, and dash against each other like two armies.

The teacher, Dr. Radcliffe, was called "Bluebeard," from having his fourth wife. The boys, however, liked him, because he had the rare merit of being impartial, while they were never tired of annoying another teacher, who had his favorites. Says Lyell of these early days, "Monsieur Borelle's room was within one in which I and eight others slept. One night, when we were very angry with him for having spatted us all round with a ruler, for a noise in the schoolroom which only *one* had made, and no one would confess, we determined to be revenged. We balanced a great weight of heavy volumes on the top of the door, so that no one could open it without their falling on his head. He was caught like a mouse in a trap, and threw a book in a rage at each boy's head, as they lay shamming sound asleep.

"Another stratagem of mine and young Prescott (son of Sir G. P.) was to tie a string across the room from the legs of two beds, so as to trip him up; from this string others branched off, the ends of which were fixed to the great toes of two sound sleepers, so that when Monsieur drew the lines, they woke, making a great outcry. At last we wearied him out, and he went and slept elsewhere.

"I conclude that there were far too many hours allotted to sleep at this school, for at all others we were glad to sleep after the labors of the day, and

got punished for late rising in the morning, and being too late for roll-call. Here, on the contrary, a great many of our best sports were at night, particularly one, which, as very unique and one which lasted all the time I was there, I must describe. It consisted of fighting, either in single combat, or whole rooms against others, with *bolsters*. These were shaken until all the contents were at one end, and then they were kept there by a girth of string or stockings. This made a formidable weapon, the empty end being the handle, and the ball at the other would hit a good blow, or coil round a fellow's leg, and by a jerk pull him up so that he fell backwards. . . . The invading party were always to station a watch at the head of the stairs, to give notice of the approach of 'Bluebeard,' for he was particularly severe against this warfare, though he never succeeded in putting it down. He used to come up with a cane, which, as none were clothed, took dire effect on those caught out of bed. He had a fortunate twist in his left foot, which made his step recognizable at a distance, and his shoe to creak loudly. This offence was high treason, not only because it led to broken heads, and made a horrible row in the night, but because Mrs. Radcliffe found that it made her *bolsters* wear out most rapidly."

Charles grew ill at Salisbury, and was taken home for three months. "I began," he says, "to get annoyed with *ennui*, which did not improve my health, for I was always most exceedingly mis-

erable if unemployed, though I had an excessive aversion to work unless forced to it. It happened that, a little before this time, my father had for a short time exchanged botany for entomology, a fit which only lasted just long enough to induce him to purchase some books on the latter subject, after which he threw it up; principally, I believe, from a dislike to kill the insects. I did not like this *department* of the subject either. . . .

"Collecting insects was just the sort of desultory occupation which suited me at that time, as it gave sufficient employment to my mind and body, was full of variety, and to see a store continually increasing gratified what in the cant phrase of the phrenologist is termed the 'accumulative propensity.' I soon began to know what was rare, and to appreciate specimens by this test. In the evenings I used to look over 'Donovan's Insects,' a work in which a great number of the British species are well given in colored plates, but which has no scientific merit. This was a royal road of arriving at the names, and required no study, but mere looking at pictures. At first I confined my attention to the Lepidoptera (butterflies, moths, etc.), as the most beautiful, but soon became fond of watching the singular habits of the aquatic insects, and used to sit whole mornings by a pond, feeding them with flies, and catching them if I could.

"I had no companion to share this hobby with me, no one to encourage me in following it up, yet

my love for it continued always to increase, and it afforded a most varied source of amusement. . . . Instead of sympathy, I received from almost every one else beyond my home either ridicule, or hints that the pursuits of other boys were more manly. . . . The disrepute in which my hobby was held had a considerable effect upon my character, for I was very sensitive of the good opinions of others, and therefore followed it up almost by stealth; so that, although I never confessed to myself that I was wrong, but always reasoned myself into a belief that the generality of people were too stupid to comprehend the interest of such pursuits; yet, I got too much in the habit of avoiding being seen, as if I was ashamed of what I did."

The temporary ill-health of the schoolboy led to the long hours of observation of nature; these led to a devotion to science, which brought a world-wide fame. Thus, often, that which seems a hindrance in life proves a blessing in the end.

At twelve, Charles was placed in a school where there were seventy boys, with much fagging and fighting. That this roughness was not in accordance with his noble and refined nature is shown by his words, years afterwards: "Whatever some may say or sing of the happy recollections of their school days, I believe the generality, if they told the truth, would not like to have them over again, or would consider them as less happy than those which follow. . . . The recollection of it makes me bless my stars I have not to go through it again.

"My ambition," he says, "during the second half-year was excited by finding myself rising near the top of a class of fifteen boys in which I was; and when miserable, as I often was, with the kicks and cuffs I received, I got into a useful habit of thinking myself happy when I got a high number in the class-paper." Each year he received a prize for speaking, and often prizes for Latin and English original composition.

At seventeen young Lyell entered Exeter College, Oxford. He still devoted many hours to entomology, and took some honors in classics. A book, as is often the case, had already helped to shape his life. He had found and read, in his father's library, Bakewell's "Geology," and was greatly excited over the views there expressed about the antiquity of the earth. Dr. Buckland, Professor of Geology at Oxford, was then at the height of his fame, and Lyell at once attended a course of his lectures and took notes.

College life was having its influence over the youth, for he wrote to his father: "It is the seeing the superiority of others that convinces one how much is to be and must be done to get any fame; and it is this which spurs the emulation, and feeds that 'Atmosphere of Learning,' which Sir Joshua Reynolds admirably describes as 'floating round all public institutions, and which even the idle often breathe in, and then wonder how they came by it.'"

And yet Lyell, like most students, found it a

difficult matter to decide what was best for a life-pursuit. His father wished him to study law. In reply, the son says: "As for the confidence and quickness which you were speaking of, as one of the chief requisites of the Bar, I don't know whether intercourse with the world will supply it, but God knows, I have little enough of it now in company."

During his college course, Lyell made a journey with some friends to Staffa, and wrote a poem upon the place, and then, with his parents and his eldest sisters, travelled in France, Switzerland, and Italy. Here, in the midst of art and beautiful scenery, his mind still turned toward science. He thought the collections in comparative anatomy in the Jardin des Plantes, in Paris, would tempt any one to "take up ardently the study of anatomy." In Cuvier's lecture-room, filled with fossil remains, he found "three glorious relics of a former world, which have added several new genera to the Mammalia."

In the Jura chain he concluded the limestone to be "of a different age from what we passed through before Dijon, for the latter abounded in organic remains, whereas I could not discover one fossil in the Jura. By the roadside I picked up many beautiful petrifactions, which must be forming daily here, where the water is charged plentifully with lime."

"The rock of the Col de Balme," he said, "is a brown, ligneous slate, with some veins of white

quartz intersecting it: the appearance is very curious. On the top was the richest carpet of turf I ever saw, spangled with thousands of the deep blue gentian, red trefoil, and other mountain flowers." Nothing said about law, but much about rocks!

At twenty-two Lyell graduated from Oxford. The same year he became a Fellow of the Geological Society of London, and also of the Linnæan Society, and, in accordance with his father's preference, began the study of law in London.

But the way to success is almost never easy. Lyell's eyes became very weak, and he was obliged to desist from reading, and go to Rome with his father. Many a young man, well-to-do, would have given up a profession, preferring a life of leisure. Not so Charles Lyell. On his return he inspected Romney Marsh, an extensive tract of land, formerly covered by the sea, and also the Isle of Wight, and wrote his first scientific paper on the geology of some rivers near his native place in Forfarshire. At twenty-six he was made secretary of the Geological Society. Already such men as Dr. Buckland felt the deepest interest in the enterprising young student, who was devoting himself to original research.

And now he was going to Paris, to perfect himself in French. Dr. Buckland and others gave him letters of introduction to such persons as Humboldt and Cuvier. Fortunate young Lyell! Such men would fan the flame of aspiration to a white heat.

Once in Paris, the stimulus of great minds did its accustomed work — developed and beautified another mind. He attended a levée at Alexander Brongniart's, "who among the English geologists has the highest reputation both for knowledge and agreeable manners of all the French *savans*," he wrote home to his father. Again he wrote: "My reception at Cuvier's last Saturday will make me feel myself at liberty to attend his *soirées* next week, and they are a great treat. He was very polite, and invited me to attend the Institute on Monday. There he introduced me to several geologists, and put me in an excellent place for hearing. . . .

"Humboldt addressed me, as Duvau had done, with, 'I have the honor of being familiar with your name, as your father has labored with no small success in botany, particularly the cryptogamiæ. . . .' He was not a little interested in hearing me detail the critiques which our geologists have made on his last geological work, — a work which would give him a rank in science if he had never published aught besides. He made me a present of his work, and I was surprised to find how much he has investigated the details of our English strata. . . . He appears to work hard at astronomy, and lives in a garret for the sake of that study. The King of Prussia invited him to adorn his court at the last Congress; thence he went to Vesuvius just after the grand eruption, and brought away much geological information on that

head, which he was good enough to communicate to me. He speaks English well. I attend lectures at the Jardin du Roi, on mining, geology, chemistry, and zoölogy, all gratis! by the first men. . . . I have promised Humboldt to pass the afternoon to-day in his study. His new edition serves as a famous lesson to me, in the comparison of England and the Continent. There are few heroes who lose so little by being approached as Humboldt."

Who shall estimate the value of such a friendship to a young man! It was a foregone conclusion that Lyell and Agassiz and Liebig, and others, who sought the society of such as Humboldt, and were *willing to work*, would come to greatness.

Cuvier introduced Lyell to Professor Van Breda of Ghent, who gave him letters to all the Dutch universities, — Ghent, Amsterdam, Haarlem, and Leyden.

The next year, 1824, Lyell made a geological tour with M. Constant Prévost, a noted French geologist, from London to Bristol and Land's End, and with Dr. Buckland, in Scotland, where they dined with the far-famed Francis Jeffrey, editor of the "Edinburgh Review." Lyell's eyes still troubled him so that he could scarcely write letters home; but he was laying up a store of knowledge from which the world was to profit in a few years.

In 1825, his eyes having improved, he resumed his law study, and was admitted to the bar. But he could not give up geological work, and published

several papers, — one on a dike of serpentine, another on shell marl and fossil fruit, and others on plastic clay in Hampshire and the fresh-water strata of Hants. He had been made a Fellow of the Royal Society at twenty-nine, and was one of the writers in the "Quarterly Review."

The law work went on, but it was easy to see where his heart was. He wrote a friend that he had been "devouring" Lamarck: "That the earth is quite as old as he supposes has long been my creed, and I will try before six months are over to convert the readers of the 'Quarterly' to that heterodox opinion. . . . Buckland has got a letter from India about modern hyænas, whose manners, habitations, diet, etc., are everything he could wish, and as much as could be expected had they attended regularly three courses of his lectures."

At thirty-one Lyell had made up his mind "that there is most real independence in that class of society who, possessing moderate means, are engaged in literary and scientific hobbies;" he had given up the law, and planned the book that was to make him famous — "Principles of Geology." He travelled now extensively in Italy and France, studying volcanoes, glaciers, and fossils. At Auvergne, he began work with his dear friend Murchison at six o'clock in the morning, "and neither heat nor fatigue has stopped us an hour," he writes to his parents. "I have really gained strength so much, that I believe that I and my eyes were never in such a condition before; and

I am sure that six hours in bed, which is all we allow, and exercise all day long for the body, and geology for the mind, . . . is the best thing that can be invented in this world for my health and happiness."

Eighteen hours of labor daily, and yet he was happy! He had found his life-work now. To a sister he writes about the beetles at Aix. He cannot be laughed out of this study as when a boy. He has been to Parma, to see Professor Guidotti's "finest collection of fossil-shells in Italy, . . . spending three days, from six o'clock in the morning till night, exchanging our respective commodities."

To his sisters he writes all his discoveries in rocks and fossils, with the enthusiasm of a boy. "I rode to the upper Val d'Arno, — a famous day for me, — an old lacustrine deposit, corresponding delightfully with our Angus lakes in all but age and *species* of animals; same genera of shells. They have just extracted the fortieth skeleton of hippopotamus; have got about twenty elephants, one or two mastodons, a rhinoceros and stags, and oxen out of number. . . . At Rome I found the geology of the city itself exceedingly interesting. The celebrated seven hills, of which you have read, and which in fact are nine, are caused by the Tiber and some tributaries, which have cut open valleys almost entirely through volcanic ejected matter, covered by travertine containing lacustrine shells."

He made the ascent of Etna, and sketched the

crater. "Inside the crater, near the lip, were huge masses of ice, between which and the scoriæ and lava of the crater issued hot sulphurous vapors, which I breathed in copiously; and for six hours after I could not, even after eating and drinking, get the horrid taste out of my mouth, for my lungs had got full of it. The wind was so high, that the guide held my hat while I drew; but though the head was cold, my feet got so hot in the cinders, that I was often alarmed that my boots would be burnt."

In 1830, the first volume of "Principles of Geology, being an Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes now in Operation," was published. "It will not pretend," he wrote to Murchison, "to give even an abstract of all that is known in geology, but it will endeavor to establish the *principles* of *reasoning* in the science; and all my geology will come in as illustration of my views of those principles, and as evidence strengthening the system necessarily arising out of the admission of such principles, which, as you know, are neither more nor less than that *no causes whatever* have from the earlist time to which we can look back, to the present, ever acted, but those *now acting*. . . . I must go to Germany. . . . Their language must be learnt; the places to which their memoirs relate, visited; and then you may see, as I may, to what extent we may indulge dreams of eminence, at least as original observers." He, too, like all the

other great ones, indulged in "dreams of eminence." Did ever man or woman achieve anything worthy without these dreams?

He had worked earnestly upon the "Principles," which showed wonderful research, study, and thought. He said, "The facts which are given in a few sentences require weeks of reading to obtain. . . . By the aid of a good amanuensis, my eyes hold out well."

The sale of the book was large and satisfactory. It was, of course, opposed, from its advanced views as to the age of the world, but Lyell wisely made no reply. He said, "I have sworn to myself that I will not go to the expense of giving time to combat in controversy. It is an interminable work." A great lesson, learned early.

In 1831 he visited Germany. Now he wrote home not only to his family, but to another, who was hereafter to brighten and beautify his life — Mary Horner, the daughter of a prominent scientist. To great personal beauty she added unusual mental ability. Wise man indeed was Charles Lyell to have known, what some fail to know beforehand, that intellect demands intellect for the best companionship.

He wrote to her: "I am sure you will work at it" (the German language) "with more zeal if you believe you can help me by it, as I labor with greater spirit, now that I regard myself as employed for you as well as for myself. Not that I am at all sanguine about the pecuniary profits

that I shall ever reap, but I feel that if I could have fair play for the next ten years, I could gain a reputation that would make a moderate income for the latter part of my life, yield me a command of society, and a respect that would entitle me to rest a little on my oars, and enable me to help somewhat those I love. . . . As to geology having *half* of my heart, I hope I shall be able to give my *whole* soul to it, with that enthusiasm by which alone any advance can be made in any science, or, indeed, in any profession."

In 1832 Lyell was made professor of geology in King's College, London, which position he resigned later, because he wished "the power of commanding *time* to increase his knowledge and fame." This year also, July 12, when he was thirty-five, he was married to Mary Horner, and made a tour up the valley of the Rhine.

The earnest life was now more earnest and busy than ever. He said, "I am never so happy as when, at the end of a week, I feel I have employed every day in a manner that will tell to the rest of my life." Would that all of us could live after so noble a plan!

"Unless I can feel that I am working to some decided end, such as that of fame, money, or partly both, I cannot be quite happy, or cannot feel a stimulus to that strenuous application without which I should not remain content." He had learned what "strenuous application" means, and knew that there is no success without it. When

congratulated by his friends "in not looking older for his hard work," he said, "The way to do much and not grow old is, to be moderate in not going out, to work a few hours, or half-hours, at a time, . . . and to go to bed at eleven o'clock." He would not accept many invitations socially. "A man should have some severity of character, and be able to refuse invitations, etc.," he said. "The fact is, that to become great in science, a man must be nearly as devoted as a lawyer, and must have more than mere talent. . . . I think I never do so much as when I have fought a battle not to go out." Those who have written books will appreciate this statement, and recall the many days when they have closed the shutters and worked, though they longed to be out-of-doors in the sunlight.

In 1833, the year after his marriage, he gave by invitation a course of seven lectures before the Royal Institution, a high honor. In 1834, he passed several months in Sweden, and wrote back to his "dearest Mary," — "I have been ten hours without a word with my love, but thinking of her more than half the time, and comforting myself that she is less alone than I am." . . . He kept a journal for her of his daily work.

"It is now twenty-five days that we have been separated, and I have often thought of what you said, that the active occupation in which I should constantly be engaged would give me a great advantage over you. I trust, however, that you also have been actively employed. At leisure

moments I have done some things towards planning my next volume. It will be necessary for us to have a work together at fossils at Kinnordy, first, and then in town, and then in Paris." Thus fully had the young wife entered into his studies.

In 1835, having received the gold medal of the Royal Society, for his "Principles of Geology," — now in its fourth edition, which Sir John Herschel said he had read three times, — he was elected president of the Geological Society of London, and made extensive researches in Switzerland, Germany, and Scotland.

In 1841, already famous as well as beloved, Lyell was invited to give twelve lectures before the Lowell Institute, in Boston. He and his wife spent thirteen months in the United States, studying the country geologically; its social life, its politics, and our benevolent and educational institutions. Between two and three thousand persons came, both morning and evening, to listen to the distinguished scholar, who had travelled almost the world over to study his beloved science.

Close friendships were formed with some of the most prominent men, like Prescott and Ticknor. Lyell visited the great lakes, and compared the supposed ancient boundaries of Lake Ontario, when it was one hundred and fifty feet higher, with its present shore. He made a careful study of Niagara Falls, which cuts its deep gorge toward Lake Ontario, for seven miles, and estimated that it wore away a foot a year. If so, he argued that

at least thirty-five thousand years have passed since the river began to cut its passage between the high rocky walls. "What would I give," said Lyell, "for a daguerrotype of the scene as it was four thousand, and again forty thousand years ago! Even four centuries would have been very important." Authorities differ as to the rate of the recession of the falls. Some estimate an inch instead of a foot yearly, requiring a period of more than four hundred thousand years.

In 1845, Lyell published his "Travels in North America, with Geological Observations," and in September of the same year, returned again to the States, spending nine months in travel and study, and bringing out later, in 1849, his "Second Visit to the United States of North America."

Already his "Elements of Geology" had appeared, which went through several editions. A seventh edition of the "Principles" had been published. He had also been knighted by the Queen, for his rare scholarship. Honored at home and abroad, working ardently and earnestly, often with failing sight, he had already won for himself the eminence of which he had dared to dream years before.

Of course he was welcomed at all great gatherings. Macaulay and Hallam, Milmore and Mrs. Somerville, Rogers, and scores of others were often at his home.

In 1851, he was appointed one of the Royal Commissioners for the first Great Exhibition held in

Hyde Park, London, and a year later gave a second course of lectures at the Lowell Institute, Boston. So kindly and cordially had he written concerning the United States, that he received the heartiest welcome. He had carried out in his life what he wrote to beautiful Mary Horner, twenty years before: "I hope we shall both of us contrive to cultivate a disposition — which David Hume said was better than a fortune of one thousand pounds a year — to look on the bright side of things. I think I shall, and I believe you will." The sweet-natured and great-minded man had looked on the bright side of America, and seen the good rather than the evil. He believed in its future. When Prescott died, to whom he was devotedly attached, he said: "From such a soil and in such an atmosphere, great literary men must continue to spring up."

All through our Civil War, he had known and loved us so well, that he was, like John Bright, our constant advocate. He deprecated the course of some of the English newspapers. "The integrity of the empire," he said, "and the non-extension and for the last two years the extinction of slavery constitute to my mind better grounds for a protracted struggle than those for which any war in our time, perhaps in all history, has been waged. . . . I am in hopes that the struggle in America will rid the country in the course of twenty years of that great curse to the whites, slave labor, and, if so, it may be worth all it will cost in blood and treasure. . . ."

"Had the States been dismembered, there would have been endless wars, more activity than ever in breeding slaves in America, and a renewal of the African slave-trade, and the future course of civilization retarded in that continent in a degree which would not, in my judgment, be counterbalanced by any adequate advantage which Europe would gain by the United States becoming relatively less strong. . . . I believe that if a small number of our statesmen had seen what I had seen of America, they would not have allowed their wishes for dismemberment to have biassed their judgment of the issue so much."

In 1853, at the request of his government, he came to New York, as one of the commissioners to the International Exhibition. Of course, now, wherever he travelled, either in Europe or America, he met the distinguished, and was honored by them. He was the friend of Berzelius, the noted chemist of Sweden, and of the great Liebig of Germany. Professor Bunsen of Heidelberg said, that all his taste for geology had been derived from Lyell's books.

During the next few years, he was much in Holland, France, and Germany, preparing for the publication of another great work in 1863, the "Antiquity of Man." He had made a careful study of the ancient Swiss Lake-dwellings, erected on piles in the midst of the water, connected with the land by bridges. On Lake Neuchâtel it is estimated that there were more than forty such

circular houses. At Wangen, near Stein, on Lake Constance, it is believed forty thousand piles were used. Some five thousand objects have been found, comprising flax, not woven, but plaited; carbonized wheat, and the bones of the dog, ox, sheep, and goat. The arrow-heads, hatchets, and the like, belong to the stone age, which geologists place, at the least, seven thousand years ago. At Zurich one human skull was found belonging to this early stone age. No traveller should pass through Zurich without seeing these memorials of a people who lived in the dawn of civilization, when the world was being made ready for the more perfect man.

Lyell had studied also the Danish "kitchen-middens," familiar to those who have been carefully over the museums at Copenhagen. These shell-mounds, the refuse heaps of this ancient race, are sometimes one thousand feet long and two hundred wide. As far back as the time of the Romans the Danish isles were covered with magnificent beech forests. In the bronze age there were no beech trees, but oaks. In the stone age the Scotch fir prevailed, and thousands of years must have elapsed while these giant forests succeeded each other.

The delta and alluvial plain of the Mississippi Lyell found to consist of sediment covering an area of thirty thousand square miles, several hundred feet deep. Taking the amount deposited annually, it would require from fifty to one

hundred thousand years to produce the present deposits.

The coral reefs of Florida, built up at the rate of one foot in a century, each reef adding ten miles to the coast, have required, according to Agassiz, at least one hundred and thirty-five thousand years for building. Human remains in a bluff on the shores of Lake Monroe, in Florida, he shows to be at least ten thousand years old.

Under the streets of Glasgow, Scotland, seventeen canoes have been dug up, one in a vertical position, as if it had sunk in a storm, with the prow uppermost. Twelve canoes one hundred yards back from the river were found nineteen feet beneath the surface. Almost all were single oak trees, hollowed out by blunt tools, probably stone axes, aided by fire, relics of the stone age.

In caverns near Liège, France, human bones have been found, with the cave-bear, elephant, rhinoceros, and other species now extinct. Skulls found in these primeval caves, especially one near Düsseldorf, called the "Neanderthal," "is the most brutal of all known human skulls, resembling those of the apes." These rude men probably were living at the same time, or even later, than the makers of the "refuse heaps" of Denmark.

Wales has been under the sea to the depth of fourteen hundred feet, as proved by glacial shells; its submergence and reëlevation would require, by careful computation, about two hundred and twenty-four thousand years.

Lyell showed that the Alps, Andes, and Himalaya Mountains were all elaborated under water. "The Alps have acquired four thousand, and even, in some places, more than ten thousand feet of their present altitude since the commencement of the Eocene (dawn of recent) period. . . . It is not too much to say that every spot which is now dry land has been sea at some former period, and every part of the space now covered by the deepest ocean has been land. The present distribution of land and water encourages us to believe that almost every conceivable transformation in the external form of the earth's crust may have been gone through. In one epoch the land may have been chiefly equatorial; in another, for the most part polar and circumpolar."

Lyell showed also the great age of the world by the changes which have taken place in climate. In Greenland are a multitude of fossil plants, which show that it formerly enjoyed a mild and genial climate. Fossil tulip and walnut trees have been found within the Arctic circle.

"On the North American continent, between the Arctic circle and the forty-second parallel of latitude," said Lyell, "we meet with signs of ice-action on a scale as grand, if not grander than in Europe." The drift covered from the Atlantic border of New England and Labrador westward to Dakota and Lake Winnipeg, and farther north, across the continent. Some stones in this bed of ice were thirty feet square, weighing over four

million pounds. Some boulders from the Alps, weighing three thousand tons each, are now found on the Juras. "It must, I think," said Lyell, "be conceded that the period required for the coming-on of the greatest cold, and for its duration when most intense, and the oscillations to which it was subject, as well as the retreat of the glaciers and the 'great thaw,' or disappearance of snow, from many mountain-chains where the snow was once perpetual, required not tens, but hundreds, of thousands of years."

In Arctic Siberia herds of elephants must have roamed, as their bodies, covered with hair and flesh, have been dug up in recent years. Great Britain and Europe have been much warmer than now. Our own immense coal fields show a former tropical climate, with their great tree-ferns and tree-rushes, while the remains of reindeers have been found in Connecticut.

No wonder Lyell became fascinated with the history of the changes of this planet, and the life of man before historic times. A great book seemed open to him, and he studied it by night and by day: the Archæan Time — no life; Paleozoic Time, including the Silurian Age, with its shells and trilobites; the Devonian, with its fishes; Carboniferous, with its coal plants; Mesozoic Time, including the Reptilian Age with its reptiles; Cenozoic Time, including the Mammalian or Tertiary, with its mammals, and Quaternary, or age of man. Paleozoic means "ancient life;" Mesozoic, "middle life;" Cenozoic, "recent life."

Lyell divided the Tertiary strata into three groups: Eocene, recent dawn; Miocene, less recent; Pliocene, more recent. In the Eocene Age Great Britain was sub-tropical, and, in North America, Vermont was like North Carolina in temperature. Then came the Glacial Period, with ice probably five thousand feet thick over New England. Then the Champlain Period, with its floods, continents depressed, and climate warm, followed in Europe by a second Glacial Period.

The "Antiquity of Man" had an extensive sale. Honors were now showered upon Sir Charles Lyell. He was offered the Presidency of the Royal Society, and a seat in Parliament for the University of London, but declined both. Oxford University had already conferred upon him the degree of D. C. L., and the Institute of France had made him corresponding member. By request of the queen, he visited her at Osborne, she having made him a baronet. Emperor William conferred upon him the Order of Merit, given also to Humboldt, and the London Royal Society, its highest honor, the Copley gold medal.

In the spring of 1873, his "dearest Mary" died, leaving him heart-broken. She was mourned in America as well as Europe. The "Boston Advertiser" said, "Strength and sweetness were hers, both in no common measure. . . . She became to her husband not merely the truest of friends, and the most affectionate and sympathizing of companions, but a very efficient helper. She was frank,

generous, and true; her moral instincts were high and pure; she was faithful and firm in friendship. . . . This woman so widely informed, so true, so strong, so brave, seemed all compact of softness, sweetness, and gentleness; a very flower that had done no more than drink the sunshine and the dew. In her smile, her greeting, the tones of her voice, there was a charm which cannot be described, but which all who knew her have felt and will recall. . . . During the war there was not a woman or a man in England that stood by the Union and the government more ardently and fearlessly than she." Lady Lyell was an efficient linguist, and a woman of unusual mental power. The success of her husband was in part the result of her lovely character. Had she sought society while he needed quiet for his work, had she been fond of dress when their income was limited and necessarily used in his extensive travels, his life might have been a failure. They had what Tolstoï well calls "the friendship of the soul; identity of sentiment and similarity of ideal." Too often in this world persons marry "opposites," and walk, alas! in opposite directions all their lives.

Lyell now worked on, for he said he must carry out what he had planned with *her*. In 1872 the eleventh edition of the "Principles" appeared. Lyell, though formerly an opponent, had become convinced of the truth of evolution, advocated by his devoted friend Darwin, and was proud of our own distinguished botanist Asa Gray, whose arti-

cles, he said, "were the ablest, and, on the whole, grappling with the subject, both as a naturalist and metaphysician, better than any one else on either side of the Atlantic."

Lyell believed ever in "an infinite and eternal Being." He said, "In whatever direction we pursue our researches, whether in time or space, we discover everywhere the clear proofs of a Creative intelligence, and of his foresight, wisdom, and power."

He used to quote Professor Agassiz, who said, "Whenever a new and startling fact is brought to light in science, people first say, 'It is not true,' then that 'it is contrary to religion,' and lastly that 'everybody knew it before.'"

For the last ten years of his life, unable to use his eyes to any great extent, Lyell had the assistance, as secretary, of the able author of the "Fairy Land of Science," Miss Arabella Buckley, now Mrs. Fisher. And yet he accomplished more than most people with the best of eyes.

Two years after his wife's death, while at work on the twelfth edition of the "Principles," the end came, February 22, 1875. He was buried in Westminster Abbey, beside his friend Sir John Herschel, — the Duke of Argyll, Professor Huxley, and other noted men acting as pall-bearers. Said the Dean of Westminster, in the funeral sermon preached in the Abbey, "He followed truth with a zeal as sanctified as ever fired the soul of a missionary, and with a humility as child-like as ever subdued the mind of a simple scholar. . . . From

early youth to extreme old age, it was to him a solemn religious duty to be incessantly learning, constantly growing, fearlessly correcting his own mistakes, always ready to receive and reproduce from others that which he had not in himself. Science and religion for him not only were not divorced, but were one and indivisible." Truly said Tyndall, Huxley, and others, "For the last twenty-five years he has been the most prominent geologist in the world; equally eminent for the extent of his labors and the breadth of his philosophical views."

To the last Sir Charles Lyell kept his affectionate, tender heart, with gentle and kindly manners. He was fair to his opponents, and appreciative of all talent. He took time to help others. He urged the name of Agassiz as the lecturer before the Lowell Institute, Boston, and we all know the grand results of his coming. Those who have no time to help others usually fail of help when their own time of need comes. Lyell was singularly free from vanity, egotism, or jealousy. He loved nature devotedly, the grandeur of the sea especially impressing him; he never tired of wandering alone beside it. He had great steadiness of purpose, and calm judgment. His perseverance was untiring; his power of work remarkable; his sympathy boundless. He was never narrow or opinionated. He died as he had lived; honored the world over for his amazing knowledge, and loved for his unselfish, earnest, and beautiful character.

JOSEPH HENRY, LL.D.

ON Thursday evening, January 16, 1879, a large company gathered in the hall of the House of Representatives at Washington. They came to honor the memory of one of our greatest in science, since Franklin, — Joseph Henry, the Secretary of the Smithsonian Institution. Addresses were made by the Hon. Hannibal Hamlin, Professor Asa Gray, a most distinguished scientist, the Hon. James A. Garfield, General W. T. Sherman, the Hon. S. S. Cox, and others.

Not alone at the Capitol were memorial services held for Professor Henry. Before the United States National Academy of Sciences, before the American Association for the Advancement of Science, before the Philosophical Society of Washington, — of all these he had been president, — before the College of New Jersey at Princeton, where he was Professor of Natural Philosophy for fourteen years, before the Albany Institute, of which he was one of the original members, and before various other societies in which he had been a leading spirit, heartfelt testimony was given to America's loss in the death of a great scholar and a good man.

Joseph Henry was born in Albany, N. Y., December 17, 1797, or 1799, probably the latter date, this uncertainty arising from the illegibility of the faded records in the old family Bible. His grandparents came from Scotland, landing in this country June 16, 1775, the day before the battle of Bunker Hill. The father, William Henry, of whom little is known, died when his first son, Joseph, was nine years old. The boy had gone two years previously to live with his maternal grandmother at Galway, in the county of Saratoga, N. Y.

Joseph's mother is remembered as a lady of great refinement, delicate in form and feature, and very beautiful in her youth. She was deeply devotional, and probably to this fact is partially due Professor Henry's earnest religious character through life.

At the district school of Galway, under Israel Phelps, Joseph exhibited no special aptitude for books, though he showed an inquisitive mind. At the age of ten, he was placed in a store kept by a Mr. Broderick, who was very kind to him, allowing him to attend school in the afternoons.

His fondness for reading developed from a singular circumstance. Having lost a pet rabbit, which had run into an opening in the foundation wall of the village meeting-house, he crept through the hole on his hands and knees, to find the runaway. Discovering a light through a crevice, boy-like, he decided to investigate his surroundings. He soon reached the vestibule of the building, and

found there a book-case containing the village library. The first book which attracted his attention was Brooke's "Fool of Quality," a work of fiction. He began to read, and soon forgot about his rabbit.

From this time he made frequent visits to the library, by the underground passage, reading all the novels he could find. In the evening, to the lads who gathered about the stove in the village store, he rehearsed the wonderful things he had read. He was a handsome, slender lad, of delicate complexion, vivacious manners, and a great favorite. Mr. Broderick, the proprietor, enjoyed the stories, and finally obtained proper access to the library for his young clerk.

When about thirteen or fourteen, Joseph was apprenticed to Mr. John F. Doty of Albany, a watch-maker and silversmith. He found very little pleasure in the trade, and was probably glad when, after two years, the apprenticeship came to an end, through Mr. Doty leaving the business.

Of course he was out of work. He was very fond of the theatre, and, having been behind the scenes, had learned how stage effects are produced. He now joined a private theatrical company, called "The Rostrum," and was soon made president of the society. He dramatized a story, and wrote a comedy, both of which were acted. He seemed destined to become an actor, probably not with the approval of his Scotch Presbyterian mother.

Lives are sometimes changed by seemingly triv-

ial events, yet nothing is trivial that influences a human being. Garfield said, "To every man of great original power there comes, in early youth, a moment of sudden discovery — of self-recognition — when his own nature is revealed to himself, when he catches for the first time a strain of that immortal song to which his own spirit answers, and which becomes thenceforth and forever the inspiration of his life.

"'Like noble music unto noble words.'"

That "moment of sudden discovery" came to Henry at sixteen. A slight accident had confined him to his mother's house for a few days. A young Scotch gentleman, Robert Boyle, who was boarding with her, had left upon the table of his chamber an unostentatious book, "Lectures on Experimental Philosophy, Astronomy, and Chemistry: by G. Gregory, D.D., Vicar of Westham."

The book begins by asking several questions: "You throw a stone, or shoot an arrow into the air; why does it not go forward in the line or direction that you give it? Why does it stop at a certain distance, and then return to you? . . . On the contrary, why does flame or smoke always mount upward, though no force is used to send them in that direction? And why should not the flame of a candle drop toward the floor when you reverse it, or hold it downward, instead of turning up and ascending into the air? . . . Again, you look into a clear well of water, and see your own

face and figure, as if painted there. Why is this? You are told that it is done by reflection of light. But what is reflection of light?"

Henry took up this book and began to read. Soon it seemed more interesting than Brooke's "Fool of Quality" and all the romances. At the very next meeting of the theatrical society, he resigned the presidency, telling his companions that he should devote his life to solid studies.

Robert Boyle, seeing that the youth was interested in the book, gave it to him. It was ever after preserved in Professor Henry's library, with these words written on the fly-leaf: "This book, although by no means a profound work, has, under Providence, exerted a remarkable influence upon my life. It accidentally fell into my hands when I was about sixteen years old, and was the first work I ever read with attention. It opened to me a new world of thought and enjoyment; invested things before almost unnoticed with the highest interest; fixed my mind on the study of nature, and caused me to resolve, at the time of reading it, that I would immediately commence to devote my life to the acquisition of knowledge."

This resolution was at once put in practice, by attending a night-school, where he soon learned all that the master could teach. His next attempt at education was to learn grammar of a travelling teacher, and so skilled did he become that he made a grammatical tour of the country districts, in imitation of his instructor, earning enough money to

enter the Albany Academy. When more money was needed, the enterprising youth found a situation as head of a district school, at eight dollars a month! He pleased his patrons so well that he received fifteen dollars for the second month. Later, he became an assistant in the academy, while still a pupil.

Says Orlando Meads, LL.D.: "When a boy in the Albany Academy in 1823 and 1824, it was my pleasure and privilege, when released from recitations, to resort to the chemical laboratory and lecture room. There might be found from day to day through the winter, earnestly engaged in experiments upon steam and upon a small steam-engine, and in chemical and other scientific investigations, two young men — both active members of the 'Lyceum,' then very different in their external circumstances and prospects in life, but of kindred tastes and sympathies; the one was Richard Varick De Witt, the other was Joseph Henry, as yet unknown to fame, but already giving promise of those rare qualities of mind and character which have since raised him to the very first rank among the experimental philosophers of his time.

"Chemistry at that time was exciting great interest, and Dr. Beck's courses of chemical lectures, conducted every winter in the lecture room of the academy, were attended not only by the students, but by all that was most intelligent and fashionable in the city. Henry . . . was then Dr. Beck's chemical assistant, and already an admirable ex-

perimentalist, and he availed himself to the utmost of the advantages thus afforded of prosecuting his investigations in chemistry, electricity, and galvanism." Dr. T. Romeyn Beck, the principal, had become interested in the studious young man, and, when he left the academy, recommended him to one of the trustees, General Stephen Van Rensselaer, as a private tutor to his sons. Young Henry's services were engaged, and, as his teaching required but about three hours each day, he devoted his leisure to higher mathematics, in conjunction with chemistry, physiology, and anatomy, as he had decided to become a physician. In his mathematical studies he went so far as to read the *Mécanique Analytique* of La Grange.

His delicate constitution seemed unable to bear the continued strain of study and teaching, and at twenty-six, through the friendship of an influential judge, Henry received the appointment of engineer in the survey of a road between the Hudson River and Lake Erie, a distance of about three hundred miles. This gave him out-of-door life, which he needed, and, though much of his work was done in winter, in deep snow, making his way through dense forests, he entirely regained his health, and gave such excellent satisfaction that he was asked to construct a canal in Ohio, and assist in a mining enterprise in Mexico. Both of these he refused, accepting the chair of Mathematics and Natural Philosophy in the Albany Academy, at the urgent solicitation of his friend, Dr. Beck.

Elected in the spring, and not entering upon his work till autumn, he spent the intervening months in geological exploration in New York State. Every hour was occupied. He had commenced solid study in earnest, as he had told the members of the "Rostrum" he should do.

Having entered upon his profession, he taught mathematics seven hours daily. But he found time to make experiments in natural philosophy. The first paper which he brought before the Albany Institute was, "On the Chemical and Mechanical Effects of Steam: with Experiments designed to illustrate the Great Reduction of Temperature in Steam of High Elasticity when suddenly expanded."

His next published scientific paper was, "On the Production of Cold by the Rarefaction of Air: accompanied by Experiments." "One of these experiments most strikingly illustrated the great reduction of temperature which takes place on the sudden rarefaction of condensed air. Half a pint of water was poured into a strong copper vessel of a globular form, and having a capacity of five gallons; a tube of one-fourth of an inch caliber, with a number of holes near the lower end, and a stop-cock attached to the other extremity, was firmly screwed into the neck of the vessel; the lower end of the tube dipped into the water, but a number of holes were above the surface of the liquid, so that a jet of air mingled with water might be thrown from the fountain.

"The apparatus was then charged with con-

densed air, by means of a powerful condensing pump, until the pressure was estimated at nine atmospheres. During the condensation, the vessel became sensibly warm. After suffering the apparatus to cool down to the temperature of the room, the stop-cock was opened: the air rushed out with great violence, carrying with it a quantity of water, which was instantly converted into snow. After a few seconds, the tube became filled with ice, which almost entirely stopped the current of air. The neck of the vessel was then partially unscrewed, so as to allow the condensed air to rush out around the sides of the screw; in this state the temperature of the whole interior atmosphere was so much reduced as to freeze the remaining water in the vessel."

Other pamphlets followed this publication, but in 1831 a notable paper in the "American Journal of Science and the Arts" brought Henry's name to the front line of discoverers in electro-magnetism. Sturgeon made the first electro-magnet; Henry made the electro-magnet what it is.

Says W. B. Taylor, in an address before the "Philosophical Society of Washington:" "The electro-magnet figured and described by Sturgeon consisted of a small bar or stout iron wire bent into a ∩ or horse-shoe form, having a copper wire wound loosely around it in eighteen turns, with the ends of the wire dipping into mercury-cups connected with the respective poles of a battery having one hundred and thirty square inches of active surface."

Henry improved upon this in 1828, but in March of 1829 he exhibited before the Institute a somewhat larger magnet. "A round piece of iron about one-quarter of an inch in diameter was bent into the usual form of a horse-shoe, and, instead of loosely coiling around it a few feet of wire as is usually described, it was tightly wound with thirty-five feet of wire covered with silk, so as to form about four hundred turns; a pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, was soldered to the ends of the wire, and the whole mounted on a stand. With these small plates, the horse-shoe became much more powerfully magnetic than another of the same size and wound in the usual manner, by the application of a battery composed of twenty-eight plates of copper and zinc each eight inches square."

"To Henry, therefore," says Mr. Taylor, "belongs the exclusive credit of having first constructed the magnetic 'spool' or 'bobbin,' that form of coil since universally employed for every application of electro-magnetism, of induction, or of magneto-electrics. This was his first great contribution to the science and to the art of galvanic magnetization. . . .

"But, in addition to this large gift to science, Henry has the preëminent claim to popular gratitude of having first practically worked out the differing functions of two entirely different kinds of electro-magnet; the one surrounded with numerous coils of no great length, designated by him

the 'quantity' magnet, the other surrounded with a continuous coil of very great length, designated by him the 'intensity' magnet. . . . Never should it be forgotten that he who first exalted the 'quantity' magnet of Sturgeon from a power of twenty pounds to a power of twenty hundred pounds was the absolute CREATOR of the 'intensity' magnet; and that the principles involved in this creation constitute the indispensable basis of every form of the electro-magnetic telegraph since invented."

Professor Silliman of Yale College said: "Henry has the honor of having constructed by far the most powerful magnets that have ever been known; and his last, weighing (armature and all) but 82½ pounds, sustains over a ton;—which is eight times more powerful than any magnet hitherto known in Europe."

"In 1831," says Professor Henry, "I arranged around one of the upper rooms of the Albany Academy a wire of more than a mile in length, through which I was enabled to make signals by sounding a bell. The mechanical arrangement for effecting this object was simply a steel bar, permanently magnetized, of about ten inches in length, supported on a pivot, and placed with its north end between the two arms of a horse-shoe magnet. When the latter was excited by the current, the end of the bar thus placed was attracted by one arm of the horse-shoe and repelled by the other, and was thus caused to move in a horizontal plane and its further end to strike a bell suitably ad-

justed." This was the first "sounding" electro-magnetic telegraph. With this growing fame he was not disposed to think too highly of himself. A friend, noticing a look of sadness in the face of the young professor, said to him, — "Albany will one day be proud of her son;" and so it proved.

A year before this, in May, 1830, Professor Henry had married, at thirty-one, Harriet L. Alexander of Schenectady, N. Y., a cultivated and helpful woman.

In 1832, Princeton College needed a professor of natural philosophy. Henry's friends heartily commended him for the position. Silliman said, — "Henry has no superior among the scientific men of the country," and Professor Renwick of Columbia College, New York, said, "He has no equal."

After six years at the Albany Academy, Henry removed to Princeton, where for fourteen years he added constantly to his fame and usefulness by original work. Of his discoveries in these fruitful years he gives the following summary, at the request of a friend: —

"I arrived in Princeton in November, 1832, and, as soon as I became fully settled in the chair which I occupied, I recommenced my investigations, constructed a still more powerful electro-magnet than I had made before, — one which would sustain over three thousand pounds, — and with it illustrated to my class the manner in which a large amount of power might, by means of a relay magnet, be called into operation at the distance of many miles. . . .

The electro-magnetic telegraph was first invented by me, in Albany, in 1830. . . . At the time of making my original experiments on electro-magnetism in Albany, I was urged by a friend to take out a patent, both for its application to machinery and to the telegraph; but this I declined, on the ground that I did not then consider it compatible with the dignity of science to confine the benefits which might be derived from it to the exclusive use of any individual. In this perhaps I was too fastidious."

Professor Asa Gray well said, "For the telegraph and for electro-magnetic machines, what was now wanted was not discovery, but invention; not the ascertainment of principles, but the devising of methods." Morse is not to be less honored because somebody discovered the principle, which he and others utilized for the race, any more than Edison, Bell, and others, because Faraday and Henry helped to make their grand work possible.

"My next investigation, after being settled at Princeton," says Professor Henry, "was in relation to electro-dynamic induction. Mr. Faraday had discovered that when a current of galvanic electricity was passed through a wire from a battery, a current in an opposite direction was induced in a wire arranged parallel to this conductor. I discovered that an induction of a similar kind took place in the primary conducting wire itself, so that a current which, in its passage through a short wire

conductor, would neither produce sparks nor shocks would, if the wire were sufficiently long, produce both those phenomena. . . .

"A series of investigations was afterwards made, resulting in producing inductive currents of different orders, having different directions, made up of waves alternately in opposite directions. . . .

"Another series of investigations, of a parallel character, was made in regard to ordinary or frictional electricity. In the course of these it was shown that electro-dynamic inductive action of ordinary electricity was of a peculiar character, and that effects could be produced by it at a remarkable distance. For example, if a shock were sent through a wire on the outside of a building, electrical effects could be exhibited in a parallel wire within the building.". . .

After this, investigations were made in atmospheric induction; induction from thunder clouds; in regard to lightning rods; on substances capable of exhibiting phosphorescence, such as the diamond, which, when exposed to the direct rays of the sun, and then removed to a dark place, emits a pale blue light; on a method of determining the velocity of projectiles; on the heat of the spots on the sun as compared with the rest of his disk; the detection of heat by the thermal telescope — "when the object was a horse in a distant field, the radiant heat from the animal was distinctly perceptible at a distance of at least several hundred yards;" on the cohesion of liquids; on the tenacity of soap-

water in films; on the origin of mechanical power, and the nature of vital force.

Henry says: —

"The mechanical power exerted by animals is due to the passage of organized matter in the stomach, from an unstable to a stable equilibrium; or, as it were, from the combustion of the food. It therefore follows that animal power is referable to the same source as that from the combustion of fuel — namely, developed power of the sun's beams. But, according to this view, what is vitality? It is that mysterious principle — not mechanical power — which determines the form and arranges the atoms of organized matter, employing for this purpose the power which is derived from the food. . . .

"Suppose a vegetable organism impregnated with a germ (a potato, for instance) is planted below the surface of the ground, in damp soil, under a temperature sufficient for vegetation. If we examine it from time to time, we find it sending down rootlets into the earth, and stems and leaves upward into the air. After the leaves have been fully expanded we shall find the tuber entirely exhausted, nothing but a skin remaining. The same effect will take place if the potato be placed in a warm cellar; it will continue to grow until all the starch and gluten are exhausted, when it will cease to increase. If, however, we now place it in the light, it will commence to grow again, and increase in size and weight. If we weigh the potato previous

to the experiment, and the plant after it has ceased to grow in the dark, we shall find that the weight of the latter is a little more than half of the original tuber. The question then is, what has become of the material which filled the sac of the potato? The answer is, one part has run down into carbonic acid and water, and in this running down has evolved the power to build up the other part into the new plant. After the leaves have been formed and the plant exposed to the light of the sun, the developed power of its rays decomposes the carbonic acid of the atmosphere, and thus furnishes the pabulum and the power necessary to the further development of the organization.

"The same is the case with wheat, and all other grains that are germinated in the earth. Besides the germ of the future plant, there is stored away, around the germ, the starch and gluten to furnish the power necessary to its development, and also the food to build it up, until it reaches the surface of the earth and can draw the sources of its future growth from the power of the sunbeam. In the case of fungi and other plants that grow in the dark, they derive the power and the pabulum from surrounding vegetable matter in process of decay, or in that of evolving power.". . .

"What then is the office of vitality? We say that it is analogous to that of the engineer who directs the power of the steam-engine in the execution of its work."

"If he had published in 1844, with some ful-

ness, as he then wrought them out," says Professor Gray, "his conception and his attractive illustrations of the sources, transformation, and equivalence of mechanical power, and given them fitting publicity, Henry's name would have been prominent among the pioneers and founders of the modern doctrine of the conservation of energy."

Henry always defined science as the "knowledge of natural law," and law as the "will of God." He found all things, even the storms, under the "control of laws — fixed, immutable, and eternal," and rejoiced in believing that "a Supreme Intelligence who knows no change" governs all. For him there was never any conflict between science and religion.

In February, 1837, Henry went to Europe, accompanied by Prof. Alexander D. Bache, at the head of the United States Coast Survey for eighteen years. He became the friend of Faraday; of Wheatstone, then Professor of Experimental Philosophy in King's College, who was engaged in developing his system of the needle telegraph; of Arago, Gay-Lussac, and other noted men. "At King's College," says Prof. Alfred M. Mayer, "Faraday, Wheatstone, Daniell, and Henry had met to try and evolve the electric spark from the thermopile. Each in turn attempted it and failed. Then came Henry's turn. He succeeded, calling in the aid of his discovery of the effect of a long interpolar wire wrapped around a piece of soft iron. Faraday became as wild as a boy, and, jumping up, shouted:

'Hurrah for the Yankee experiment!'" "It is not generally known or appreciated," says Professor Mayer, "that Henry and Faraday independently discovered the means of producing the electric current and the electric spark from a magnet. . . . Henry cannot be placed on record as the *first* discoverer of the magneto-electric current, but it *can* be claimed that he stands alone as its *second* independent discoverer." Both James D. Forbes of Edinburgh and Henry obtained the spark, but were anticipated by Faraday.

Henry spoke before the various scientific societies. He was no longer the apprentice to a watchmaker, or the leader of private theatricals, but a distinguished scholar. By his own will and energy he had attained to this enviable position.

Meantime a man of science, in England, had thought out a great project for the benefit of his fellow-men. James Smithson, a wealthy English chemist, a Fellow of the Royal Society, unmarried, died in 1829. He left his property, over five hundred and forty thousand dollars, after the death of his nephew, provided that he died childless, "to the United States of America, to found at Washington, under the name of the Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." The nephew died six years later, unmarried.

This was indeed a wonderful gift, — and from a stranger! Difficulties at once presented themselves. How could the property be used "for the

increase and diffusion of knowledge among men"? "For ten years," says Garfield, "Congress wrestled with those nine words of Smithson, and could not handle them. Some political philosophers of that period held that we had no constitutional authority to accept the gift at all, and proposed to send it back to England. Every conceivable proposition was made."

John Quincy Adams desired a great astronomical observatory. One person wished an agricultural school; another, a college for women; another, that the funds should be devoted to meteorological observations all over the Union. Finally, a board of regents was appointed, with power to choose a suitable person as secretary.

He must be a learned man, a wise financier, with good judgment and pleasant manners. Professor Henry fulfilled all the conditions. He was admired for his learning; in finance he was wise, as thirty years have proved, the institute with its endowment now being valued at one and a half million dollars; his kindly manner made him accessible, willing to listen to any one who hoped or believed he had discovered something in the line of knowledge. A man who can be harsh or cold to an ignorant person, or indeed to anybody, does not deserve to hold any public position. With natural quickness of temper in early life, he had gained remarkable self-control. Like Baron Cuvier, he had no tolerance for sarcasm or "practical jokes." Henry was unanimously chosen, entering upon his duties

December 3, 1846. He had a definite plan of the work which ought to be done, and "after due deliberation it received the almost unanimous approval of the scientific world."

He believed that the money should be used in original scientific work; by helping men to publish the results of such work; to aid in varied explorations; to send scientific publications all over the world. The institution is now the principal agent of scientific and literary communication between the old world and the new. The number of foreign institutions and correspondents receiving the Smithsonian publications exceeds two thousand, scattered from New Zealand and India to Yokohama, in Japan, and Cape Town, in Southern Africa. The weight of matter sent abroad for ten years, ending 1877, was ninety-nine thousand pounds. Among the first subjects taken up by the institution for investigation was that of American archæology, an attempt to ascertain the industrial, social, and intellectual character of the earliest races on our continent. The first publication of "Smithsonian Contributions" was a work on the mounds and earthworks found in the Mississippi valley, a most fascinating study.

The Smithonian, "first in the world, organized a comprehensive system of telegraphic meteorology, and has thus given first to Europe and Asia, and now to the United States, that most beneficent national application of modern science — the storm warnings."

So much of value has been gathered by government surveys and by voluntary contribution that the institution has sent duplicates to various societies of specimens in geology, mineralogy, botany, zoölogy, and archæology, while it has remaining, "boxed up, varieties of art and nature" more than enough to twice fill the halls and galleries of the building.

The work of Professor Henry grew more and more onerous, but he seemed to leave nothing undone. For many years he served gratuitously as chairman of the Lighthouse Board. When a substitute was needed for sperm oil, after almost numberless experiments, he showed that lard oil is the best illuminant, thereby saving the country over one hundred thousand dollars yearly, since 1865.

During the last twelve years of his life, he devoted much time to our system of coast fog-signals, making "contributions to the science of acoustics, unquestionably the most important of the century."

Observations were made, among other places, at Block Island and Point Judith. The distance between these fog-horns is seventeen miles, and the sound of one can be distinctly heard at the other when the air is quiet and homogeneous; but if the wind blows from one towards the other, the listener at the station from which the wind blows is unable to hear the other horn.

While at work in the Lighthouse Depot, in Staten Island, December, 1877, Henry's right hand became

in a paralytic condition. This foretold that the end was near. He died at noon, May 13, 1878, asking, with his latest breath, which way the wind came, as though still thinking how to save human lives in a fog at sea. He was buried May 16, at Rock Creek Cemetery, near Georgetown, D. C. He was ready when death came. Two weeks before, he said to a friend: "I may die at any moment. I would like to live long enough to complete some things I have undertaken, but I am content to go. I have had a happy life, and I hope I have been able to do some good."

Several times during his connection with the Smithsonian Institution he was offered more lucrative positions, but he remained where he believed he could be most useful. He was called to the professorship of chemistry in the Medical Department of the University of Pennsylvania, with double the salary of his secretaryship; but he declined. He was urged also to take the presidency of the college at Princeton. John C. Calhoun desired him to accept a professorship in the University of Virginia, as there were so many difficulties in connection with the secretaryship. Henry declined, saying that "his honor was committed to the institution." Calhoun grasped his hand, exclaiming, "Professor Henry, you are a man after my own heart."

He seemed to have no time to accumulate money. Fortunately, a fund of forty thousand dollars has been raised by friends, the income of which goes

to his family during life, and afterwards to the National Academy of Sciences, to be devoted to original research.

In character he was above reproach. He said, "I think that immorality and great mental power exercised in the discovery of scientific truths are incompatible with each other; and that more error is introduced from defect in moral sense than from want of intellectual capacity."

He loved nature. "A life devoted exclusively to the study of a single insect," he said, "is not spent in vain. No animal, however insignificant, is isolated; it forms a part of the great system of nature, and is governed by the same general laws which control the most prominent beings of the organic world." In 1870, when gazing upon the Aar glacier, from the Rhone valley, he exclaimed to his daughter, while the tears coursed down his cheeks: "This is a place to die in. We should go no further." A really great man is never afraid to show that he has a tender heart.

He loved his home. Out from it, in his early married life, two children went by death, and later, an only son in his early manhood. Three daughters were left him. One of them records in her diary: "Had father with us all the evening. I modelled his profile in clay, while he read 'Thomson's Seasons' to us. In the earlier part of the evening he seemed restless and depressed, but the influence of the poet drove away the cloud, and then an expression of almost childlike sweetness rested

upon his lips, singularly in contrast, yet beautifully in harmony, with the intellect of the brow above."

Again she writes: "We were all up until a late hour, reading poetry with father and mother, father being the reader. He attempted 'Cowper's Grave,' by Mrs. Browning, but was too tender-hearted to finish the reading of it. We then laughed over the 'Address to the Mummy,' soared to heaven with Shelley's 'Skylark,' roamed the forest with Bryant, culled flowers from other poetical fields, and ended with 'Tam O'Shanter.' I took for my task to recite a part of the latter from memory, while father corrected, as if he were 'playing schoolmaster.'"

He was orderly and painstaking in his work, deciding with great caution. Prof. Asa Gray tells a story of his boyhood which well illustrates this. "It goes back to the time when he was first allowed to have a pair of boots, and to choose for himself the style of them. He was living with his grandmother, in the country, and the village Crispin could offer no great choice of patterns; indeed, it was narrowed down to the alternative of round toes or square. Daily the boy visited the shop and pondered the alternatives, even while the manufacture was going on, until, at length, the shoemaker, who could brook no more delay, took the dilemma by both horns, and produced the most remarkable pair of boots the wearer ever had; one boot round-toed, the other square-toed. . . . He

probably never again postponed decision till it was too late to choose."

A single incident illustrates the kindness of the man, who was always called the "model of a Christian gentleman." "Early in the war, in the autumn of 1861, a caller at the presidential mansion, very anxious to see the chief magistrate of the nation, was informed that he could not then be seen, being engaged in an important private consultation. The caller, not to be repulsed, wrote on a piece of paper that he must see Mr. Lincoln personally, on a matter of vital and pressing importance to the public welfare. This, of course, secured his admission to the presence of Mr. Lincoln, who was sitting with a middle-aged gentleman. Observing the hesitancy of the visitor, the President told him he might speak freely, as only a friend was present.

"Whereupon the visitor announced that for several evenings past he had observed a light exhibited on the highest of the Smithsonian towers, for a few minutes, about nine o'clock, with mysterious movements, which, he felt satisfied, were designed as signals to the rebels encamped on Munson's Hill, in Virginia. Having gravely listened to this information with raised eyebrows, but a subdued twinkle of the eye, the President turned to his companion, saying, 'What do you think of that, Professor Henry?'

"Rising with a smile, the person addressed replied that, from the time mentioned, he presumed

the mysterious light shone from the lantern of an attendant who was required at nine o'clock each evening to observe and record the indications of the meteorological instruments placed on the tower. The painful confusion of the officious informant at once appealed to Henry's sensibility, and, quite unmindful of the President, he approached the visitor, offering his hand, and with a courteous regard counselled him never to be abashed at the issue of a conscientious discharge of duty, and never to let the fear of ridicule interfere with its faithful execution."

Henry had learned how to triumph over the misfortunes of life. In 1865, the Smithsonian building was partially burned, with nearly one hundred thousand letters, his notes of original research for thirty years, the annual report in manuscript, ready for the press, a valuable library, etc.

"A few years ago," he said, "such a calamity would have paralyzed me for future efforts, but in my present view of life I take it as the dispensation of a kind and wise Providence, and trust that it will work to my spiritual advantage."

A bronze statue of Joseph Henry, by W. W. Story, costing fifteen thousand dollars, was unveiled in the grounds of the Smithsonian Institution, April 19, 1883. Ten thousand people were assembled to witness the ceremonies. Noah Porter, ex-president of Yale College, delivered the oration. There it will tell the story of a self-made man — of whom Garfield said: "Remembering his

great career as a man of science, as a man who served his government with singular ability and faithfulness, who was loved and venerated by every circle, who blessed with the light of his friendship the worthiest and the best, whose life added new lustre to the glory of the human race, we shall be most fortunate if ever in the future we see his like again."

Prof. Joseph Henry was succeeded by Prof. Spencer F. Baird as secretary of the Smithsonian Institution. He died August 19, 1887, and Prof. S. P. Langley was called to the position, accepting the office November 18, 1887.

LOUIS AGASSIZ.

IN the midst of as beautiful scenery as one finds on earth, snow-white Alps, blue lakes, great fields of purple crocus, and picturesque homes, Jean Louis Rodolphe Agassiz was born at Motier, on Lake Morat, Switzerland, May 28, 1807.

His father, a clergyman, descended from a long line of clergymen, was a gentle but efficient man, universally esteemed. His mother, Rose Mayor, the daughter of a physician on the shore of Lake Neuchâtel, was a woman of strong character and most tender affection. She had buried her first four children; therefore Louis was cared for with unusual solicitude.

Until he was ten years old, he was taught by his parents, and allowed to develop his natural tastes. Possibly his sweetness of disposition resulted, in part, from the wise training of the father and mother. Doubtless as many children are spoiled by undue thwarting and irritating as by over-indulgence. Though Louis met almost unsurmountable obstacles later in life, he was able to rejoice, having enjoyed a sunny childhood. Such a childhood we can give to our children but once.

In a great stone basin back of the parsonage, the boy made his first aquarium. There he gathered

fishes, frogs, tadpoles, indeed, everything which he could obtain from Lake Morat. In the house he had pet birds, hares, rabbits, field-mice, with their families, all cared for as though they were royal visitors.

He was skilful as a carpenter and boot-maker. When the village cobbler came to the house, two or three times a year, to make shoes for the family, the lad was quick to imitate him, and made well fitting shoes for his sister's dolls.

Mrs. Elizabeth Cary Agassiz, in her fascinating life of her husband, tells this incident of his boyhood: "Though fond of quiet, indoor occupation, he was an active, daring boy. One winter day, when about seven years of age, he was skating with his little brother Auguste, two years younger than himself, and a number of other boys, near the shore of the lake. They were talking of a great fair held that day at the town of Morat, on the opposite side of the lake, to which M. Agassiz had gone in the morning, not crossing upon the ice, however, but driving around the shore.

"The temptation was too strong for Louis, and he proposed to Auguste that they should skate across, join their father at the fair, and come home with him in the afternoon. They started accordingly. The other boys remained on their skating ground till twelve o'clock, the usual dinner hour, when they returned to the village. Mme. Agassiz was watching for her boys, thinking them rather late, and, on inquiring for them among the troop of

urchins coming down the village street, she learned on what errand they had gone. Her anxiety may be imagined. The lake was not less than two miles across, and she was by no means sure that the ice was safe.

"She hurried to an upper window with a spy-glass, to see if she could descry them anywhere. At the moment she caught sight of them, already far on their journey, Louis had laid himself down across a fissure in the ice, thus making a bridge for his little brother, who was creeping over his back. Their mother directed a workman, an excellent skater, to follow them as swiftly as possible. He overtook them just as they had gained the shore, but it did not occur to him that they could return otherwise than they had come, and he skated back with them across the lake. Weary, hungry, and disappointed, the boys reached the house without having seen the fair or enjoyed the drive home with their father in the afternoon."

At ten, Louis was sent to a school for boys at Bienne, where, though the children studied nine hours a day, the time was wisely divided between work and play, so that they were kept well and happy. The lad always remembered affectionately his teacher at this school, Mr. Rickly. When the vacations came, Louis and Auguste walked twenty miles home to Motier, and did not find the journey long or tedious.

At fourteen, Louis left Bienne, having finished his education, as he supposed, prior to entering the

business house of his uncle, François Mayor, at Neuchâtel. That his young mind turned longingly towards a different future, may be seen from his desires written at this time on a sheet of foolscap.

"I wish to advance in the sciences, and for that I need D'Anville, Ritter, an Italian dictionary, a Strabo in Greek, Mannert and Thiersch; and also the works of Malte-Brun and Seyfert. I have resolved, as far as I am allowed to do so, to become a man of letters, and at present I can go no further: first, in ancient geography, for I already know all my note-books, and I have only such books as Mr. Rickly can lend me; I must have D'Anville or Mannert; second, in modern geography also, I have only such books as Mr. Rickly can lend me, and the Osterwold geography, which does not accord with the new divisions; I must have Ritter or Malte-Brun; third, for Greek I need a new grammar, and I shall choose Thiersch; fourth, I have no Italian dictionary, except one lent me by Mr. Moltz; I must have one; fifth, for Latin I need a larger grammar than the one I have, and I should like Seyfert; sixth, Mr. Rickly tells me that, as I have a taste for geography, he will give me a lesson in Greek (*gratis*) in which we would translate Strabo, provided I can find one. For all this I ought to have about twelve louis. I should like to stay at Bienne till the month of July, and afterward serve my apprenticeship in commerce at Neuchâtel for a year and a half. Then I should like to pass four years at a university in Germany,

and finally finish my studies at Paris, where I would stay about five years. Then, at the age of twenty-five, I could begin to write."

At this early age, then, he was thinking of being an author!

He begged his parents to defer the business project for two years, that he might study at the College of Lausanne. They were willing and glad to please their boy; but they knew from experience the ills of poverty, and they hoped to save him from it by a wise choice of a life-work.

They gratified him, however, and he went to Lausanne. His uncle, Dr. Mathias Mayor, a physician of Lausanne, seeing that the boy was deeply interested in anatomy, advised that he should study medicine; so this was decided upon, as being more in accord with Louis' tastes than business.

As poor Vincenzio Galileo found it a difficult matter to make a wool merchant or a doctor out of a boy destined to be a man of science, so did the father of Louis Agassiz.

At seventeen, Louis left Lausanne for the medical school at Zurich. Here he became the friend as well as pupil of Professor Schinz, who held the chair of Natural History and Physiology. He gave young Agassiz a key to his private library, and also to his collection of birds; of course, the love for natural history grew stronger. Both boys, for Auguste had come to Zurich with his brother, were too poor to buy books even when they cost but a few shillings a volume. The Swiss minis-

ter was saving to the uttermost to pay for board and decent clothes for his sons, to say nothing of books. Therefore the use of Schinz's library was a great favor.

Said Agassiz in after years, "My inability to buy books was, perhaps, not so great a misfortune as it seemed to me; at least, it saved me from too great dependence on written authority. I spent all my time in dissecting animals and in studying human anatomy, not forgetting my favorite amusements of fishing and collecting. I was always surrounded with pets, and had at this time some forty birds flying about my study, with no other home than a large pine-tree in the corner. I still remember my grief when a visitor, entering suddenly, caught one of my little favorites between the floor and the door, and he was killed before I could extricate him. Professor Schinz's private collection of birds was my daily resort, and I then described every bird it contained, as I could not afford to buy even a text-book of ornithology.

"I also copied with my own hand, having no means of purchasing the work, two volumes of Lamarck's 'Animaux sans Vertèbres,' and my dear brother copied another half-volume for me. I finally learned that the study of the things themselves was far more attractive than the books I so much coveted, and when, at last, large libraries became accessible to me, I usually contented myself with turning over the leaves of the volumes on natural history, looking at the illustrations, and

recording the titles of the works, that I might readily consult them for identification of such objects as I should have an opportunity of examining in nature."

The boys remained two years at Zurich. One vacation, as they were walking home, the family having moved from Motier to Orbe, they were overtaken by a gentleman who asked them to ride, shared his lunch with them, and took them to their own door. Some days afterward he wrote to M. Agassiz that he had been so impressed by his son Louis that he wished to adopt him and provide for him through life.

This request caused great commotion in the little home, for the writer of the letter was a man of wealth in Geneva, but, after careful consideration, both parents and son declined the offer, preferring to struggle with poverty rather than bear separation.

At the end of the two years in Zurich, Auguste went to the commercial house of his uncle at Neuchâtel, and Louis to the University of Heidelberg, taking letters of introduction from Professor Schinz and others. Professor Tiedemann, the chancellor, had studied with Schinz; therefore, Agassiz received a warm welcome, and an offer of books from his library.

The young student worked earnestly. He wrote to his father: "Every morning I rise at six o'clock, dress and breakfast. At seven I go to my lectures given during the morning. . . . If, in the interval,

I have a free hour, as sometimes happens from ten to eleven, I occupy it in making anatomical preparations. . . . From twelve to one I practise fencing. We dine at about one o'clock, after which I walk till two, when I return to the house and to my studies till five o'clock. From five to six we have a lecture from the renowned Tiedemann. After that, I either take a bath in the Neckar, or another walk. From eight to nine I resume my special work, and then, according to my inclination, go to the Swiss Club, or, if I am tired, to bed. I have my evening service and talk silently with you, believing that at that hour you also do not forget your Louis, who thinks always of you."

At Heidelberg, like Humboldt, Agassiz needed a congenial friend, and found one in Alexander Braun, of Carlsruhe, an ardent lover of botany, afterward Director of the Botanical Gardens in Berlin. He wrote to his parents concerning Agassiz, "a rare comet on the Heidelberg horizon. . . . Not only do we collect and learn to observe all manner of things, but we have also an opportunity of exchanging our views on scientific matters in general. I learn a great deal from him, for he is much more at home in zoölogy than I am. He is familiar with almost all the known mammalia, recognizes the birds from far off by their song, and can give a name to every fish in the water.

"In the morning we often stroll together through the fish market, where he explains to me all the different species. He is going to teach me how to

stuff fishes, and then we intend to make a collection of all the native kinds. Many other useful things he knows; speaks German and French equally well, English and Italian fairly, so that I have already appointed him to be my interpreter on some future vacation trip to Italy. He is well acquainted with ancient languages also, and studies medicine besides."

Schimper, another brilliant botanist, was a friend of both Braun and Agassiz. The professor in zoölogy, Leuckart, was very fond of these bright pupils, and allowed himself to be gotten up at seven in the morning, to give them extra lectures.

When vacation came, Braun took Agassiz to his home; a cultured place, rich in books, music, and collections of plants and animals. Agassiz was very happy there; possibly the happiness was increased by the fact that Braun had a lovely and artistic sister, Cecile. Agassiz wrote home, "My happiness would be perfect were it not for the painful thought which pursues me everywhere, that I live on your privations; yet it is impossible for me to diminish my expenses further. You would lift a great weight from my heart if you could relieve yourself of this burden by an arrangement with my uncle at Neuchâtel. . . . Otherwise I am well, going on as usual, always working as hard as I can, and I believe all the professors whose lectures I attend are satisfied with me."

In the spring of 1827, when Agassiz was twenty, he was taken ill of typhus fever, and it was

feared he would not recover. As soon as possible he was removed to Braun's home, and most tenderly cared for. When he became able, he went to his own home, at Orbe. From there he writes to Braun: "I had the good fortune to find at least thirty specimens of Bombinator obstetricans, with the eggs. Tell Dr. Leuckart that I will bring him some, — and some for you also. I kept several alive, laid in damp moss; after fourteen days the eggs were almost as large as peas, and the little tadpoles moved about inside in all directions. The mother stripped the eggs from her legs, and one of the little tadpoles came out, but died for want of water. Then I placed the whole mass of eggs in a vessel filled with water, and behold! in about an hour some twenty young ones were swimming freely about. I shall spare no pains to raise them, and I hope, if I begin aright, to make fine toads of them in the end. My oldest sister is busy every day in making drawings for me to illustrate their gradual development."

In the fall of 1827, Agassiz and Braun, after spending a little more than a year at Heidelberg, went to the University of Munich, there meeting Schimper. He wrote home, that from one of his windows he could see "the whole chain of the Tyrolean Alps, as far as Appenzell. . . . It is a great pleasure to have at least a part of our Swiss mountains always in sight. To enjoy it the more, I have placed my table opposite the window, so that every time I lift my head my eyes rest on our dear country."

At Munich, the young students were stimulated by the presence of many noted men. Döllinger lectured on comparative anatomy; Schelling, on philosophy; Oken, on natural history, physiology, and zoölogy; Martius, on botany. Agassiz and Braun roomed in Döllinger's house. This room soon became the intellectual centre for the bright men of the college, and was called "the little academy." Here different students gave lectures, each on his special subject of study; the professors, even, coming as listeners.

"In that room," said Agassiz, years later, "I made all the skeletons represented on the plates of Wagler's 'Natural System of Reptiles'; there I once received the great anatomist Meckel, sent to me by Döllinger to examine my anatomical preparations, and especially the many fish-skeletons I had made from fresh-water fishes. By my side were constantly at work two artists; one engaged in drawing various objects of natural history, the other in drawing fossil fishes. I kept always one, and sometimes two artists, in my pay. It was not easy, with an allowance of little more than fifty pounds a year; but they were even poorer than I, and so we managed to get along together. My microscope I had earned by writing." Poor Agassiz! he was yet to see greater pecuniary trials than this.

Says Mr. Dinkel, one of the artists who worked with Agassiz for many years: "I soon found myself engaged four or five hours almost daily in

painting for him fresh-water fishes from the life, while he was at my side, sometimes writing out his descriptions, sometimes directing me. . . . He never lost his temper, though often under great trial; he remained self-possessed, and did everything calmly, having a friendly smile for every one, and a helping hand for those who were in need. He was at that time scarcely twenty years old, and was already the most prominent among the students of Munich. They loved him, and had a high consideration for him. . . . He liked merry society, but he himself was in general reserved, and never noisy. He picked out the gifted and highly learned students, and would not waste his time in ordinary conversation. Often, when he saw a number of students going off on some empty pleasure-trip, he said to me, 'There they go with the other fellows. . . . I will go my own way, Mr. Dinkel, — and not alone. I will be a leader of others.'"

Agassiz writes to his brother Auguste: "It will interest you to know that I am working with a young Dr. Born upon an anatomy and natural history of the fresh-water fishes of Europe. We have already gathered a great deal of material, and I think by the spring, or in the course of the summer, we shall be able to publish the first number. . . . I earnestly advise you to while away your leisure hours with study. Read much, but only good and useful books. . . . Remember that statistical and political knowledge alone distinguishes the true merchant from the mere tradesmen, and guides him

in his undertakings. . . . Write me about what you are reading, and about your plans and projects, for I can hardly believe that any one could exist without forming them; I, at least, could not."

It is not strange that the watchful mother begins to be anxious, for she hears nothing from her son about her "project" of medicine. She writes him that she detects in his letters "a certain sadness and discontent." "How is it," she says, "that you look forward only with distaste to the practice of medicine? Have you reflected seriously before setting aside this profession? Indeed, we cannot consent to such a step; you would lose ground in our opinion, in that of your family, and in that of the public you would pass for an inconsiderate, fickle young fellow, and the slightest stain on your reputation would be a mortal blow to us. . . . Of course you will not gather roses without thorns. Life consists of pains and pleasures everywhere. To do all the good you can to your fellow-beings, to have a pure conscience, to gain an honorable livelihood, to procure for yourself by work a little ease, to make those around you happy, that is true happiness; all the rest but mere accessories and chimeras."

And then the good Swiss minister adds, thus to quiet his son's restless nature, "If it be absolutely essential to your happiness that you should break the ice of the two poles in order to find the hairs of a mammoth, . . . at least wait till your trunk is packed and your passports are signed

before you talk with us about it. Begin by reaching your first aim, a physician's and surgeon's diploma. . . . My own philosophy is to fulfil my duties in my sphere, and even that gives me more than I can do." Fortunately Louis Agassiz did not possess the kind of philosophy that brings content in a small parish on a Swiss lake; his sphere was to be the world, and two continents were to be proud of him.

In 1817, the King of Bavaria had sent two naturalists, M. Martius and M. Spix, on an exploring expedition to Brazil. They returned in four years, laden with treasures. M. Martius issued colored illustrations of all the unknown plants he had collected, and M. Spix several volumes on the monkeys, birds, and reptiles of Brazil. He had intended to give a complete natural history of Brazil, but died before his work was finished. Martius asked Agassiz to continue the work of Spix, in the line of fishes.

Agassiz writes to his sister Cecile: "I hesitated for a long time to accept this honorable offer, fearing that the occupation might withdraw me too much from my studies; but, on the other hand, the opportunity for laying the foundation of a reputation by a large undertaking seemed too favorable to be refused. The first volume is already finished, and the printing was begun some weeks ago. . . . Already forty colored folio plates are completed. Will it not seem strange when the largest and finest book in papa's library is one written by his

Louis? Will it not be as good as to see his prescription at the apothecary's? It is true that this first effort will bring me in but little; nothing at all, in fact, because M. de Martius has assumed all the expenses, and will, of course, receive the profits. My share will be a few copies of the book, and these I shall give to the friends who have the first claim."

He writes to his father, as though half apologizing for the fact that he is writing a book on natural history, at the same time showing the real purpose of his life: "I wish it may be said of Louis Agassiz that he was the first naturalist of his time, a good citizen, and a good son, beloved of those who knew him. I feel within myself the strength of a whole generation to work toward this end, and I will reach it if the means are not wanting."

Thus early in life he had fixed the mark to which he would attain, "the first naturalist of his time." No wonder he succeeded, when he felt within himself "the strength of a whole generation to work toward this end."

In the summer of 1829, when he was twenty-two, the first part of the "Brazilian Fishes" was published, and a copy sent to the fond parents. Good M. Agassiz wrote back: "I have no terms in which to express the pleasure it has given me. In two words, for I have only a moment to myself, I repeat my urgent entreaty that you would hasten your return as much as possible. . . . The old

father, who waits for you with open heart and arms, sends you the most tender greeting." He had been devoting his time to science — just what they feared, — but how proud they were to have him succeed!

Cuvier, the great leader in zoölogy, to whom the book was dedicated, wrote back: "You and M. de Martius have done me honor in placing my name at the head of a work so admirable as the one you have just published. The importance and the rarity of the species therein described, as well as the beauty of the figures, will make the work an important one in ichthyology, and nothing could heighten its value more than the accuracy of your descriptions. It will be of the greatest use to me in my 'History of Fishes.' . . . I shall do all in my power to accelerate the sale among amateurs, either by showing it to such as meet at my house, or by calling attention to it in scientific journals."

Another project had now taken form in Agassiz's active brain, his great work on "Poissons Fossiles," which a few years later placed him in the front rank of scientific men. He wrote to Auguste: "Having, by permission of the director of the museum, one of the finest collections of fossils in Germany at my disposition, and being also allowed to take the specimens home as I need them, I have undertaken to publish the ichthyological part of the collection. Since it only makes the difference of one or two people more to direct, I have these specimens also drawn at the same time. Nowhere

so well as here, where the Academy of Fine Arts brings together so many draughtsmen, could I have the same facility for completing a similar work; and as it is an entirely new branch, in which no one has as yet done anything of importance, I feel sure of success; the more so because Cuvier, who alone could do it (for the single reason that every one else has till now neglected the fishes), is not engaged upon it. Add to this that just now there is a real need of this work for the determination of the different geological formations." And then he urges Auguste to intercede with his uncle at Neuchâtel for one hundred louis. "At this very time, when he was keeping two or three artists on his slender means," says his wife, "he made his own breakfast in his room, and dined for a few pence a day at the cheapest eating-houses. But where science was concerned the only economy he recognized, either in youth or old age, was that of an expenditure as bold as it was carefully considered."

He was now at work finishing the "Brazilian Fishes," and carrying forward the "Fresh-Water Fishes" and the "Fossil Fishes." Besides these, he read medical works till midnight, and wrote seventy-four theses on anatomical, pathological, surgical, and obstetrical subjects.

He took his degree of medicine April 3, 1830. He writes to his mother: "The whole ceremony lasted nine days. At the close, while they considered my case, I was sent out of the room. On my

return, the dean said to me, 'The faculty have been *very much*' (emphasized) 'pleased with your answers; they congratulate themselves on being able to give the diploma to a young man who has already acquired so honorable a reputation.' . . . The rector then added that he should look upon it as the brightest moment of his rectorship when he conferred upon me the title I had so well merited."

And the glad mother writes back: "I cannot thank you enough, my dear Louis, for the happiness you have given me in completing your medical examinations, and thus securing to yourself a career as safe as it is honorable. . . . You have for my sake gone through a long and arduous task; were it in my power I would gladly reward you, but I cannot even say that I love you the more for it, because that is impossible. My anxious solicitude for your future is a proof of my ardent affection for you; only one thing was wanting to make me the happiest of mothers, and this, my Louis, you have just given me."

Agassiz had taken the degree of Doctor of Philosophy, a year earlier. "The time had come," said he, years afterward, "when even the small allowance I received from borrowed capital must cease. I was now twenty-four years of age. I was Doctor of Philosophy and Medicine, and author of a quarto volume on the fishes of Brazil. I had travelled on foot all over Southern Germany, visited Vienna, and explored extensive tracts of the Alps. I knew every animal, living and fossil, in the

museums of Munich, Stuttgart, Tübingen, Erlangen, Wurzburg, Carlsruhe, and Frankfort; but my prospects were as dark as ever, and I saw no hope of making my way in the world, except by the practical pursuit of my profession as physician."

December 4, 1830, Agassiz said good-by to Munich, and started with Mr. Dinkel, his artist, for Concise, his father having moved there from Orbe. Here he remained a year, arranging, meantime, his own valuable collections in natural history, at the house of his grandfather Mayor, at Cudrefin, on Lake Neuchâtel, and practising a little in medicine, in the neighboring villages.

He longed to go to Paris for study, but poverty was his constant companion. Finally, an old friend of his father, a Swiss clergyman, M. Christinot, having come into possession of a small amount of money, urged his young friend to take it. His uncle also contributed a little, and Agassiz and Dinkel left for Paris in September, 1831.

On their arrival they found inexpensive lodgings, and at once began to work in the museums. He writes to his sister Olympe: "M. Cuvier and M. Humboldt especially treat me on all occasions as an equal, and facilitate for me the use of the scientific collections so that I can work here as if I were at home. . . . In the morning I follow the chemical courses at the Pitié. . . . At ten o'clock, or perhaps at eleven, I breakfast, and then go to the Museum of Natural History, where I stay till dark. Between five and six I dine, and after that turn to

such medical studies as do not require daylight. . . . On Saturday only, I spend the evening at M. Cuvier's."

He writes later to his brother that there is another excellent reason why he does not spend more evenings in society, because he has "no presentable coat. . . . You can imagine that, after the fuel bill for the winter is paid, little remains for other expenses out of my two hundred francs a month, five louis of which are always due to my companion. Far from having anything in advance, my month's supply is thus taken up at once." Evidently he had no more money than when he and Auguste copied whole volumes at the Zurich school.

Cuvier was so much drawn to the young naturalist that he gave him and his artist a corner in one of his own laboratories, and, more than this, his drawings of fossil fishes and notes which he had taken in the British Museum and elsewhere. Cuvier said, three months later, with regard to some work, "You are young; you have time enough for it, and I have none to spare."

Agassiz now studied fifteen hours daily, sometimes seventeen. Cuvier commended his devotion, but said one evening as he left him, "Be careful, and remember that *work kills.*" The next day he was paralyzed and died soon after, Agassiz never seeing him again.

It became evident that Paris, with her scientific treasures, could not be enjoyed longer. He must go back to Switzerland, and find a place to teach,

as his sympathetic mother urged him to do. Just when the sky was darkest, a letter came from Humboldt, enclosing a check for one thousand francs! "Consider it," he said, "an advance which need not be paid for years, and which I will gladly increase when I go away or even earlier. It would pain me deeply should the urgency of my request, made in the closest confidence, — in short, a transaction as between two friends of unequal age, — be disagreeable to you. I should wish to be pleasantly remembered by a young man of your character. Yours, with the most affectionate respect, Alexander Humboldt."

How delicately offered was this charity in the guise of a loan! To give is blessed; to give without wounding the recipient is more blessed still!

The tender heart of Agassiz was deeply moved. He wrote his mother: "Oh! if my mother would forget for one moment that this is the celebrated M. de Humboldt, and find courage to write him only a few lines, how grateful I should be to her. I think it would come better from her than from papa, who would do it more correctly, no doubt, but perhaps not quite as I should like."

She wrote a thankful letter, and the great man replied: "I should scold your son, madame, for having spoken to you of the slight mark of interest I have been able to show him; and yet, how can I complain of a letter so touching, so noble in sentiment, as the one I have just received from your hand? Accept my warmest thanks for it. . . .

One might well despair of the world if a person like your son, with information so substantial and manners so sweet and prepossessing, should fail to make his way."

This money made it possible for Agassiz to work in Paris, until a professorship of Natural History was created for him at Neuchâtel, through the influence of Humboldt and others. Humboldt wrote: "Agassiz is distinguished by his talents, by the variety and substantial character of his attainments, and by that which has a special value in these troubled times, his natural sweetness of disposition."

This "sweetness of disposition" was worth more to Agassiz, all through life, than a fortune. It drew everybody to him. It opened the pockets of the wealthy to carry forward his great projects. It won the hearts of his pupils on two hemispheres. It made his home a delight, and his presence a constant blessing.

He assumed the duties of his professorship at Neuchâtel in the autumn of 1832, giving his first lecture, "Upon the Relations between the different branches of Natural History and the then prevailing tendencies of all the Sciences," November 12, at the Hôtel de Ville. A society for the study of the natural sciences was soon formed, and Agassiz became its secretary. So natural, so enthusiastic, so full of his subject, was he, that everybody became interested. To little companies of his friends and neighbors he lectured on botany,

on zoölogy, and the philosophy of nature. Even the children were delighted to gather and be told how lakes, springs, rivers, and valleys are formed.

"When it was impossible to give the lessons out-of-doors, the children were gathered around a large table, where each one had before him or her the specimens of the day, sometimes stones and fossils, sometimes flowers, fruits, or dried plants. . . . When the talk was of tropical or distant countries, pains were taken to procure characteristic specimens, and the children were introduced to dates, bananas, cocoa-nuts, and other fruits, not to be easily obtained in those days in a small inland town. They, of course, concluded the lesson by eating the specimen, a practical illustration which they greatly enjoyed."

Three months after his settlement at Neuchâtel, where eighty louis had been guaranteed to him for three years, he was invited to Heidelberg, to succeed his former professor, Leuckart, in zoölogy. He would receive a salary of five hundred florins, besides about fifteen hundred gulden for lectures and literary work. He declined the honor, because he wished more time to devote to his writing. The following year Neuchâtel purchased his collections in natural history, thus affording him some pecuniary aid in his work.

A serious misfortune now threatened him in the loss of sight. Having injured his eyes by microscopic work, for several months he was shut up in a dark room, practising the study of his fossils by

touch alone; by the tongue when the fingers were not sufficiently sensitive to feel out the impression. With great care his eyes improved, so that he was able to use them through life more constantly than most persons.

In October, 1833, when he was twenty-six, Agassiz married Cecile Braun of Carlsruhe, the sister of his life-long friend Alexander. They began housekeeping in a small apartment at Neuchâtel, both practising the closest economy that the books might be carried on; the "Fresh-Water Fishes," and the "Fossil Fishes." She was a skilful artist, had done much work for her brother in botany, and now helped her young husband in drawing and coloring his fishes.

The first number of the "Fossil Fishes" had already appeared, with the following title, which shows the plan of the great work, to which he devoted ten years, from 1833 to 1843: —

"Researches on the Fossil Fishes: comprising an Introduction to the Study of these Animals; the Comparative Anatomy of Organic Systems which may contribute to facilitate the Determination of Fossil Species; a New Classification of Fishes, expressing their relations to the Series of Formations; the Explanation of the Laws of their Succession and Development during all the Changes of the Terrestrial Globe, accompanied by General Geological Considerations; finally, the Description of about a thousand Species which no longer exist, and whose Characters have been

restored from Remains contained in the Strata of the Earth."

The work was inscribed to Humboldt. "These pages owe to you their existence; accept their dedication." It met everywhere the most favorable reception. Élie de Beaumont wrote to Agassiz: "It promises a work as important for science as it is remarkable in execution. Do not let yourself be discouraged by obstacles of any kind; they will give way before the concert of approbation which so excellent a work will awaken."

Agassiz had become known to scholars throughout Europe, as an indefatigable worker, but he was still poor. Now and then there came a gleam of sunshine into the straitened life. In 1834, he was greatly surprised to receive from the London Geological Society, through Sir Charles Lyell, the Wollaston prize, of about thirty pounds, conferred upon him for his work on fishes.

He writes back to Lyell: "You cannot imagine the joy your letter has given me. The prize awarded me is at once so unexpected an honor and so welcome an aid that I could hardly believe my eyes when, with tears of relief and gratitude, I read your letter. In the presence of a savant, I need not be ashamed of my penury, since I have spent the little I had wholly in scientific researches. I do not, therefore, hesitate to confess to you that at no time could your gift have given me greater pleasure. Generous friends have helped me to bring out the first number of my 'Fossil

Fishes;' the plates of the second are finished, but I was greatly embarrassed to know how to print a sufficient number of copies before the returns from the first should be paid in. The text is ready also, so that now, in a fortnight, I can begin the distribution, and, the rotation once established, I hope that preceding numbers will always enable me to publish the next in succession without interruption. I even count upon this resource as affording me the means of making a journey to England before long."

In August, 1834, Agassiz went to England, and there formed delightful friendships with such men as Lyell, Murchison, Buckland, and others. He was allowed to cull, from sixty or more collections, some two thousand fossil fishes, and deposit them in the Somerset House in London, where Mr. Dinkel, the artist, remained for several years at work, copying.

In the summer of 1836, he began his remarkable study of the glaciers. He was so cramped for means to carry forward his "Fossil Fishes," that it seemed probable that he must discontinue it, when opportunely his original drawings were purchased by Lord Francis Egerton and given to the British Museum. The financial condition was thus bettered for a time.

His investigation of the slopes of the Jura led to an address before the Helvetic Association assembled at Neuchâtel in 1837, in which he said: "Siberian winter established itself for a time over

a world previously covered with a rich vegetation and peopled with large mammalia, similar to those now inhabiting the warm regions of India and Africa. Death enveloped all nature in a shroud, and the cold, having reached its highest degree, gave to this mass of ice, at the maximum of tension, the greatest possible hardness." He showed how huge boulders had been distributed over the continent.

His views excited much opposition, from most of the older geologists. Even Humboldt said, "Your ice frightens me." But the discussion convinced the scientific world that Agassiz was both original and brilliant. He was soon called to a professorship of geology and mineralogy at Geneva, with a salary of three thousand francs, and also to Lausanne; but he refused both offers. So pleased were the people of Neuchâtel that they made him accept a present of six thousand francs, payable during three years.

In 1838, Agassiz founded a lithographic printing establishment in Neuchâtel, where his work could be done under his own direction instead of in Munich. He was now, besides his duties as professor, at work on "Living and Fossil Echinoderms and Mollusks," as well as "Fresh-Water and Fossil Fishes," and soon after upon the "Études sur les Glaciers," with an atlas of thirty-two plates. The book gave an account of all previous glacial study, and the observations of himself and companions.

"Agassiz displayed during these years," said

one of his co-workers, "an incredible energy, of which the history of science offers, perhaps, no other example." He worked always till midnight, often till two or three o'clock, sitting for hours at his microscope, troubled much with congestion of the head and eyes. The expense involved in his work was enormous, and he was burdening himself with debts, which are more wearing and destructive to health and happiness than any amount of work can ever be.

Still he struggled on, through these dark days of poverty. He was only thirty-three, so young-looking that, on seeing him, people asked if he were "the son of the celebrated professor of Neuchâtel." He had already been chosen a member of the Royal Society of London.

In 1840 he made his first permanent station on the Alps, taking with him barometers, thermometers, hygrometers, psychometers, boring apparatus, and microscopes, making the Hospice of the Grimsel his base of supplies, and the lower Aar glacier the scene of his work. A huge boulder, its upper surface forming a roof, with a stone wall constructed on one side, became the sleeping-room of Agassiz and five friends. This abode was called the Hôtel des Neuchâtelois. Jacob Leuthold, an intrepid Swiss, was their chief guide. He died at thirty-seven, sincerely mourned by all. They made dangerous ascents of snow-covered peaks, measured the depth and forward movement of glaciers, Agassiz even being lowered by ropes one hundred

and twenty-five feet into a glacial well, to investigate its formation.

All Europe was becoming interested in glaciers. Edward Forbes wrote from Edinburgh: "You have made all the geologists glacier-mad here, and they are turning Great Britain into an ice-house." Darwin was deeply interested. He wrote from North Wales: "The valley about here and the site of the inn at which I am now writing must once have been covered by at least eight hundred or one thousand feet in thickness of solid ice! Eleven years ago I spent a whole day in the valley where yesterday everything but the ice of the glaciers was palpably clear to me, and I then saw nothing but plain water and bare rock."

Agassiz now began work on his "Nomenclator Zoölogicus," and his "Bibliographia Zoölogiæ et Geologiæ," the former comprising "an enumeration of all the genera of the animal kingdom, with the etymology of their names, the names of those who had first proposed them, and the date of their publication." The latter contained a list of all the authors named in the Nomenclator, with notices of their works. This was published by the Royal Society in England, in 1848, the expense being too great for one person.

In 1843 the "Fossil Fishes," in five large volumes, was completed, and the following year his "Monograph on the Fossil Fishes of the Old Red Sandstone, or the Devonian System of Great Britain and Russia," was published, a large volume

accompanied by forty-one plates. The discovery of these fossils was due to Hugh Miller, whose interesting life and pathetic death will always be associated with the study of the Old Red Sandstone.

In the spring of 1846, a great change took place in the life of the overworked naturalist. He had long hoped to visit the United States for scientific investigation, and now the time had come. The King of Prussia, at the request of Humboldt, granted him fifteen thousand francs for this purpose—he had previously given Agassiz two hundred pounds for his glacial researches. . . . Leaving his wife and daughters with Alexander Braun, her brother, at Carlsruhe, and his son Alexander at school at Neuchâtel, Agassiz said good-bye to his students, who came at two o'clock at night, in procession with torchlights. Going to Paris, he spent some time in bringing out his second work upon the glaciers, "Système Glaciaire," receiving the Monthyon Prize of Physiology from the Academy, and sailed for America in September, 1846.

Humboldt wrote him from Sans-Souci: "Be happy in this new undertaking, and preserve for me the first place under the head of friendship in your heart. When you return, I shall be here no more, but the king and queen will receive you on this historic hill with the affection which, for so many reasons, you merit. Your illegible but much attached friend."

Sir Charles Lyell, of England, who had given a

successful course of lectures before the Lowell Institute, Boston, arranged a similar course with Mr. Lowell for his friend Agassiz. Perhaps money has never been given more wisely in America than by the refined John Lowell, Jr., of Boston, who, dying in a foreign country at thirty-seven, bereft of wife and children, left a quarter of a million dollars to "provide for regular courses of *free* public lectures upon the most important branches of natural and moral science, to be annually delivered in the city of Boston." None of the bequest could be used for buildings, and ten per cent. of the accumulation of the fund was to be set aside annually to continue it. Since December 1, 1839, from six to ten courses have been given yearly to large audiences, by some of the most distinguished persons in Europe and America.

"Natural and moral science!" How broad the subject, and how incalculable the benefit to any city, great or small! What a means for the best general education; what an uplifting of the whole mental and social life of a community!

Agassiz came to Boston and gave twelve lectures on the "Plan of the Creation, especially in the Animal Kingdom." His speech had a foreign accent; but his enthusiastic love of his subject, his skill in drawing on the blackboard, and his eloquent but simple language soon won all hearts.

He was as pleased with the Americans as they were with him. He wrote to his beloved mother (his father had died ten years before): "I can only

say that the educated Americans are very accessible and very pleasant. They are obliging to the utmost degree; indeed, their cordiality toward strangers exceeds any that I have met elsewhere. . . . The liberality of the American naturalists toward me is unparalleled. . . . The government (of the State of New York) has just completed the publication of a work unique of its kind, a natural history of the State in sixteen volumes, quarto, with plates. Twenty-five hundred copies have been printed, only five hundred of which are for sale, the rest being distributed throughout the State. Four volumes are devoted to geology and mining alone; the others, to zoölogy, botany, and agriculture. Yes, twenty-five hundred copies of a work in sixteen volumes, quarto, scattered throughout the State of New York alone!

"When I think that I began my studies in natural history by copying hundreds of pages from a Lamarck which some one had lent me, and that today there is a state in which the smallest farmer may have access to a costly work, worth a library to him in itself, I bless the efforts of those who devote themselves to public instruction."

Agassiz was at once asked to give a second course before the Lowell Institute, on glaciers. This, like the first, was greatly enjoyed by the two thousand or more persons present. Invitations now came from other cities, but he said, "I will limit myself to what I need in order to repay those who have helped me through a difficult

crisis. . . . Beyond that all must go again to science, — there lies my true mission."

He passed his fortieth birthday, May 28, 1847, with Dr. B. E. Cotting, curator of the Lowell Institute, at whose home he had stayed through some weeks of illness. His host, seeing him standing thoughtfully at the window, said, "Why so sad?"

"That I am so old and have done so little," was the reply.

In the summer of 1847, Agassiz rented a small house in East Boston, sufficiently near to the ocean to study marine animals. He also gave lectures in New York, Philadelphia, Albany, and other eastern cities.

The next spring, the Lawrence Scientific School was organized at Cambridge, in connection with Harvard University, and Agassiz was offered the chair of Natural History (zoölogy and geology), with a salary of three hundred pounds. The school owed its existence to Abbott Lawrence, formerly our minister to England.

Agassiz accepted the position, and opened his first course in April, 1848. Here he found congenial friends, Longfellow, Lowell, Prescott, Motley, Gray, Holmes, and others. M. Christinot, who had so generously helped to send him to Paris years before, came to the Cambridge home and was put in charge of it. "If your old friend," he said, "can live with his son Louis, it will be the height of his happiness."

The small plot of ground about the house became

a zoölogical garden, with its tank for turtles and an alligator, its cage for eagles, a tame bear, and a family of opossums. Agassiz had already begun his Museum of Comparative Zoölogy, on the banks of the Charles River, in an old shanty. The outlook was hopeful; but he was sad at heart, for Cecile, his wife, had died since he came to America, and his children seemed too young to bring into a home where there was no mother.

In the summer of 1848, Agassiz organized an expedition of students and naturalists for the examination of the eastern and northern shores of Lake Superior. At Niagara, he saw for the first time a living garpike, the only representative among modern fishes of the fossil type of Lepidosteus. He made a careful study of the fauna and geology of the lake, and the results were published in a book. Charles Darwin wrote, "I have seldom been more deeply gratified than by receiving your most kind present of 'Lake Superior.' . . . I had heard of it, and had much wished to read it, but I confess it was the very great honor of having in my possession a work with your autograph as a presentation copy that has given me such lively and sincere pleasure."

Agassiz had published another book in America, in 1848, "Principles of Zoölogy," which had a large sale, and was much used in schools. In 1849, his only son, fifteen years old, came to live with his father. The following year, 1850, Agassiz married Elizabeth Cabot Cary, of Boston, a cultivated

and lovely woman. His daughters, much younger than their brother, arrived from Europe the same year. M. Christinot, though urged to remain, now preferred to find another home, settled in New Orleans as pastor, and later died in Switzerland.

The winter of 1851 was spent in the examination of the Florida reefs and keys, a work undertaken at the request of Prof. A. D. Bache, at the head of the United States Coast Survey. The results were valuable in showing "how far the soil now building up from accumulations of mud and coral débris was likely to remain for a long time shifting and uncertain, and how far and in what localities it might be relied upon as affording a stable foundation," for building lighthouses, etc. Agassiz brought back for his museum a fine collection of corals, of all varieties and in all stages of growth, with drawings made on the spot, from the living animals.

This year he accepted a professorship at the medical college in Charleston, S. C., lecturing during the three winter months, between his autumn and spring courses at Cambridge. The overwork finally resulted in a dangerous illness, and he was obliged to discontinue it in 1853. The year previous he received the Prix Cuvier for his "Fossil Fishes." His fond mother wrote: "This has given me such happiness, dear Louis, that the tears are in my eyes as I write it to you."

He now issued a circular asking for collections of fishes from various fresh-water systems of the

United States, and responses came from every direction. New England captains, when they started on a cruise, took out cans, furnished by Agassiz, for collections in distant ports. Fishermen and farmers, indeed all classes, heartily joined in coöperating with the man who had said in the University at Munich, "I will be a leader of others," and he had reached the mark which he set for himself. In 1854 he was urged to accept a professorship in the recently established University of Zurich, Switzerland; but he declined, for he had one definite aim in America, to found a great museum, where the best methods of study could be adopted. He said in his "Fossil Fishes": "Possessing no fossil fishes myself, and renouncing forever the acquisition of collections so precious, I have been forced to seek the materials for my work in all the collections of Europe containing such remains; I have, therefore, made frequent journeys in Germany, in France, and in England, in order to examine, describe, and illustrate the objects of my researches; but, notwithstanding the cordiality with which even the most precious specimens have been placed at my disposition, a serious inconvenience has resulted from this mode of working, namely, that I have rarely been able to compare directly the various specimens of the same species from different collections, and that I have often been obliged to make my identification from memory, or from simple notes, or, in the more fortunate cases, from my drawings only. It is impossible to

imagine the fatigue, the exhaustion of all the faculties, involved in such a method." He hoped to found a museum where students should have specimens for work, ready for their use.

In the winter of 1855, Agassiz resumed his public lectures, as his salary of three hundred was insufficient to support his family, but when the spring came he found himself exhausted by the extra work.

And now his noble wife thought out a plan to aid him. She opened a school in their house, for young ladies. Agassiz's surprise and pleasure knew no bounds when he was informed of the project. He immediately took charge of the classes in physical geography, natural history, and botany, giving a lecture daily on one or other of these subjects. The school, with sixty or seventy girls, was continued for eight years, Agassiz having the coöperation of his brother-in-law, Professor Felton, the noted Greek scholar, and other distinguished men. This school was a blessing in more ways than one. All these years, the debts incurred by the publication of the "Fossil Fishes," and the glacial investigations, had burdened him. The wonder was that the genial, untiring worker could labor at all under this depressing load. Noble devotees to science! What have they not suffered to advance the cause of knowledge! We sit by our pleasant firesides and read what others have wrought for us, perhaps in want and sorrow of soul, and we forget to be grateful or to help lift burdens.

This school opened by the helpful wife made Agassiz a free man — no longer shackled by that worst form of slavery, debt. Well said John Ruskin: "My first word to all men and boys who care to hear me is, don't get into debt. Starve and go to heaven, but don't borrow. . . . Don't buy things you can't pay for!"

Indefatigable, versatile, comprehensive in mind, Agassiz at once planned another great work, to be published in ten volumes, though it was finally reduced to four: "Contributions to the Natural History of the United States." Mr. Francis C. Gray of Boston, a personal friend and a lover of letters and science, set the subscription before the public. Very soon, to Agassiz's great delight, he received the names of seventeen hundred subscribers, at twelve dollars a volume.

He had now reached his fiftieth birthday, completing his first volume of the new work on that day. His students serenaded him, and Longfellow wrote, to be read at the "Saturday Club," composed of Hawthorne, Holmes, Lowell, Dana, and others, this exquisite poem: —

It was fifty years ago,
  In the pleasant month of May,
In the beautiful Pays de Vaud,
  A child in its cradle lay.

And Nature, the old nurse, took
  The child upon her knee,
Saying: "Here is a story-book
  Thy Father has written for thee."

"Come wander with me," she said,
"Into regions yet untrod,
And read what is still unread
In the manuscripts of God."

And he wandered away and away
With Nature, the dear old nurse,
Who sang to him night and day
The rhymes of the universe.

And whenever the way seemed long,
Or his heart began to fail,
She would sing a more wonderful song,
Or tell a more marvellous tale.

So she keeps him still a child,
And will not let him go,
Though at times his heart beats wild
For the beautiful Pays de Vaud;

Though at times he hears in his dreams
The Ranz des Vaches of old,
And the rush of mountain streams
From glaciers clear and cold;

And the mother at home says, "Hark!
For his voice I listen and yearn;
It is growing late and dark,
And my boy does not return!"

This year, 1857, Agassiz received an unexpected honor — a call to one of the most coveted places at the Jardin des Plantes; the chair of palæontology in the Museum of Natural History, Paris. Though obliged to refuse it because he considered his life-work to be in America, he appreciated the favor as also the bestowal of the Order of the

Legion of Honor, and the Copley medal from England. Twenty-seven years before, he had received in Paris the aid of Humboldt in his destitution; now, two hemispheres competed for his services.

The following year, 1858, Mr. Francis C. Gray died, leaving fifty thousand dollars for the establishment of a Museum of Comparative Zoölogy, to be used neither for buildings nor for salaries, but purely for scientific needs.

"All things come round to him who will but wait," says Longfellow, in the "Falcon of Sir Federigo." Other gifts soon followed. Harvard University gave land for the site of the building. The Massachusetts Legislature gave lands to the amount of one hundred thousand dollars. Over seventy-one thousand was promptly subscribed by citizens of Boston and Cambridge. Agassiz contributed all his collections, worth thousands of dollars. The corner-stone of the museum was laid one sunny afternoon in June, 1859, and then the happy Agassiz hastened across the ocean, to rejoice with his mother, in her home near the foot of the Jura. She was glad and proud now that he had become a naturalist.

The museum was dedicated November 13, 1860. The plan included a main building 364 feet long, with wings 205 long, the whole enclosing a hollow square. The lecture rooms were at once opened. Especially welcome were teachers of schools, for whom admittance was free. His lectures were

open to women as well as to men. This would naturally be expected, from the broad-mindedness of the man, and the respect he must have had for the capacity of woman, from such a mother and such a wife. "He had great sympathy," says Mrs. Agassiz, "with the desire of women for larger and more various fields of study and work." To such men women can never be too grateful.

In 1863, he helped to organize the National Academy of Sciences. He frequently gave lectures in the large cities, using the money for the further development of the museum.

In 1865 he started, with his wife and several assistants, for sixteen months of scientific investigation in Brazil, the expenses borne by his friend, Mr. Nathaniel Thayer, of Boston. He writes to his mother, —

"All those who know me seem to have combined to heighten the attraction of the journey, and facilitate it in every respect. The Pacific Mail Steamship Company have invited me to take passage with my whole party on their fine steamer, the Colorado. They will take us, free of all expense, as far as Rio de Janeiro, — an economy of fifteen thousand francs at the start. . . . I seem like the spoiled child of the country, and I hope God will give me strength to repay, in devotion to her institutions and to her scientific and intellectual development, all that her citizens have done for me. . . .

With all my heart,

"Your Louis."

The story of this expedition has been told, chiefly by Mrs. Agassiz, in that most interesting volume, "A Journey in Brazil."

On Agassiz's return, he gave a course of lectures before the Lowell Institute, and the Cooper Institute, New York, spending the summer at his pleasant seaside home and laboratory at Nahant.

The fisherman at Nahant would pull two or three miles to bring him a rare fish; and only for the pleasure of seeing him rush out of his little laboratory, crying: "Oh! where *did* you get that? That is a species which goes as far as Brazil. Nobody has ever seen it north of Cape Cod. Come in, come in, and sit down!"

In 1868, Agassiz, invited by Mr. Samuel Hooper, joined a party of friends in an excursion to the Rocky Mountains. This year he was appointed non-resident professor at Cornell University, Ithaca, New York.

The Massachusetts Legislature now gave seventy-five thousand dollars, and private individuals an equal sum, to provide for the new collections at the museum. Later, the museum received from the Legislature twenty-five thousand more, and a birthday gift to Agassiz, of one hundred thousand dollars, was also used by him for his precious work. September 15, 1869, at the Humboldt Centennial Celebration, Agassiz delivered an eloquent address before the Boston Society of Natural History, and the "Humboldt Scholarship" was founded at the museum. The bread cast upon the waters by Humboldt had been found after many days.

Agassiz was now completely prostrated by overwork, and told by his physician that for the sev-

eral months in which he remained shut up in his room he must not think. Yet he could not banish one subject from his thoughts, and, with tears in his eyes, he would sometimes exclaim, — "Oh, my museum! my museum! always uppermost, by day and by night, in health and in sickness, always — *always!*"

The great mind rallied for one more voyage of research in his beloved science. In the coast-survey steamer Hassler, with his wife and friends, he sailed December 4, 1871, around Cape Horn, landing at several places along the coast, gathering rich treasures from deep-sea dredgings, entering the Golden Gate August 24, 1872.

In October, Agassiz returned to Cambridge. Through the gift of Mr. John Anderson, a wealthy New York merchant, of the island of Penikese, in Buzzard's Bay, with its buildings and an endowment of fifty thousand dollars, a summer school of natural history was at once opened. This year was a very busy one. A series of articles were in preparation for the "Atlantic Monthly," in opposition to the views of Darwin on evolution. He had already published two successful books, "Methods of Study in Natural History," and "Geological Sketches." December 2, 1873, a lecture was given at Fitchburg, before a meeting of the Massachusetts Board of Agriculture. The next day Agassiz spoke of dimness of sight, and of feeling "strangely asleep," and on December 14 he was asleep in death.

He was buried from the college chapel, the students who loved him laying a wreath of laurel upon the bier, and singing his requiem. The noble mother, fortunately, had died six years before him.

They buried him at Mount Auburn. From the glacier of the Aar, not far from the spot where his little hut once stood, they brought a boulder for his monument, and from his old home in Switzerland, pine trees to grow beside his grave. He loved both countries, and both have shared in his sacred resting-place.

His work will never cease. His museum at Cambridge now has seventy-one rooms and twelve galleries, with invested funds of over five hundred and eighty thousand dollars, while the buildings and collections are valued at about seven hundred thousand dollars. It is now under the charge of Prof. Alexander Agassiz, the son of Louis, and to his constant generosity and devotion the museum is deeply indebted.

Agassiz said, "My hope is that there shall arise upon the grounds of Harvard a museum of natural history which shall compete with the British Museum and with the Jardin des Plantes. Do not say it cannot be done, for you cannot suppose that what exists in England and France cannot be reached in America. I hope even that we shall found a museum which will be based upon a more suitable foundation, and better qualified to advance the highest interests of science than these institutions of the old world."

Agassiz not only wrote books and built museums. He gave to the world a high ideal of a seeker after truth. He stimulated the intellectual activity of two continents, and blessed both of them by his own brilliant mind and his noble character.

FRANCIS TREVELYAN BUCKLAND.

MOST of those whose lives are sketched in this volume lived to be old men; but Frank Buckland, the pet and pride of thousands in England, died in his prime, almost at the beginning of his fame; a man of whose life our "Popular Science Monthly" says, "None more active, varied, and useful is recorded in scientific biography."

He was the oldest son of the Dean of Westminster, Dr. William Buckland, and was born December 17, 1826, at Christ Church, Oxford, of which cathedral his father was canon at that time.

"I was told," says Frank, in later years, "that, soon after my birth, my father and my godfather, the late Sir Francis Chantry, weighed me in the kitchen scales against a leg of mutton, and that I was heavier than the joint provided for the family dinner that day. In honor of my arrival, my father and Sir Francis went into the garden and planted a birch tree. I know the taste of the twigs of that birch tree well. Sir Francis Chantry offered to give me a library. 'What is the use of a library to a child an hour old?' said my father. 'He will live to be sorry for that answer,' said Sir Francis. I never got the library.

"One of my earliest offences in life was eating the end of a carriage candle. For this, the birch rod not being handy, my father put me into a furze bush, and therein I did penance for ten minutes. A furze bush does not make a pleasant lounge when only very thin summer garments are worn."

The father, Dean Buckland, was distinguished as a man of letters, and for his geological research. The mother, as is often the case with sons of genius, was a remarkable woman, who idolized her boy, and who received in return an affection unusual in its intimacy and confidence.

She began to write about him early, in her journal. "At two and a half years of age," she says, "he never forgets either pictures or people he has seen. Four months ago, as well as now, he would have gone through all the natural history books in the Radcliffe Library, without making one error in miscalling a parrot, a duck, a kingfisher, an owl, or a vulture."

On taking him to see the camelopard and kangaroos in Windsor Park, she says, "He ran about with the latter and the other live animals without the least fear, though he got thrown down by them. He is a robust, sturdy child, sharp as a needle, but so volatile that I foresee some trouble in making him fix his attention."

When three and a half, she says, "he certainly is not at all premature; his great excellence is in his disposition, and apparently very strong reasoning powers, and a most tenacious memory as to facts.

He is always asking questions, and never forgets the answers he receives, if they are such as he can comprehend. If there is anything he cannot understand, or any word, he won't go on till it has been explained to him. He is always wanting to see everything made, or to know how it is done; there is no end to his questions, and he is never happy unless he sees the relations between cause and effect."

At four he began collecting specimens of natural history. At this time a clergyman brought some fossils to Dr. Buckland. Calling his son, who was playing in the room, the Dean said, "Frankie, what are these?"

"They are the vertebræ of an ichthyosaurus," lisped the child, unable to speak plainly.

Mrs. Buckland gave her boy a small cabinet, which now bears this inscription: "This is the first cabinet I ever had; my mother gave it to me when about four years old, December, 1830. It is the nucleus of all my natural-history work. Please take care of the poor old thing."

"In his early home at Christ Church," says Frank Buckland's brother-in-law, George C. Bompas, in his interesting life of the naturalist, "besides the stuffed creatures, which shared the hall with the rocking-horse, there were cages full of snakes, and of green frogs, in the dining-room, where the sideboard groaned under successive layers of fossils, and the candles stood on ichthyosauri's vertebræ. Guinea-pigs were often running

over the table, and, occasionally, the pony, having trotted down the steps from the garden, would push open the dining-room door, and career round the table, with three laughing children on his back; and then, marching through the front door, and down the steps, would continue his course round Tom Quad.

"In the stable yard and large wood-house were the fox, rabbits, guinea-pigs, and ferrets, hawks and owls, the magpie and jackdaw, besides dogs, cats, and poultry, and in the garden was the tortoise (on whose back the children would stand to try its strength), and toads immured in various pots, to test the truth of their supposed life in rock cells."

The boy Frank naturally developed a taste for natural history in the midst of such surroundings. At nine years of age, he was sent to school at Cotterstock, in Northamptonshire, and at twelve was elected scholar of Winchester College.

He tells an interesting experience on his entrance. "Immediately after chapel, the old stager boys all came round the new arrivals, to examine and criticise them. I perfectly recollect one boy, H., to whose special care my poor confiding mother had entrusted her innocent, unsuspecting cub, coming up to me with a most solemn face, and asking me if I had brought with me a copy of the school-book, 'Pempe moron proteron.' I said I had not. 'Then,' said he, 'you must borrow one at once, or the doctor,' i. e. Dr. Moberly, the

head master, 'will be sure to flog you to-morrow morning, and your college tutor, one of the præfects, will also lick you.'

"So he sent me to another boy, who said he had *lent* his 'Pempe moron proteron,' but he passed me on to a third, he on to a fourth; so I was running about all over the college till quite late, in a most terrible panic of mind, till at last a good-natured præfect said, 'Construe it, you little fool.' I had never thought of this before. I saw it directly: *Pempe* (send) *moron* (a fool) *proteron* (further). So the title of this wonderful book, after all, was, 'Send a fool further.' I then went to complain to H.; he only laughed, and shied a Donnegan's Lexicon at my head."

"A few nights afterwards," says Frank, "I dreamt I was wandering on the seashore, and that a crab was pinching my foot. Instantly awakening, I experienced a most frightful pain in my great toe. I bore it for a while, until at last it became so intense that I had to jump up with a howl of agony; all was quiet, but the pull continued, and I had to follow my toe and outstretched leg out of bed. I then found a bit of netted whipcord tight round it; but the whipcord was so ingeniously twisted among the beds, that it was impossible to find out *who had* pulled it. I returned to bed as savage as a wounded animal. The moment I was settled, the boys all burst into a shout: 'Toe fit tied! By Jove, what a lark!' This barbarous process is called 'toe fit tie' be-

cause there is a line in Prosody which begins, 'To fit ti, ut verto verti.' Hence the origin of this Winchester custom."

A school friend says of Frank at this time: "Imagine a short, quick-eyed little boy, with a shock head of reddish brown hair (not much amenable to a hair-brush), a white neck-cloth tied like a piece of rope with no particular bow, and his bands sticking out under either ear as fancy pleased him, — in fact, a boy utterly indifferent to personal appearance, but good-tempered and eccentric, with a small museum in his sleeve or cupboard, sometimes a snake, or a pet mouse, or a guinea-pig, or even a hedge-hog. In the summer he would be always in the hedgerows, after birds, weasels, or mice, or in the water-meadows, after crayfish, tomculls, and other fish which hide under stones. . . . In fact, he was a born naturalist."

Another says: "Frank set up a sort of amateur dispensary or hospital. He had a patient or two. One man I remember, with a bad hand, who used to come down to College Gate at twelve o'clock to consult him and be experimented upon. In his toys (cupboard) he had various bottles and specimens, one very highly treasured possession being a three-legged chicken.

"His own natural disposition was of the sweetest and gentlest. I never saw him in a passion, though he used to get a good deal teased at one time for his untidiness. But he always had a bright smile amidst it all, and was ready to do

anything for anybody immediately after. One thing used to strike me very much about him, and that was his exceeding love for his mother. Boys are generally reticent upon this point, but Frank seemed never tired of telling me about his, and how much he owed her. . . .

"In school hours he was a painstaking and conscientious worker, never leaving his lessons or preparing his task quicker or better than when he had some pet, a dormouse or sometimes a snake, twisting and wriggling inside his college waistcoat, which, having found its way out at his boots, would be carefully replaced under the waistcoat, to go through the same journey again."

While at Winchester, Frank determined to become a surgeon, and chose as a parting gift from one of his tutors, instead of Goldsmith's poems, "Graham's Domestic Medicine." At his request, his parents sent him a lancet, with which he bled his college mates, if they were courageous enough to submit to the operation, offering each one sixpence as an inducement. Nevertheless, when, in vacation, he witnessed an amputation at the Infirmary, he fainted.

When Frank left Winchester, Bishop Moberly said, "I always had the utmost satisfaction in him as a school-boy; and I look back with very great regard to his simple, earnest character, and his devotion to the studies which have made him so well known. To me he was just what I always found him, full of curious information, excellently kind-tempered and affectionate."

In 1844, at the age of eighteen, Frank entered Christ Church, Oxford. Here he turned the court between his college rooms and the canon's gardens into a menagerie. He owned a young bear, Tiglath Pileser, Jacko the monkey, an eagle, a jackal, besides marmots, guinea-pigs, squirrels, and dormice, an adder and other snakes, tortoises, green frogs and a chameleon. Skeletons and stuffed specimens were numerous.

Many of these pets strayed away. The marmot got into the chapter-house, and the eagle stationed himself in the chapel doorway, and attacked those who wished to enter.

Dr. Liddon tells of being invited to Frank's rooms, to breakfast with him. "The marmots, which had hibernated in the cellar below, had just, as he expressed it, 'thawed.' There was great excitement; the creatures ran about the table, as entitled to the honors of the day; though there were other beasts and reptiles in the room too, which in later life would have made breakfasting difficult. Speaking of reptiles, one very early incident in my Oxford life was joining in a hunt of Frank's adder. It had escaped into Mr. Benson's rooms, and was pursued into the bedroom by a group of undergraduates, who had, however, different objects in view. Frank certainly had the well-being of the adder chiefly at heart; the rest of us, I fear, were governed by the lower motive of escaping being bitten anyhow — if consistently with the adder's safety, well — if not, still of es-

caping. Eventually, the adder was caught, I believe, without great damage.

"One day I met Frank just outside Tom Gate. His trousers pockets were swollen out to an enormous size; they were full of slow-worms in damp moss. Frank explained to me that this combination of warmth and moisture was good for the slow-worms, and that they enjoyed it. They certainly were very lively, poking their heads out incessantly, while he repressed them with the palms of his hands. . . .

"He was certainly one of the most popular men in Christ Church; when he was in the schools, to be examined *viva voce,* almost the whole undergraduate world of Christ Church was there. . . . He always struck me, in respect of the most serious matters, as combining strength and simplicity very remarkably; it was impossible to talk to him and not to be sure that God, life, death, and judgment were to him solid and constantly present realities."

Another college friend says: "One evening when I was devoting an hour to coaching him up for his 'little go,' I took care to tuck up my legs, in Turkish fashion, on the sofa, for fear of a casual bite from the jackal which was wandering about the room. After a time I heard the animal munching up something under the sofa, and was relieved that he should have found something to occupy him. When our work was finished, I told Buckland that the jackal had found something to eat

under the sofa. 'My poor guinea-pigs!' he exclaimed; and, sure enough, four or five of them had fallen victims."

Tiglath Pileser, the bear, had to be sent away from Christ Church. The dean said, "I hear you keep a bear in college; well, either you or your bear must go." So Tig was sent to Islip, seven miles from Oxford, a living held by Dean Buckland, who had now become Dean of Westminster. The bear did so much mischief at Islip, in grocer's shops and houses, that he was sent to the zoölogical gardens, where he died in cutting his teeth.

Jacko, the monkey, was a source of great amusement, and greatly prized by young Buckland. "Once, when carrying him on a railway train, in a lawyer's blue bag," says Mr. Buckland, in his "Curiosities of Natural History," published some years afterwards, "Jacko, who must needs see everything that was going on, suddenly poked his head out of the bag, and gave a malicious grin at the ticket-giver. This much frightened the poor man, but, with great presence of mind, quite astonishing under the circumstances, he retaliated the insult, 'Sir, that's a dog; you must pay for it accordingly.' In vain was the monkey made to come out of the bag and exhibit his whole person; in vain were arguments in full accordance with the views of Cuvier and Owen urged eagerly, vehemently, and without hesitation (for the train was on the point of starting), to prove that the animal in question was not a dog, but a monkey. A dog

it was in the peculiar views of the official, and three-and-sixpence was paid.

"Thinking to carry the joke further (there were just a few minutes to spare), I took out from my pocket a live tortoise I happened to have with me, and, showing it, said, 'What must I pay for this, as you charge for *all* animals?' The employé adjusted his specs, withdrew from the desk to consult with his superior; then returning, gave the verdict with a grave but determined manner, 'No charge for them, sir; them be insects.'" Whenever Jacko got loose, he found mischief. One day he covered a shoe, sole and all, with blacking, and poured what was left in the bottle inside the shoe. He also rubbed the white kitchen table all over with black-lead and water.

Young Buckland spent his vacations at the University of Giessen, under the famous teacher and chemist, Professor Liebig, to whom he became greatly attached. "Returning in October, 1845, I brought with me," he says, "about a dozen green tree-frogs, which I had caught in the woods near the town. . . . I started at night on my homeward journey by the diligence, and I put the bottle containing the frogs into the pocket inside the diligence. My fellow-passengers were sleepy old smoke-dried Germans. Very little conversation took place, and, after the first mile, every one settled himself to sleep, and soon all were snoring. I suddenly awoke with a start, and found all the sleepers had been roused at the same moment.

On their sleepy faces were depicted fear and anger. What had woke us all up so suddenly ?

"The morning was just breaking, and my frogs, though in the dark pocket of the coach, had found it out, and, with one accord, all twelve of them had begun their morning song. As if at a given signal, they one and all of them began to croak as hard as ever they could. The noise their united concert made seemed, in the closed compartment of the coach, quite deafening: well might the Germans look angry ; they wanted to throw the frogs, bottle and all, out of the window, but I gave the bottle a good shaking, and made the frogs keep quiet. The Germans all went to sleep again, but I was obliged to remain awake, to shake the frogs when they began to croak. It was lucky that I did so, for they tried to begin their concert again two or three times.

"These frogs came safely to Oxford, and, the day after their arrival, a stupid housemaid took off the top of the bottle, to see what was inside; one of the frogs croaked at that instant, and so frightened her that she dared not put the cover on again. They all got loose in the garden, when, I believe, the ducks ate them, for I never heard or saw them again."

The next autumn, after a short tour in Switzerland, he returned to Oxford, this time bringing a jar full of red slugs. "They at least were noiseless and would not croak like frogs. In the opposite corner of the diligence placidly slumbered a trav-

eller with ample bald head; Frank also slept, but, waking at midnight, he saw, with horror, that two of his red slugs had escaped and were crawling over the traveller's bald pate. What was to be done? To remove them might waken the sleeper. Frank sat, as it were, on tenter-hooks, until the diligence stopped at the next stage, when, firmly covering up the jar and what remained of the slugs, he slipped quietly out of the diligence, resolved to proceed on his journey by another conveyance next morning, rather than face that man's awakening."

Young Buckland took his degree in 1848, and entered St. George's Hospital. "My object," he said, "in studying medicine (and may God prosper it!) is not to gain a name, money, and high practice, but to do good to my fellow-creatures and assist them in the hour of need. . . . My object in life to be a great high-priest of nature, and a great benefactor of mankind." Wealthy, and of the highest social position, he had determined not to live for himself, but for the good of others.

He was now twenty-two; genial, full of kindness, democratic in his feelings, one of "nature's noblemen." At his father's house, the Deanery, he met Lyell, Davy, Faraday, Sir John Herschel, Guizot, Liebig, Agassiz, Ruskin, Rogers, Lord Brougham, Sir Robert Peel, Lord John Russell, Lady Franklin, Lady Shelley, and scores of other distinguished persons.

Here his menagerie was larger than ever. The

stuffed forms of Tiglath Pileser and Billy the hyæna were in the hall. Jenny, a monkey from Gibraltar, had come to join Jacko, bringing a pet chicken with her, which lived in her cage, and which she fondled as a nurse does a child. Here were tailless Manx cats, lizards, snakes, and fifty or sixty rats, usually kept in the cellar. Young Buckland would often take snakes out of his pockets to show his friends. "Don't be afraid," he said to a young lady at a party, as he showed her some snakes; "they won't hurt you, I've taken out their fangs. Now, do be a good girl, and don't make a fuss;" and he wreathed one snake around her neck, and one round each arm. "His sisters were so often bedecked with similar reptilian necklaces and armlets that they became used to the somewhat clammy, crawling sensation which is a drawback to such ornaments."

About this time, Buckland wrote an article on the muscles of the arm, and took it to several periodicals, but none would accept it. Urged by Mr. White Cooper, the queen's oculist, he wrote an article upon his rats, which the friend carried to "Bentley's Miscellany." It was accepted, and thus began his successful authorship. This was subsequently published in his first book, "Curiosities of Natural History," in 1857.

He tells of one of his rat families: "One day a poor mother had moved her young about into several parts of the cage, but could not fix on one point. I saw what was wanting, she could not

obtain cover for them. I put my hand into the cage, full of tow and cotton wool; she came instantly and took it out of my hand, and covered up her young. But, notwithstanding all this care, and although evidently most anxious for their welfare, this kind mother, obeying, I suppose, some wise law of nature, devoured during the following night every one of the little ones of which she had been so careful the preceding day."

After being house-surgeon at St. George's Hospital for some time, Buckland became assistant surgeon to the Second Life Guards in 1854. He had already given his first lecture, "The House We Live in," delivered at a Working Men's Coffee House and Institute established by his mother, in Westminster, London.

About this time he was nearly fatally poisoned by a cobra. He says, "I had not walked a hundred yards before, all of a sudden, I felt just as if somebody had come behind me and struck me a severe blow on the head and neck, and at the same time I experienced a most acute pain and sense of oppression at the chest, as though a hot iron had been run in and a hundred-weight put on the top of it. I knew instantly, from what I had read, that I was poisoned. I said as much to my friend, a most intelligent gentleman, who happened to be with me, and told him, if I fell, to give me brandy and *eau-de-luce*, words which he kept repeating in case he might forget them. At the same time I enjoined him to keep me going, and not on any

account to allow me to lie down. I then forgot everything for several minutes, and my friend tells me I rolled about as if very faint and weak. He also informs me that the first thing I did was to fall against him, asking him if I looked seedy. He most wisely answered, 'No, you look very well.' I don't think he thought so, for his own face was as white as a ghost; I recollect this much. He tells me my face was of a greenish yellow color.

"After walking, or rather staggering, along for some minutes, I gradually recovered my senses, and steered for the nearest chemist's shop. Rushing in, I asked for *eau-de-luce.* Of course, he had none, but my eye caught the words, '*spiritus ammoniæ*,' or hartshorn, on a bottle. I reached it down myself, and, pouring a large quantity into a tumbler with a little water, both of which articles I found on a soda-water stand in the shop, drank it off, though it burnt my mouth and lips very much. Instantly I felt relief from the pain at the chest and head. The chemist stood aghast, and, on my telling him what was the matter, recommended a warm bath. If I had then followed his advice, these words would never have been placed on record. After a second draught at the hartshorn bottle, I proceeded on my way, feeling very stupid and confused."

In August, 1856, Dean Buckland died, and in November, 1857, Mrs. Buckland. On December 17, her son wrote in his journal: "Thirty-one years ago, at 6 A. M., I came into the world, at the

old house in Christ Church, Quadrangle. I am now about half-way across the stage of life, and thank God I am just beginning to feel my feet. But, oh! what I have lost since last birthday, the best friend a man can have in the world, — his mother."

He did not know that he was very much more than "half-way across the stage of life already." It is well that we walk by faith rather than sight.

"Oh! blissful, peaceful ignorance,
'Tis blessed not to know;
It keeps me quiet in those Arms
Which will not let me go,
And hushes all my soul to rest
On the Bosom which loves me so.

"So I go on, not knowing —
I would not if I might —
I'd rather walk with God in the dark
Than walk alone in the light;
I'd rather walk with him by faith
Than walk alone by sight."

In 1859, after a laborious search of some weeks in the vaults of St. Martin's in the Fields, Buckland found the body of John Hunter, the father of modern physiology, and the coffin was reinterred in Westminster Abbey. Though a most disagreeable task, he said, "I must not shrink from doing a thing at first sight disagreeable, or nothing will ever be accomplished. Nothing like determination and perseverance." The Leeds School of

Medicine presented him a silver medal, as a mark of respect for his exertions.

In 1860, he helped to organize the Acclimatization Society, formed for the purpose of varying and increasing the food supply of Great Britain by introducing new animals and preserving the native fish. He also became voluntary consulting surgeon at the Zoölogical Gardens, doctoring the sick, and increasing by his example the tenderness shown to animals.

His life had now become a most active one. He wrote many valuable articles for the magazines, since issued in books, the "Log Book of a Fisherman and Zoölogist," and other volumes, and lectured frequently, to large audiences, on his favorite subjects.

In 1863, after eight years of service in the Life Guards, he resigned, and began to devote himself more than ever to fish culture. In January and February of each year he collected the eggs of trout and other fish from the Rhine, Switzerland, France, and elsewhere, distributing some throughout the country and artificially hatching others. Fish-hatching boxes were exhibited in the South Kensington Museum, and at the Crystal Palace. Trout ova in ice were sent to Australia, where, after incubation had been suspended for a hundred days, when placed in running water, the fish came into the world strong and healthy.

In 1864, Buckland made extended investigations in oyster culture; delivered lectures upon the sub-

ject before the British Association of Bath, the Society of Arts, the London Institution, indeed all through England and Ireland. He was appointed Scientific Referee to the South Kensington Museum, giving a course of lectures and of class demonstration. He sent about sixteen thousand young fish and eggs to the Horticultural Gardens, and with these he helped to illustrate his lectures and inform the public.

Through "Land and Water," a paper established by himself and a few friends, he reached and educated a large constituency.

In 1863, the year previous, he had married Miss Hannah Papes, and made his home at 37 Albany St., Regent's Park. Here he gathered all his pets, who found in Mrs. Buckland a person as kind and tender as their master. Here were brought his favorite monkeys, "Hag" and "Tiny." The latter came from the Zoölogical Gardens "as good as dead," but, through Mrs. Buckland's good nursing, she became well and strong.

With these pets, the overworked naturalist had great merriment. He says in his "Log Book": "When the fire is lighted in the morning, in my museum, the servants put the monkeys in their night cage before it, and directly I come down to breakfast I let them out. They are only allowed to be loose in my museum as they do so much mischief; and in my museum I alone am responsible for the damage they do. The moment the door of the cage is opened, they both rush out like rockets,

and the Hag goes immediately to the fender and warms herself like a good monkey; as she, being older, seems to know that if she misbehaves herself she will have to be put back into her cage. . . .

"Tiny steals whatever is on the table, and it is great fun to see her snatch off the red herring from the plate and run off with it to the top of the bookshelves. While I am getting my herring, Tiny goes to the breakfast table again, and, if she can, steals the egg; this she tucks under her arm, and bolts away, running on her hind legs. This young lady has of late been rather shy of eggs, as she once stole one that was quite hot, and burnt herself. . . .

"Having poured out the tea, I open the 'Times' newspaper quite wide, to take a general survey of its contents. If I do not watch her carefully, Tiny goes behind the chair, on to the book-shelf, and comes crash into the middle of the 'Times.' Of course, she cannot go through the 'Times'; but she takes her chance of a fall somewhere, and her great aim seems, to perform the double feat of knocking the 'Times' out of my hand and upsetting the tea-pot and its contents; or, better still, the tea-pot on the floor. Lately, I am glad to say, she did not calculate her fall quite right; for she put her foot into the hot tea and stung herself smartly, and this seems to have had the effect of making her more careful for the future. All the day of this misfortune she walked upon her heels, and not upon her toes as usual.

"The Hag will also steal, but in a more quiet manner. She is especially fond of sardines in oil, and I generally let her steal them, because the oil does her good, though the servants complain of the marks of her oily feet upon the cloth. Sometimes the two make up a stealing party. One morning I was in a particular hurry, having to go away on salmon-inspection duty by train. I left the breakfast things for a moment, and in an instant Tiny snatched up a broiled leg of pheasant and bolted with it — carried it under her arm round and round the room, after the fashion of the clown in the pantomime. While I was hunting Tiny for my pheasant, the Hag bolted with the toast; I could not find time to catch either of the thieves, and so had to go off without any breakfast.

"Tiny and the Hag sometimes go out stealing together. They climb up my coat and search all the pockets. I generally carry a great many cedar pencils; the monkeys take these out and bite off the cut ends. . . . When I come home in the evening, tired from a long day's work, I let out the monkeys, and give them some sweet stuff I bring home for them. By their affectionate greeting and amusing tricks they make me forget for a while the anxieties and bothers of a very active life. They know perfectly well when I am busy, and they remain quiet and do not tease me. The Hag sits on the top of my head, and 'looks fleas' in my hair, while Tiny tears up with her teeth a thick ball of crumpled paper, the nucleus of which

she knows is a sugar-plum, one of a parcel sent by Mrs. Owen, the kind-hearted wife of my friend, Mostyn Owen, of the Dee Salmon Board, and received through the post in due form, directed, 'Miss Tiny and Miss Jenny Buckland.'"

Besides these monkeys, a writer tells of another pet which he found when calling on Mr. Buckland. "'It's a jolly little brute, and won't hurt,' exclaimed Mr. Buckland, as we were about to retreat from the threshold. The monkeys had seized the jaguar's tail, and, lifting it up with its hind legs bodily to the altitude of their cage, were rapidly denuding it of fur. No animal with any feelings of self-respect would submit silently to such humiliation, and the jaguar was making the place hideous with his yells.

"Hearing the cries of her pet, Mrs. Buckland came to the rescue; and it was amusing to see this child of the forest, with gleaming eyes and frantic yelps, cast itself at her feet, and nestle meekly in the folds of her dress; she had nursed it through a very trying babyhood, when Mr. Bartlett had sent it from the Zoo, apparently dying and paralyzed in the fore-legs, with a promise of fifteen pounds reward for a cure. That sum has long since been swallowed up in damages for clothes destroyed and boots devoured, as the invalid's health and appetite returned."

Mr. Buckland used to say: "Mrs. Buckland can tame any animal in the world — *ecce signum*, myself."

In 1867, Mr. Buckland was appointed Inspector of Fisheries. This was the realization of the wish of his life. He says in his diary, after receiving the appointment: "When I read this I felt a most peculiar feeling; not joy, nor grief, but a pleasurable, stunning sensation, if there can be such a thing. The first thing I did was to utter a prayer of thanksgiving to Him who really appointed me, and who has thus placed me in a position to look after and care for His wonderful works. May He give me strength to do my duty in my new calling!"

Buckland carried forward his work with the greatest zeal and energy. He writes in his journal: "I am now working from 8 A. M. to 6 P. M., then a bit in the evening, — fourteen hours a day; but, thank God, it does not hurt me. I should, however, collapse if it were not for Sunday. The machinery has time to get cool. The mill-wheel ceases to patter the water, the mill-head is ponded up, and the superfluous water let off by an easy, quiet current, which leads to things above."

Salmon, which had formerly abounded in Wales and England, and been used extensively for food, had almost or altogether ceased to exist in many rivers. Buckland carefully studied their habits. He put himself, as he often said, in the place of the salmon. He waded the pools, to feel the force and direction of the current against which they come up from the sea into the rivers. He did not spare himself in storm or cold.

"Most fish live either in fresh or in salt water; the salmon inhabits both. Bred in the higher waters of our rivers, the young salmon of one, two, or three years' growth make their way down to the sea as smolts, and return thence, impelled by the instinct of reproduction, to seek the gravelly spawning beds in the mountain streams. In early spring and through the summer and autumn months they come from the sea, bright-coated and silvery, and swim and leap and struggle up the rivers. Then is the fisherman's harvest. In winter the spawning time comes on, when the laws of nature and of man alike forbid their capture; for the fish, at other times so rich a luxury, are now vapid and unwholesome. Lean and flabby, the males with hooked beaks and scarred in fighting, the spawned fish, or kelts, rush down again to the sea; whence, after a while, they return, fresh and silvery, fattened to twice their former weight, and reënter the rivers as fresh-river fish, the joy alike of the fisherman and the epicure."

Buckland constructed salmon ladders over the weirs, that the fish might have free passage from the rivers to the sea. He sent a series of models of these ladders to the American Fishery Commissioners, with five boxes of specimen oysters, and a photograph of his museum, with its casts and curiosities. He helped to obtain proper legislation from Parliament, both as to fishes and sea-birds; indeed all living things, especially those aquatic, had his sympathy and help.

The results of his work were soon apparent. The yearly sales of English and Welsh salmon in Billingsgate market, London, before 1861, averaged about eight tons only. From 1867 to 1876 the average sale was eighty-eight tons. The sales of Irish salmon in Billingsgate, three hundred and fifty tons yearly; of Scotch salmon, over one thousand tons yearly. Thus was food provided for millions of people.

Everywhere Buckland was the friend of animals. He urged that pigs should have "pure, clean, wholesome water" to drink. He assisted at the opening of the Brighton Aquarium, a place which American visitors can never forget, and aided in the establishing of other aquaria.

In 1873, Mr. Buckland published a "History of British Fishes." All his books went through many editions. In 1874, at the Jubilee Anniversary of the Society for the Prevention of Cruelty to Animals, he spoke against cruelty to seals.

He wrote in the "Times": "Captain David Gray, of the sealing and whaling ship Eclipse, and myself first brought forward, some three years ago, the necessity for a close time for Arctic seals. The principal sealing ground is at Jan Mayen Island, thirteen hundred miles due north from London. . . . The ships (sixty sail) arrive at the ice from the 15th to the 20th March, just as the young seals are born. The seal-hunters at once attack them, and the most horrible cruelty ensues. I quote Captain Gray's own words to me: 'Last

year, the fleet set to work to kill the seals on March 26, 1874, and in forty-eight hours the fishing was completely over, the old seals being shot, wounded, or scared away, while thousands upon thousands of young ones were left crying piteously for their mothers. These mostly perished of famine in the snow, as they were not old enough to make worth while the trouble of killing them.

"'If you could imagine yourself surrounded by four or five hundred thousand babies, all crying at the pitch of their voices, you would have some idea of the piteous noise they make. Their cry is very like that of a human infant. These motherless seals collect into lots of five or six, and crawl about the ice, their heads fast becoming the biggest part of their bodies, searching, no doubt, to find the nourishment they stand so much in need of.'"

In 1876, an international close time was established, prohibiting the killing of seals until after April 3.

Mr. Buckland's reports on crab, lobster, herring, and other fisheries were most full and interesting. "Before the young crabs are born," he said, "the mother crab tucks up under her tail her numerous family of from one to two million coral-like eggs, and she sidles on tiptoe many a mile from her rocky home to some sandy flat in the deep sea, where her young family may flourish best. There, or perhaps on returning home, in early spring, the time for all young things to come forth, the tiny crabs burst the egg; yet so unlike their parent,

that till lately they were thought some strange animalcula; goggle eyes, a hawk's beak, a scorpion's tail, a rhinoceros's horn, adorn a body fringed with legs, yet scarcely bigger than a grain of sand.

"Several strange shapes are assumed in turn ere the young crab attains the parent form. For the parents of so numerous a family it is well that nature has provided the young crabs with a strong suit of clothes, which does not wear out; but it is quickly outgrown. The young crabs shed from time to time the horny case, even to the finger-nails and eyelids; and mother Nature straightway provides, underneath, a new, soft, leathery suit, which quickly hardens into shell. Another marvel is, that the growth is, as it were, by leaps and bounds; each time it bursts its case the young crab swells suddenly to twice the size of the discarded shell.

"In crab youth several new suits are annually required. In maturer life the lady crab, it seems, is content with one new dress each year; yet is not the romance of life over. In the time of her soft-shelled weakness and seclusion, a male crab in full armor constantly attends her, guards her from danger, and solaces her in her retirement. An old crab's shell, covered sometimes with barnacles, or with oysters of several years' growth, shows that the patriarch has outlived the change of fashions which occupied his youth."

The report on herring showed that eight hundred million fish are taken yearly in Scotland, by more than seven thousand boats.

"The Log-Book of a Fisherman and Zoölogist" was published in 1875, and a new edition of "White's Natural History of Selborne," to which Buckland added many original observations. Most of his writing was done on the cars, on his way to different places to give lectures or attend to official business.

In 1878, he was appointed one of the commissioners to inquire into the sea fisheries of England and Wales, which furnish so much food for the people. Over a hundred million soles are sold yearly in London alone, besides fifty million plaice and whiting, and ten million eels. Mr. Buckland's correspondence with many countries had become extensive. He had been elected a member of various societies, and had received many gold medals, for his wide scientific knowledge and its practical application.

In December, 1879, he writes, "This Christmas week, I regret to say, I shall not have the opportunity of spending my time up to my neck in water, collecting salmon eggs for Australia or New Zealand, from one or other of our northern rivers, or in one of the southern rivers, getting trout eggs for the Thames. I must say I very much enjoy collecting salmon and trout eggs; it is very cold, and, at the same time, very hard work, but I very much prefer it to indoors and the fireside."

The exposure of this kind of work is seen by his description of it. "Here is a list of my 'Spawning kit.' First, the waterproof dress; this very

useful garment is in fact a diver's dress, and, when properly put on, admits not a drop of water. It has, however, one fault, *it is apt to freeze* when I am out of the water, and then one feels encased, as it were, in a suit of inflexible armor. Second, the spawning tins. . . . Third, a long, shallow basket. . . . Fourth, house-flannel, cut into lengths of one yard; this is absolutely necessary to hold the struggling salmon. Those who are unaccustomed to spawn salmon have an awkward habit of putting their fingers into the gills of the fish, and if the fish's gills are injured and bleed, he suffers much from it. I never to my knowledge killed a fish in my life while spawning it. Fifth, dry towels; these are most necessary, as the slime from the salmon makes one's hands very slippery . . . besides which, wiping the hands warms them, and, when working in the water at this time of year, the cold to the hands and arms is fearful. . . . Eleventh, ordinary baggage, and especially a bottle of scented hair-oil, with which to well anoint the chest and arms and tips of ears, when working in the water; a most excellent and serviceable plan. I took this hint from the Esquimaux."

Frank Buckland's last Fishery Report was made in March, 1880, containing an interesting description of the anatomy of the salmon, its food, habits, and the like.

Mr. Buckland had brought on lung trouble by constant exposure and tireless energy, and must have foreseen the end. At first it seemed hard to

him that he should be taken in the midst of his best work, but he said, "God is so good, so very good to the little fishes, I do not believe he would let their inspector suffer shipwreck at last. I am going a long journey, where I think I shall see a great many curious animals. This journey I must go alone."

He had before this written in his diary: "I think it not improbable that, in a future state, the mind will be allowed a greater scope of knowledge, and the gates of omniscience will be thrown open to it, so that those things which it now sees through a glass, darkly, will be opened to the view and understanding. O most glorious reward, for a mind occupied here on earth in investigating the wonderful works of the Creator, from the magnificent and stupendously grand scene of geology, and the theory of the heavens, to the minute and delicate construction of a microscopic animalcule, or the immeasurably fine thread of a plant!"

He died December 19, 1880, and was buried in Brompton Cemetery, on Christmas Eve.

His last book, "Notes and Jottings from Animal Life," was published soon after his death.

No wonder that the noble son of the Dean of Westminster is remembered and loved. A friend wrote, after his death: "Energy was only one of Mr. Buckland's characteristics. His kindliness was another. Perhaps no man ever lived with a kinder heart. It may be doubted whether he ever willingly said a hard word or did a hard action.

He used to say of one gentleman, by whom he thought he had been aggrieved, that he had forgiven him seventy times seven already, so that he was not required to forgive him any more.

"He could not resist a cry of distress, particularly if it came from a woman. Women, he used to say, are such doe-like, timid things, that he could not bear to see them unhappy. One night, walking from his office, he found a poor servant-girl crying in the street. She had been turned out of her place that morning, as unequal to her duties; she had no money and no friends nearer than Taunton, where her parents lived. Mr. Buckland took her to an eating-house, gave her a dinner, drove her to Paddington, paid for her ticket, and left her in charge of the guard of the train. His nature was so simple and generous that he did not even seem to realize that he had done an exceptionally kind action."

To read of such a life as this makes us trust humanity, and reassures us that there are many, very many noble and lovely characters in the world, both men and women. While we need good judgment and common sense, so as to discriminate wisely, we need also the sweet, sunny nature which, with some measure of ideality, sees rose colors amid the sombre tints of life. We usually find in other hearts what we cultivate in our own.

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