
ΒΑΣΙΛΕΩΣ ΜΕΓΑΛΟΥ
ΕΥΚΡΑΤΙΔΟΥ

THE

MOON HOAX;

OR,

A DISCOVERY THAT THE

MOON

HAS A VAST POPULATION OF

HUMAN BEINGS.

BY

RICHARD ADAMS LOCKE.

Illustrated with a View of the Moon,

AS SEEN BY LORD ROSSE'S TELESCOPE.

"The clouds still rested on one half of it, insomuch that I could discover nothing in it; but the other appeared to me a vast ocean planted with innumerable islands, that were covered with fruits and flowers, and interwoven with a thousand little shining seas that ran among them. I could see persons dressed in glorious habits with garlands upon their heads, passing among the trees, lying down by the sides of fountains, or resting on beds of flowers; and could hear a confused harmony of singing birds, falling waters, human voices, and musical instruments. Gladness grew in me upon the discovery of so delightful a scene. I wished for the wings of an eagle, that I might fly away to those happy seats; but the genius told me there was no passage to them except through the gates of death that I saw opening every moment upon the bridge."

ADDISON.

NEW YORK:
WILLIAM GOWANS.
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ADVERTISEMENT.

It appears to be as natural for the human mind to be craving after the wonderful, the mysterious, the marvellous, and the new discoveries, as it is for the physical appetite to desire food, drink, and sleep, and thereby as it were constantly attempting to lift up the veil that hides incomprehensibilities from our vision.

This interposition was, no doubt, wisely ordained, for the gazing upon such mysteries might strike us blind, and rob us of the little stock of happiness allotted to us while probationers here. May this longing not be the germ of the proof of our immortality?

The history of the human race is not only filled with instances of this kind of craving, but it is universal, from the loftiest minds as approach nearest the deity, such as Newton, La Place, and Mrs. Somerville, down to the most untutored savage that roams the forest wilds. Hence the key to the popularity of these charming productions which facinate our youth and continue to delight our manhood by letting us into the supposed mysteries of an enchanting fairy land, with a grace of narrative that quite takes us captive, while our curiosity and wonder is raised to the highest pitch in watching the developements unfolded in the narratives of these authors, and quite impatient till we learn the result of the plot, or discovery.

I allude to such productions as the Arabian Nights, Sir Thomas More's Utopia, Bishop Berkeley's Adventures of Signior Gaudentio Di Lucca, Swift's Gulliver's Travels, De Foe's Robinson Crusoe, Bunyan's Pilgrim's Progress, and Lord Erskine's Armata, besides numerous others of a similar character but of a less celebrated reputation.

Among this class of extraordinary fictitious narratives and supposed discovery, may be placed the renowned Moon Hoax, by Richard Adams Locke. When it first made its appearance from day to day in one of the morning papers, the interest in the discovery was intense, so much so that the circulation of the paper augmented five fold, and in fact, was the means of giving the journal a permanent footing as a daily newspaper. Nor did this multiplied circulation of the paper satisfy the public appetite. The proprietors of the journal had an edition of 60,000 published in pamphlet form, which were sold off in less than one month; and of late this pamphlet edition has become so scarce that a single copy was lately sold at the sale of Mr. Haswell's Library for $3.75.

The book is still in demand. As an instance of this the following will give some idea at what pains and cost some will go to procure it. I lately had a letter from a Gentleman residing in Wisconsin, making inquiry if I had such a book, he further informed me that his attention had been called to my book establishment in consequence of having sent to the *Sunday Times*, published in this city, the following query, "Can you inform me if such a book can be procured, and if so where, as 'The celebrated Moon Hoax?'" The answer was that if it could be procured at all, it would be at 85 Centre Street, New York. By this circuitous method, this dilligent far-west bookcollector procured his copy of the "Moon Hoax" to his great satisfaction.

August 1, 1859. PUBLISHER.

THE MOON,

AS SEEN BY

LORD ROSSE'S TELESCOPE.

1856.

GREAT

ASTRONOMICAL DISCOVERIES

LATELY MADE

BY SIR JOHN HERSCHEL, L.L., D.F.R.S., &c.,

AT THE

CAPE OF GOOD HOPE.

FIRST PUBLISHED IN THE NEW YORK SUN IN AUGUST AND SEPTEMBER, 1835, FROM THE SUPPLEMENT TO THE EDINBURGH JOURNAL OF SCIENCE.

In this unusual addition to our Journal, we have the happiness of making known to the British public, and thence to the whole civilized world, recent discoveries in Astronomy which will build an imperishable monument to the age in which we live, and confer upon the present generation of the human race a proud distinction through all future time. It has been poetically said, that the stars of heaven are the hereditary regalia of man, as the intellectual sovereign of the animal creation. He may now fold the Zodiack around him with a loftier consciousness of his mental supremacy.

It is impossible to contemplate any great Astronomical discovery without feelings closely allied to a sensation of awe, and nearly akin to those with which a departed spirit may be supposed to discover the realities of a future state. Bound by the irrevocable laws of nature to the globe on which we live, creatures "close shut up in infinite expanse," it seems like acquiring a fearful supernatural power when any remote mysterious works of the Creator yield tribute to our curiosity. It seems

almost a presumptuous usurpation of powers denied us by the divine will, when man, in the pride and confidence of his skill, steps forth, far beyond the apparently natural boundary of his privileges, and demands the secrets and familiar fellowship of other worlds. We are assured that when the immortal philosopher to whom mankind is indebted for the thrilling wonders now first made known, had at length adjusted his new and stupendous apparatus with a certainty of success, he solemnly paused several hours before he commenced his observations, that he might prepare his own mind for discoveries which he knew would fill the minds of myriads of his fellow-men with astonishment, and secure his name a bright, if not transcendant conjunction with that of his venerable father to all posterity. And well might he pause! From the hour the first human pair opened their eyes to the glories of the blue firmament above them, there has been no accession to human knowledge at all comparable in sublime interest to that which he has been the honored agent in supplying; and we are taught to believe that, when a work, already preparing for the press, in which his discoveries are embodied in detail, shall be laid before the public, they will be found of incomparable importance to some of the grandest operations of civilized life. Well might he pause! He was about to become the sole depository of wondrous secrets which had been hid from the eyes of all men that had lived since the birth of time. He was about to crown himself with a diadem of knowledge which would give him a conscious pre-eminence above every individual of his species who then lived, or who had lived in the generations that are passed away. He paused ere he broke the seal of the casket which contained it.

To render our enthusiasm intelligible, we will state at once, that by means of a telescope of vast dimensions and an entirely new principle, the younger Herschel, at his observatory in the Southern Hemisphere, has already made the most extraordinary discoveries in every planet of our solar system; has discovered planets in other solar systems; has obtained a distinct view of objects in the moon, fully equal to that which the unaided eye commands of terrestrial objects at the distance of

a hundred yards; has affirmatively settled the question whether this satellite be inhabited, and by what order of beings; has firmly established a new theory of cometary phenomena; and has solved or corrected nearly every leading problem of mathematical astronomy.

For our early and almost exclusive information concerning these facts, we are indebted to the devoted friendship of Dr. Andrew Grant, the pupil of the elder, and for several years past the inseperable coadjutor of the younger Herschel. The amanuensis of the latter at the Cape of Good Hope, and the indefatigable superintendent of his telescope during the whole period of its construction and operation, Dr. Grant has been enabled to supply us with intelligence equal, in general interest at least, to that which Dr. Herschel himself has transmitted to the Royal Society. Indeed our correspondent assures us that the voluminous documents now before a committee of that institution contain little more than details and mathematical illustrations of the facts communicated to us in his own ample correspondence. For permission to indulge his friendship in communicating this invaluable information to us, Dr. Grant and ourselves are indebted to the magnanimity of Dr. Herschel, who, far above all mercenary considerations, has thus signally honored and rewarded his fellow-laborer in the field of science. The engravings of lunar animals and other objects, and of the phases of the several planets, are accurate copies of drawings taken in the observatory by Herbert Home, Esq., who accompanied the last powerful series of reflectors from London to the Cape, and superintended their erection; and he has thus recorded the proofs of their triumphant success. The engravings of the belts of Jupiter is a reduced copy of an imperial folio drawing by Dr. Herschel himself, and contains the results of his latest observation of that planet. The segment of the inner ring of Saturn is from a large drawing by Dr. Grant.

We first avail ourselves of the documents which contain a description and history of the instrument by which these stupendous discoveries have been made. A knowledge of the one is essential to the credibility of the other.

THE YOUNGER HERSCHEL'S TELESCOPE.

It is well known that the great reflecting telescope of the late elder Herschel, with an object-glass four feet in diameter, and a tube forty feet in length, possesses a magnifying power of more than six thousand times. But a small portion of this power was ever advantageously applied to the nearer astronomical objects; for the deficiency of light from objects so highly magnified, rendered them less distinct than when viewed with a power of a third or fourth of this extent. Accordingly the powers which he generally applied when observing the moon or planets, and with which he made his most interesting discoveries, ranged from 220, 460, 750, and 900 times; although, when inspecting the double and treble fixed stars, and the more distant nebulæ, he frequently applied the full capacity of his instrument. The law of optics, that an object becomes dim in proportion as it is magnified, seemed, from its exemplification in this powerful telescope, to form an insuperable boundary to further discoveries in our solar system. Several years, however, prior to the death of this venerable astronomer, he conceived it practicable to construct an improved series of parabolic and spherical reflectors, which, by uniting all the meritorious points in the Gregorian and Newtonian instruments, with the highly interesting achromatic discovery of Dolland, would, to a great degree, remove the formidable obstruction. His plan evinced the most profound research in optical science, and the most dexterous ingenuity in mechanical contrivance; but accumulating infirmities, and eventually death, prevented its experimental application. His son, the present Sir John Herschel, who had been nursed and cradled in the observatory, and a practical astronomer from his boyhood, was so fully convinced of the value of the theory, that he determined upon testing it, at whatever cost. Within two years of his father's death he completed his new apparatus, and adapted it to the old telescope with nearly perfect success. He found that the magnifying power of 6,000 times, when applied to the moon, which was the severest criterion that could be selected, produced, under these new

reflectors, a focal object of exquisite distinctness, free from every achromatic obscurity, and containing the highest degree of light which the great speculum could collect from that luminary.

The enlargement of the angle of vision which was thus acquired, is ascertained by dividing the moon's distance from the observatory by the magnifying power of the instrument; and the former being 240,000 miles, and the latter 6,000 times, leaves a quotient of 40 miles as the apparent distance of that planet from the eye of the observer. Now it is well known that no terrestrial objects can be seen at a greater distance than this, with the naked eye, even from the most favorable elevations. The rotundity of the earth prevents a more distant view than this with the most acute natural vision, and from the highest eminences; and, generally, objects seen at this distance are themselves elevated on mountainous ridges. It is not pretended, moreover, that this forty miles telescopic view of the moon presented its objects with equal distinctness, though it did in equal size to those of this earth, so remotely stationed.

The elder Herschel had nevertheless demonstrated, that with a power of 1,000 times, he could discern objects in this satellite of not more than 122 yards in diameter. If therefore the full capability of the instrument had been elicited by the new apparatus of reflectors constructed by his son, it would follow, in mathematical ratio, that objects could be discerned of not more than 22 yards in diameter. Yet in either case they would be seen as mere feeble, shapeless points, with no greater conspicuity than they would exhibit upon earth to the unaided eye at the distance of forty miles. But although the rotundity of the earth presented no obstruction to a view of these astronomical objects, we believe Sir John Herschel never insisted that he had carried out these extreme powers of the telescope in so full a ratio. The deficiency of light, though greatly economised and concentrated, still maintained some inverse proportion to the magnitude of the focal image. The advance he had made in the knowledge of this planet, though magnificent and sublime, was thus but partial and unsatisfactory. He was, it is true, enabled to confirm some discoveries of former observers,

and to confute those of others. The existence of volcanoes discovered by his father and by Schroeter of Berlin, and the changes observed by the latter in the volcano in the *Mare Crisium* or Lucid Lake, were corroborated and illustrated, as was also the prevalence of far more extensive volcanic phenomena. The disproportionate height attributed to the lunar mountains was corrected from careful admeasurement; whilst the celebrated conical hills, encircling valleys of vast diameter, and surrounding the lofty central hills, were distinctly perceived. The formation which Professor Frauenhofer uncharitably conjectured to be a lunar fortification, he ascertained to be a tabular buttress of a remarkably pyramidical mountain; lines which had been whimsically pronounced roads and canals, he found to be keen ridges of singularly regular rows of hills; and that which Schroeter imagined to be a great city in the neighborhood of *Marius*, he determined to be a valley of disjointed rocks scattered in fragments, which averaged at least a thousand yards in diameter. Thus the general geography of the planet, in its grand outlines of cape, continent, mountain, ocean, and island, was surveyed with greater particularity and accuracy than by any previous observer; and the striking dissimilarity of many of its local features to any existing on our own globe, was clearly demonstrated. The best enlarged maps of that luminary which have been published were constructed from this survey; and neither the astronomer nor the public ventured to hope for any great accession to their developments. The utmost power of the largest telescope in the world had been exerted in a new and felicitous manner to obtain them, and there was no reasonable expectation that a larger one would ever be constructed, or that it could be advantageously used if it were. A law of nature, and the finitude of human skill, seemed united in inflexible opposition to any further improvement in telescopic science, as applicable to the known planets and satellites of the solar system. For unless the sun could be prevailed upon to extend a more liberal allowance of light to these bodies, and they be induced to transfer it, for the generous gratification of our curiosity, what adequate substitute could be obtained? Telescopes do not create light, they can-

not even transmit unimpaired that which they receive. That anything further could be derived from human skill in the construction of instruments, the labors of his illustrious predecessors, and his own, left the son of Herschel no reason to hope. Huygens, Fontana, Gregory, Newton, Hadley, Bird, Short, Dolland, Herschel, and many others, all practical opticians, had resorted to every material in any wise adapted to the composition either of lenses or reflectors, and had exhausted every law of vision which study had developed and demonstrated. In the construction of his last amazing specula, Sir John Herschel had selected the most approved amalgams that the advanced stage of metallic chemistry had combined; and had watched their growing brightness under the hands of the artificer with more anxious hope than ever lover watched the eye of his mistress; and he had nothing further to expect than they had accomplished. He had the satisfaction to know that if he could leap astride a cannon ball, and travel upon its wings of fury for the respectable period of several millions of years, he would not obtain a more enlarged view of the distant stars than he could now possess in a few minutes of time; and that it would require an ultra-railroad speed of fifty miles an hour, for nearly the live-long year, to secure him a more favorable inspection of the gentle luminary of night. The interesting question, however, whether this light of the solemn forest, of the treeless desert, and of the deep blue ocean as it rolls; whether this object of the lonely turret, of the uplifted eye on the deserted battle-field, and of all the pilgrims of love and hope, of misery and despair, that have journeyed over the hills and valleys of this earth, through all the eras of its unwritten history to those of its present voluminous record; the exciting question, whether this "observed" of all the sons of men, from the days of Eden to those of Edinburgh, be inhabited by beings like ourselves, of consciousness and curiosity, was left for solution to the benevolent index of natural analogy, or to the severe tradition that it is tenanted only by the hoary solitaire whom the criminal code of the nursery had banished thither for collecting fuel on the Sabbath-day.

The limits of discovery in the planetary bodies, and in this

one especially, thus seemed to be immutably fixed; and no expectation was elevated for a period of several years. But, about three years ago, in the course of a conversational discussion with Sir David Brewster upon the merits of some ingenious suggestions by the latter, in his article on optics in the Edinburgh Encyclopedia (p. 644), for improvements in the Newtonian Reflectors, Sir John Herschel adverted to the convenient simplicity of the old astronomical telescopes that were without tubes, and the object-glass of which, placed upon a high pole, threw its focal image to a distance of 150, and even 200 feet. Dr. Brewster readily admitted that a tube was not necessary, provided the focal image were conveyed into a dark apartment, and there properly received by reflectors. Sir John then said that, if his father's great telescope, the tube alone of which, though formed of the lightest suitable materials, weighed 3,000 lbs., possessed an easy and steady mobility with its heavy observatory attached, an observatory moveable without the incumbrance of such a tube, was obviously practical. This also was admitted, and the conversation became directed to that all-invincible enemy. The paucity of light in powerful magnifiers. After a few moments' silent thought, Sir John diffidently inquired whether it would not be possible to effect *a transfusion of artificial light through the focal object of vision!* Sir David, somewhat startled at the originality of the idea, paused awhile, and then hesitatingly referred to the refrangibility of rays, and the angle of incidence. Sir John, grown more confident, adduced the example of the Newtonian Reflector, in which the refrangibility was corrected by the second speculum, and the angle of incidence restored by the third. "And," continued he, "why cannot the illuminated microscope, say the hydro-oxygen, be applied to render distinct, and, if necessary, even to magnify the focal object?" Sir David sprung from his chair in an ecstacy of conviction, and leaping half-way to the ceiling, exclaimed, "Thou art the man!" Each philosopher anticipated the other in presenting the prompt illustration that if the rays of the hydro-oxygen microscope, passed through a drop of water containing the larvæ of a gnat and other objects invisible to the naked eye, rendered them not only keenly but firmly

magnified to dimensions of many feet; so could the same artificial light, passed through the faintest focal object of a telescope, both distinctify (to coin a new word for an extraordinary occasion) and magnify its feeblest component members. The only apparent desideratum was a recipient for the focal image which should transfer it, without refranging it, to the surface on which it was to be viewed under the revivifying light of the microscopic reflectors. In the various experiments made during the few following weeks, the co-operative philosophers decided that a medium of the purest plate glass (which it is said they obtained, by consent, be it observed, from the shop window of Mons. Desanges, the jeweller to his ex-majesty Charles X., in High street) was the most eligible they could discover. It answered perfectly with a telescope which magnified 100 times, and a microscope of about thrice that power.

Sir John Herschel then conceived the stupendous fabric of his present telescope. The power of his father's instrument would still leave him distant from his favorite planet nearly forty miles, and he resolved to attempt a greater magnifier. Money, the wings of science as the sinews of war, seemed the only requisite, and even the acquisition of this, which is often more difficult than the task of Sisyphus, he determined to achieve. Fully sanctioned by the high optical authority of Sir David Brewster, he laid his plan before the Royal Society, and particularly directed to it the attention of His Royal Highness the Duke of Sussex, the ever munificent patron of science and the arts. It was immediately and enthusiastically approved by the committee chosen to investigate it, and the chairman, who was the Royal President, subscribed his name for a contribution of £10,000, with a promise that he would zealously submit the proposed instrument as a fit object for the patronage of the privy purse. He did so without delay, and his Majesty, on being informed that the estimated expense was £70,000, naively inquired if the costly instrument would conduce to any improvement in *navigation?* On being informed that it undoubtedly would, the sailor King promised a *carte blanch* for the amount which might be required.

Sir John Herschel had submitted his plans and calculations in adaptation to an object-glass of twenty-four feet in diameter: just six times the size of his venerable father's. For casting this ponderous mass, he selected the large glass-house of Messrs. Hartly and Grant, (the brother of our invaluable friend Dr. Grant) at Dumbarton. The material chosen was an amalgamation of two parts of the best crown with one of flint glass, the use of which, in separate lenses, constituted the great achromatic discovery of Dolland. It had been found, however, by accurate experiments, that the amalgam would as completely triumph over every impediment, both from refrangibility and discoloration, as the separate lenses. Five furnaces of the metal, carefully collected from productions of the manufactory, in both the kinds of glass, and known to be respectively of nearly perfect homogenous quality, were united, by one grand conductor, to the mould; and on the third of January, 1833, the first cast was effected. After cooling eight days, the mould was opened, and the glass found to be greatly flawed within eighteen inches of the centre. Notwithstanding this failure, a new glass was more carefully cast on the 27th of the same month, which on being opened during the first week of February, was found to be immaculately perfect, with the exception of two slight flaws so near the line of its circumference that they would be covered by the copper ring in which it was designed to be enclosed.

The weight of this prodigious lens was 14,826 lbs. or nearly seven tons after being polished; and its estimated magnifying power 42,000 times. It was therefore presumed to be capable of representing objects in our lunar satellite of little more than eighteen inches in diameter, provided its focal image of them could be rendered distinct by the transfusion of artificial light. It was not, however, upon the mere illuminating power of the hydro-oxygen microscope, as applied to the focal pictures of this lens, that the younger Herschel depended for the realization of his ambitious theories and hopes. He calculated largely upon the almost illimitable applicability of this instrument as a second magnifier, which would supersede the use,

and infinitely transcend the powers of the highest magnifiers in reflecting telescopes.

So sanguinely indeed did he calculate upon the advantages of this splendid alliance, that he expressed confidence in his ultimate ability to study even the entomology of the moon, in case she contained insects upon her surface. Having witnessed the completion of this great lens, and its safe transportation to the metropolis, his next care was the construction of a suitable microscope, and of the mechanical frame-work for the horizontal and vertical action of the whole. His plans in every branch of his undertaking having been intensely studied, even to their minutest details, were easily and rapidly executed. He awaited only the appointed period at which he was to convey his magnificent apparatus to its destination.

A correspondence had for some time passed between the Boards of England, France, and Austria, with a view to improvements in the tables of longitude in the southern hemisphere; which are found to be much less accurate than those of the northern. The high opinion entertained by the British Board of Longitude of the principles of the new telescope, and of the profound skill of its inventor, determined the government to solicit his services in observing the transit of Mercury over the sun's disk, which will take place on the 7th of November in the present year: and which, as it will occur at 7h. 47m. 55s. night, conjunction, meantime; and at 8h. 12m. 22s. middle, true time, will be invisible to nearly all the northern hemisphere. The place at which the transits of Mercury and of Venus have generally been observed by the astronomers of Europe, when occurring under these circumstances, is the Cape of Good Hope; and no transit of Venus having occurred since the year 1769, and none being to occur before 1874, the accurate observation of the transits of Mercury, which occur more frequently, has been found of great importance both to astronomy and navigation. To the latter useful art, indeed, the transits of Mercury are nearly as important as those of Venus; for although those of the latter planet have the peculiar advantage of determining exactly the great solar parallax, and thence the distances of all the planets from the sun, yet the

transits of Mercury, by exactly determining the place of its own node, independently of the parallax of the great orb, determine the parallax of the earth and moon; and are therefore especially valuable in lunar observations of Longitude. The Cape of Good Hope has been found preferable, in these observations, to any other station in the hemisphere. The expedition which went to Peru, about the middle of the last century, to ascertain, in conjunction with another in Lapland, the true figure of the earth, found the attraction of the mountainous regions so strong as to cause the plum-line of one of their large instruments to deflect seven or eight seconds from the true perpendicular; whilst the elevated plains at the Cape unite all the advantages of a lucid atmosphere with an entire freedom from mountainous obstruction. Sir John Herschel, therefore, not only accepted the appointment with high satisfaction, but requested that it might commence at least a year before the period of the transit, to afford him time to bring his ponderous and complicated machinery into perfect adjustment, and to extend his knowledge of the southern constellations.

His wish was immediately assented to, and his arrangements being completed, he sailed from London on the 4th of September, 1834, in company with Dr. Andrew Grant, Lieutenant Drummond, of the Royal Engineers, F.R.A.S., and a large party of the best English mechanics. They arrived, after an expeditious and agreeable passage, and immediately proceeded to transport the lens, and the frame of the large observatory, to its destined site, which was a piece of table-land of great extent and elevation, about thirty-five miles to the north-east of Cape-town; and which is said to be the very spot on which De la Caille, in 1750, constructed his invaluable solar tables, when he measured a degree of the meridian, and made a great advance to exactitude in computing the solar parallax from that of Mars and the Moon. Sir John accomplished the ascent to the plains by means of two relief teams of oxen, of eighteen each, in about four days; and, aided by several companies of Dutch boors, proceeded at once to the erection of his gigantic fabric.

The ground plan of the structure is in some respects similar to that of the Herschel telescope in England, except that

instead of circular foundations of brickwork, it consists of parallel circles of railroad iron, upon wooden framework; so constructed that the turn-outs, or rather turn-ins, from the largest circle, will conduct the observatory, which moves upon them, to the innermost circle, which is the basis of the lens-works; and to each of the circles that intervene. The diameter of the smallest circle is twenty-eight feet: that of the largest our correspondent has singularly forgotten to state, though it may be in some measure computed from the angle of incidence projected by the lens, and the space occupied by the observatory. The latter is a wooden building fifty feet square and as many high, with a flat roof and gutters of thin copper. Through the side proximate to the lens, is an aperture four feet in diameter to receive its rays, and through the roof another for the same purpose in meridional observations. The lens, which is inclosed in a frame of wood, and braced to its corners by bars of copper, is suspended upon an axis between two pillars which are nearly as high as those which supported the celebrated quadrant of Uleg Beg, being one hundred and fifty feet. These are united at the top and bottom by cross-pieces, and strengthened by a number of diagonal braces; and between them is a double capstan for hoisting the lens from its horizontal line with the observatory to the height required by its focal distance when turned to the meridian; and for elevating it to any intermediate degree of altitude that may be needed. This last operation is beautifully regulated by an immense double sextant, which is connected and moves with the axis of the lens, and is regularly divided into degrees, minutes, and seconds; and the horizontal circles of the observatory being also divided into 360 degrees, and minutely subdivided, the whole instrument has the powers and regularity of the most improved theodolite. Having no tube, it is connected with the observatory by two horizontal levers, which pass underneath the floor of that building from the circular basis of the pillars; thus keeping the lens always square with the observatory, and securing to both a uniform and simple movement. By means of these levers, too, a rack and windlass, the observatory is brought to any degree of approximation to the pillars that the altitude of an observation may

require; and although, when at its nearest station it cannot command an observation with the great lens within about fifteen degrees of the meridian, it is supplied with an excellent telescope of vast power, constructed by the elder Herschel, by which every high degree can be surveyed. The field of view, therefore, whether exhibited on the floor or on the wall of the apartment, has a diameter of nearly fifty feet, and, being circular, it has therefore an area of nearly 1875 feet. The place of all the horizontal movements having been accurately levelled by Lieut. Drummond, with the improved level of his invention which bears his name, and the wheels both of the observatory and of the lens-works being facilitated by friction-rollers in patent axle-boxes filled with oil, the strength of one man applied to the extremity of the levers is sufficient to propel the whole structure upon either of the railroad circles; and that of two men applied to the windlass is fully adequate to bring the observatory to the basis of the pillars. Both of these movements, however, are now effected by a locomotive apparatus commanded within the apartment by a single person, and showing, by means of an ingenious index, every inch of progression or retrogression.

We have not thus particularly described the telescope of the younger Herschel because we consider it the most magnificent specimen of philosophical mechanism of the present or any previous age, but because we deemed an explicit description of its principles and powers an almost indispensable introduction to a statement of the sublime expansion of human knowledge which it has achieved. It was not fully completed until the latter part of December, when the series of large reflectors for the microscope arrived from England; and it was brought into operation during the first week of the ensuing month and year. But the secresy which had been maintained with regard to its novelty, its manufacture, and its destination, was not less rigidly preserved for several months respecting the grandeur of its success. Whether the British Government were sceptical concerning the promised splendor of its discoveries, or wished them to be scrupulously veiled until they had accumulated a a full-orbed glory for the nation and reign in which they origi-

nated, is a question which we can only conjecturally solve. But certain it is that the astronomer's royal patrons enjoined a masonic taciturnity upon him and his friends until he should have officially communicated the results of his great experiment. Accordingly, the world heard nothing of him or his expedition until it was announced a few months since in the scientific journals of Germany, that Sir John Herschel, at the Cape of Good Hope, had written to the astronomer-royal of Vienna, to inform him that the portentous comet predicted for the year 1835, which was to approach so near this trembling globe that we might hear the roaring of its fires, had turned upon another scent, and would not even shake a hair of its tail upon our hunting-grounds. At a loss to conceive by what extra authority he had made so bold a declaration, the men of science in Europe who were not acquainted with his secret, regarded his "postponement," as his discovery was termed, with incredulous contumely, and continued to terrorize upon the strength of former predictions.

NEW LUNAR DISCOVERIES.

Until the 10th of January, the observations were chiefly directed to the stars in the southern signs, in which, without the aid of the hydro-oxygen reflectors, a countless number of new stars and nebulæ were discovered. But we shall defer our correspondent's account of these to future pages, for the purpose of no longer withholding from our readers the more generally and highly interesting discoveries which were made in the lunar world. And for this purpose, too, we shall defer Dr. Grant's elaborate mathematical details of the corrections which Sir John Herschel has made in the best tables of the moon's tropical, sidercal, and synodic revolutions, and of those phenomena of syzygies on which a great part of the established lunar theory depends.

It was about half-past nine o'clock on the night of the 10th, the moon having then advanced within four days of her mean libration, that the astronomer adjusted his instruments for the

inspection of her eastern limb. The whole immense power of his telescope was applied, and to its focal image about one half of the power of his microscope. On removing the screen of the latter, the field of view was covered throughout its entire area with a beautifully distinct, and even vivid representation of *basaltic rock*. Its color was a greenish brown, and the width of the columns, as defined by their interstices on the canvass, was invariably twenty-eight inches. No fracture whatever appeared in the mass first presented, but in a few seconds a shelving pile appeared of five or six columns width, which showed their figure to be hexagonal, and their articulations similar to those of the basaltic formation at Staffa. This precipitous shelf was profusely covered with a dark red flower, "precisely similar," says Dr. Grant, "to the Papaver Rhœas, or rose-poppy of our sublunary cornfields; and this was the first organic production of nature, in a foreign world, ever revealed to the eyes of men."

The rapidity of the moon's ascension, or rather of the earth's diurnal rotation, being nearly equal to five hundred yards in a second, would have effectually prevented the inspection, or even the discovery of objects so minute as these, but for the admirable mechanism which constantly regulates, under the guidance of the sextant, the required altitude of the lens. But its operation was found to be so consummately perfect, that the observers could detain the object upon the field of view for any period they might desire. The specimen of lunar vegetation, however, which they had already seen, had decided a question of too exciting an interest to induce them to retard its exit. It had demonstrated that the moon has an atmosphere constituted similarly to our own, and capable of sustaining organized, and therefore, most probably, animal life. The basaltic rocks continued to pass over the inclined canvass plane, through three successive diameters, when a verdant declivity of great beauty appeared, which occupied two more. This was preceded by another mass of nearly the former height, at the base of which they were at length delighted to perceive that novelty, a lunar forest. "The trees," says Dr. Grant, "for a period of ten minutes, were of one unvaried kind, and unlike

any I have seen, except the largest kind of yews in the English churchyards, which they in some respects resemble. These were followed by a level green plain, which, as measured by the painted circle on our canvass of forty-nine feet, must have been more than half a mile in breadth; and then appeared as fine a forest of firs, unequivocal firs, as I have ever seen cherished in the bosom of my native mountains. Wearied with the long continuance of these, we greatly reduced the magnifying power of the microscope, without eclipsing either of the reflectors, and immediately perceived that we had been insensibly descending, as it were, a mountainous district of a highly diversified and romantic character, and that we were on the verge of a lake, or inland sea; but of what relative locality or extent, we were yet too greatly magnified to determine. On introducing the feeblest acromatic lens we possessed, we found that the water, whose boundary we had just discovered, answered in general outline to the Mare Nubium of Riccoli, by which we detected that, instead of commencing, as we supposed, on the eastern longitude of the planet, some delay in the elevation of the great lens had thrown us nearly upon the axis of her equator. However, as she was a free country, and we not, as yet, attached to any particular province, and moreover, since we could at any moment occupy our intended position, we again slid in our magic lenses to survey the shores of the Mare Nubium. Why Riccoli so termed it, unless in ridicule of Cleomedes, I know not; for fairer shores never angels coasted on a tour of pleasure. A beach of brilliant white sand, girt with wild castellated rocks, apparently of green marble, varied at chasms, occurring every two or three hundred feet, with grotesque blocks of chalk or gypsum, and feathered and festooned at the summit with the clustering foliage of unknown trees, moved along the bright wall of our apartment until we were speechless with admiration. The water, wherever we obtained a view of it, was nearly as blue as that of the deep ocean, and broke in large white billows upon the strand. The action of very high tides was quite manifest upon the face of the cliffs for more than a hundred miles; yet diversified as the scenery was during this and a much greater dis-

tance, we perceived no trace of animal existence, notwithstanding we could command at will a perspective or a foreground view of the whole. Mr. Holmes, indeed, pronounced some white objects of a circular form, which we saw at some distance in the interior of a cavern, to be bona fide specimens of a large cornu ammonis; but to me they appeared merely large pebbles, which had been chafed and rolled there by the tides. Our chase of animal life was not yet to be rewarded.

Having continued this close inspection nearly two hours, during which we passed over a wide tract of country, chiefly of a rugged and apparently volcanic character; and having seen few additional varieties of vegetation, except some species of lichen, which grew everywhere in great abundance, Dr. Herschel proposed that we should take out all our lenses, give a rapid speed to the panorama, and search for some of the principal valleys known to astronomers, as the most likely method to reward our first night's observation with the discovery of animated beings. The lenses being removed, and the effulgence of our unutterably glorious reflectors left undiminished, we found, in accordance with our calculations, that our field of view comprehended about twenty-five miles of the lunar surface, with the distinctness both of outline and detail which could be procured of a terrestrial object at the distance of two and a half miles; an optical phenomenon which you will find demonstrated in Note 5. This afforded us the best landscape views we had hitherto obtained, and although the accelerated motion was rather too great, we enjoyed them with rapture. Several of those famous valleys, which are bounded by lofty hills of so perfectly conical a form as to render them less like works of nature than of art, passed the canvass before we had time to check their flight; but presently a train of scenery met our eye, of features so entirely novel, that Dr. Herschel signalled for the lowest convenient gradation of movement. It was a lofty chain of obelisk-shaped, or very slender pyramids, standing in irregular groups, each composed of about thirty or forty spires, every one of which was perfectly square, and as accurately truncated as the finest specimens of Cornish crystal. They were of a faint lilac hue, and

very resplendent. I now thought that we had assuredly fallen on productions of art; but Dr. Herschel shrewdly remarked, that if the Lunarians could build thirty or forty miles of such monuments as these, we should ere now have discovered others of a less equivocal character. He pronounced them quartz formations, of probably the wine-colored amethyst species, and promised us, from these and other proofs which he had obtained of the powerful action of laws of crystallization in this planet, a rich field of mineralogical study. On introducing a lens, his conjecture was fully confirmed; they were monstrous amethysts, of a diluted claret color, glowing in the intensest light of the sun! They varied in height from sixty to ninety feet, though we saw several of a still more incredible altitude. They were observed in a succession of valleys divided by longitudinal lines of round-breasted hills, covered with verdure and nobly undulated; but what is most remarkable, the valleys which contained these stupendous crystals were invariably barren, and covered with stones of a ferruginous hue, which were probably iron pyrites. We found that some of these curiosities were situated in a district elevated half a mile above the valley of the Mare Fœcunditatis, of Mayer and Riccioli; the shores of which soon hove in view. But never was a name more inappropriately bestowed. From "Dan to Beersheba" all was barren, barren—the sea-board was entirely composed of chalk and flint, and not a vestige of vegetation could be discovered with our strongest glasses. The whole breadth of the northern extremity of this sea, which was about three hundred miles, having crossed our plane, we entered upon a wild mountainous region abounding with more extensive forests of larger trees than we had before seen—the species of which I have no good analogy to describe. In general contour they resembled our forest oak; but they were much more superb in foliage, having broad glossy leaves like that of the laurel, and tresses of yellow flowers which hung, in the open glades, from the branches to the ground. These mountains passed, we arrived at a region which filled us with utter astonishment. It was an oval valley, surrounded, except at a narrow opening towards the south, by hills, red as the purest vermilion, and evidently

crystallized; for wherever a precipitous chasm appeared—and these chasms were very frequent, and of immense depth—the perpendicular sections presented conglomerated masses of polygon crystals, evenly fitted to each other, and arranged in deep strata, which grew darker in color as they descended to the foundations of the precipices. Innumerable cascades were bursting forth from the breasts of every one of these cliffs, and some so near their summits, and with such great force, as to form arches many yards in diameter. I never was so vividly reminded of Byron's simile, "the tale of the white horse in the Revolution." At the foot of this boundary of hills was a perfect zone of woods surrounding the whole valley, which was about eighteen or twenty miles wide, at its greatest breadth, and about thirty in length. Small collections of trees, of every imaginable kind, were scattered about the whole of the luxuriant area; and here our magnifiers blest our panting hopes with specimens of conscious existence. In the shade of the woods on the south-eastern side, we beheld continuous herds of brown quadrupeds, having all the external characteristics of the bison, but more diminutive than any species of the bos genus in our natural history. Its tail is like that of our bos grunniens; but in its semi-circular horns, the hump on its shoulders, and the depth of its dewlap, and the length of its shaggy hair, it closely resembled the species to which I first compared it. It had, however, one widely distinctive feature, which we afterwards found common to nearly every lunar quadruped we have discovered; namely, a remarkable fleshy appendage over the eyes, crossing the whole breadth of the forehead and united to the ears. We could most distinctly perceive this hairy veil, which was shaped like the upper front outline of a cap known to the ladies as Mary Queen of Scots' cap, lifted and lowered by means of the ears. It immediately occurred to the acute mind of Dr. Herschel, that this was a providential contrivance to protect the eyes of the animal from the great extremes of light and darkness to which all the inhabitants of our side of the moon are periodically subjected.

The next animal perceived would be classed on earth as a monster. It was of a bluish lead color, about the size of a

goat, with a head and beard like him, and a *single horn*, slightly inclined forward from the perpendicular. The female was destitute of the horn and beard, but had a much longer tail. It was gregarious, and chiefly abounded on the acclivitous glades of the woods. In elegance of symmetry it rivalled the antelope, and like him it seemed an agile sprightly creature, running with great speed, and springing from the green turf with all the unaccountable antics of a young lamb or kitten. This beautiful creature afforded us the most exquisite amusement. The mimicry of its movements upon our white painted canvass was as faithful and luminous as that of animals within a few yards of the camera obscura, when seen pictured upon its tympan. Frequently when attempting to put our fingers upon its beard, it would suddenly bound away into oblivion, as if conscious of our earthly impertinence; but then others would appear, whom we could not prevent nibbling the herbage, say or do what we would to them.

On examining the centre of this delightful valley, we found a large branching river, abounding with lovely islands, and water-birds of numerous kinds. A species of grey pelican was the most numerous; but a black and white crane, with unreasonably long legs and bill, were also quite common. We watched their pisciverous experiments a long time, in hopes of catching sight of a lunar fish; but although we were not gratified in this respect, we could easily guess the purpose with which they plunged their long necks so deeply beneath the water. Near the upper extremity of one of these islands we obtained a glimpse of a strange amphibious creature, of a spherical form, which rolled with great velocity across the pebbly beach, and was lost sight of in the strong current which set off from this angle of the island. We were compelled, however, to leave this prolific valley unexplored, on account of clouds which were evidently accumulating in the lunar atmosphere, our own being perfectly translucent. But this was itself an interesting discovery, for more distant observers had questioned or denied the existence of any humid atmosphere in this planet.

The moon being now low on her descent, Dr. Herschel inferred that the increasing refrangibility of her rays would

prevent any satisfactory protraction of our labors, and our minds being actually fatigued with the excitement of the high enjoyments we had partaken, we mutually agreed to call in the assistants at the lens, and reward their vigilant attention with congratulatory bumpers of the best "East India Particular." It was not, however, without regret that we left the splendid valley of the red mountains, which, in compliment to the arms of our royal patron, we denominated "the Valley of the Unicorn;" and it may be found in Blunt's map, about midway between the Mare Fœcunditatis and the Mare Nectaris.

The nights of the 11th and 12th being cloudy, were unfavorable to observation; but on those of the 13th and 14th further animal discoveries were made of the most exciting interest to every human being. We give them in the graphic language of our accomplished correspondent:—

"The astonishing and beautiful discoveries which we had made during our first night's observation, and the brilliant promise which they gave of the future, rendered every moonlight hour too precious to reconcile us to the deprivation occasioned by these two cloudy evenings; and they were borne with strictly philosophical patience, notwithstanding that our attention was closely occupied in superintending the erection of additional props and braces to the twenty-four feet lens, which we found had somewhat vibrated in a high wind that arose on the morning of the 11th. The night of the 13th (January) was one of pearly purity and loveliness. The moon ascended the firmament in gorgeous splendor, and the stars, retiring around her, left her the unrivalled queen of the hemisphere. This being the last night but one, in the present month, during which we should have an opportunity of inspecting her western limb, on account of the libration in longitude which would thence immediately ensue, Dr. Herschel informed us that he should direct our researches to the parts numbered 2, 11, 26, and 20 in Blunt's map, and which are respectively known in the modern catalogue by the names of Endymion, Cleomedes, Langrenus, and Petavius. To the careful inspection of these, and the regions between them and the extreme western rim, he proposed to devote the whole of this highly

favorable night. Taking then our twenty-five miles breadth of her surface upon the field of view, and reducing it to a slow movement, we soon found the first very singularly shaped object of our inquiry. It is a highly mountainous district, the loftier chains of which form three narrow ovals, two of which approach each other in slender points, and are united by one mass of hills of great length and elevation; thus presenting a figure similar to that of a long skein of thread, the bows of which have been gradually spread open from their connecting knot. The third oval looks also like a skein, and lies as if carelessly dropped from nature's hand in connection with the other; but that which might fancifully be supposed as having formed the second bow of this second skein is cut open, and lies in scattered threads of smaller hills which cover a great extent of level territory. The ground plan of these mountains is so remarkable that it has been accurately represented in almost every lineal map of the moon that has been drawn; and in Blunt's, which is the best, it agrees exactly with my description. Within the grasp, as it were, of the broken bow of hills last mentioned, stands an oval-shaped mountain, enclosing a valley of an immense area, and having on its western ridge a volcano in a state of terrific eruption. To the north-east of this, across the broken, or what Mr. Holmes called 'the vagabond mountains,' are three other detached oblong formations, the largest and last of which is marked F in the catalogue, and fancifully denominated the Mare Mortuum, or more commonly the 'Lake of Death.' Induced by a curiosity to divine the reason of so sombre a title, rather than by any more philosophical motive, we here first applied our hydro-oxygen magnifiers to the focal image of the great lens. Our twenty-five miles portion of this great mountain circus had comprehended the whole of its area, and of course the two conical hills which rise in it about five miles from each other; but although this breadth of view had heretofore generally presented its objects as if seen within a terrestrial distance of two and a half miles, we were, in this instance, unable to discern these central hills with any such degree of distinctness. There did not appear to be any mist or smoke around them, as in the case of the volcano which

we had left in the south-west, and yet they were comparatively indistinct upon the canvass. On sliding in the gas-light lens the mystery was immediately solved. They were old craters of extinct volcanoes, from which still issued a heated though transparent exhalation, that kept them in an apparently oscillatory or trembling motion, most unfavorable to examination. The craters of both these hills, as nearly as we could judge under this obstruction, were about fifteen fathoms deep, devoid of any appearance of fire, and of nearly a yellowish white color throughout. The diameter of each was about nine diameters of our painted circle, or nearly 450 feet; and the width of the rim surrounding them about 1000 feet; yet notwithstanding their narrow mouths, these two chimneys of the subterranean deep had evidently filled the whole area of the valley in which they stood with the lava and ashes with which it was encumbered, and even added to the height, if not indeed caused the existence of the oval chain of mountains which surrounded it. These mountains, as subsequently measured from the level of some large lakes around them, averaged the height of 2,800 feet; and Dr. Herschel conjectured from this and the vast extent of their abutments, which ran for many miles into the country around them, that these volcanoes must have been in full activity for a million of years. Lieut. Drummond, however, rather supposed that the whole area of this oval valley was but the exhausted crater of one vast volcano, which in expiring had left only these two imbecile representatives of its power. I believe Dr. Herschel himself afterwards adopted this probable theory, which is indeed confirmed by the universal geology of the planet. There is scarcely a hundred miles of her surface, not even excepting her largest seas and lakes, in which circular or oval mountainous ridges may not be easily found; and many, very many of these having numerous enclosed hills in full volcanic operation, which are now much lower than the surrounding circles, it admits of no doubt that each of these great formations is the remains of one vast mountain which has burnt itself out, and left only these wide foundations of its ancient grandeur. A direct proof of this is afforded in a tremendous volcano, now in its prime, which I shall hereafter

notice. What gave the name of 'The Lake of Death' to the annular mountain I have just described, was, I suppose, the dark appearance of the valley which it encloses, and which, to a more distant view than we obtained, certainly exhibits the general aspect of the waters on this planet. The surrounding country is fertile to excess: between this circle and No. 2 (Endymion), which we proposed first to examine, we counted not less than twelve luxuriant forests, divided by open plains, which waved in an ocean of verdure, and were probably prairies like those of North America. In three of these we discovered numerous herds of quadrupeds similar to our friends the bisons in the Valley of the Unicorn, but of much larger size; and scarcely a piece of woodland occurred in our panorama which did not dazzle our vision with flocks of white or red birds upon the wing.

"At length we carefully explored the Endymion. We found each of the three ovals volcanic and sterile within; but, without, most rich, throughout the level regions around them, in every imaginable production of a bounteous soil. Dr. Herschel has classified not less than thirty-eight species of forest trees, and nearly twice this number of plants, found in this tract alone, which are widely different to those found in more equatorial latitudes. Of animals, he classified nine species of mammalia, and five of ovipara. Among the former is a small kind of rein-deer, the elk, the moose, the horned bear, and the biped beaver. The last resembles the beaver of the earth in every other respect than in its destitution of a tail, and its invariable habit of walking upon only two feet. It carries its young in its arms like a human being, and moves with an easy gliding motion. Its huts are constructed better and higher than those of many tribes of human savages, and from the appearance of smoke in nearly all of them, there is no doubt of its being acquainted with the use of fire. Still its head and body differ only in the points stated from that of the beaver, and it was never seen except on the borders of lakes and rivers, in which it has been observed to immerse for a period of several seconds.

"Thirty degrees farther south, in No. 11, or Cleomedes, an

immense annular mountain, containing three distinct craters, which have been so long extinguished that the whole valley around them, which is eleven miles in extent, is densely crowded with woods nearly to the summits of the hills. Not a rod of vacant land, except the tops of these craters, could be descried, and no living creature, except a large white bird resembling the stork. At the southern extremity of this valley is a natural archway or cavern, 200 feet high, and 100 wide, through which runs a river which discharges itself over a precipice of grey rock 80 feet in depth, and then forms a branching stream through a beautiful campaign district for many miles. Within twenty miles of this cataract is the largest lake, or rather inland sea, that has been found throughout the seven and a half millions of square miles which this illuminated side of the moon contains. Its width, from east to west, is 198 miles, and from north to south, 266 miles. Its shape, to the northward, is not unlike that of the bay of Bengal, and it is studded with small islands, most of which are volcanic. Two of these, on the eastern side, are now violently eruptive; but our lowest magnifying power was too great to examine them with convenience, on account of the cloud of smoke and ashes which beclouded our field of view: as seen by Lieut. Drummond, through our reflecting telescope of 2,000 times, they exhibited great brilliancy. In a bay, on the western side of this sea, is an island 55 miles long, of a crescent form, crowded through its entire sweep with the most superb and wonderful natural beauties, both of vegetation and geology. Its hills are pinnacled with tall quartz crystals, of so rich a yellow and orange hue that we at first supposed them to be pointed flames of fire; and they spring up thus from smooth round brows of hills which are covered as with a velvet mantle. Even in the enchanting little valleys of this winding island we could often see these splendid natural spires, mounting in the midst of deep green woods, like church steeples in the vales of Westmoreland. We here first noticed the lunar palm-tree, which differs from that of our tropical latitudes only in the peculiarity of very large crimson flowers, instead of the spadix protruded from the common calyx. We, however, perceived no fruit on any speci-

mens we saw: a circumstance which we attempted to account for from the great (theoretical) extremes in the lunar climate. On a curious kind of tree-melon we nevertheless saw fruit in great abundance, and in every stage of inception and maturity. The general color of these woods was a dark green, though not without occasional admixtures of every tint of our forest seasons. The hectic flush of autumn was often seen kindled upon the cheek of earliest spring; and the gay drapery of summer in some places surrounded trees leafless as the victims of winter. It seemed as if all the seasons here united hands in a circle of perpetual harmony. Of animals we saw only an elegant striped quadruped about three feet high, like a miniature zebra; which was always in small herds on the green sward of the hills; and two or three kinds of long-tailed birds, which we judged to be golden and blue pheasants. On the shores, however, we saw countless multitudes of univalve shell-fish, and among them some huge flat ones, which all three of my associates declared to be cornu ammonæ; and I confess I was here compelled to abandon my sceptical substitution of pebbles. The cliffs all along these shores were deeply undermined by tides; they were very cavernous, and yellow crystal stalactites larger than a man's thigh were shooting forth on all sides. Indeed every rood of this island appeared to be crystallized; masses of fallen crystals were found on every beach we explored, and beamed from every fractured headland. It was more like a creation of an oriental fancy than a distant variety of nature brought by the powers of science to ocular demonstration. The striking dissimilitude of this island to every other we had found on these waters, and its near proximity to the main land, led us to suppose that it must at some time have been a part of it; more especially as its crescent bay embraced the first of a chain of smaller ones which ran directly thither. The first one was a pure quartz rock, about three miles in circumference, towering in naked majesty from the blue deep, without either shore or shelter. But it glowed in the sun almost like a sapphire, as did all the lesser ones of whom it seemed the king. Our theory was speedily confirmed; for all the shore of the main land was battlemented and spired with these unobtainable

jewels of nature ; and as we brought our field of view to include the utmost rim of the illuminated boundary of the planet, we could still see them blazing in crowded battalions as it were, through a region of hundreds of miles. In fact we could not conjecture where this gorgeous land of enchantment terminated; for as the rotary motion of the planet bore these mountain summits from our view, we became further remote from their western boundary.

" We were admonished by this to lose no time in seeking the next proposed object of our search, the Langrenus, or No. 26, which is almost within the verge of the libration in longitude, and of which, for this reason, Dr. Herschel entertained some singular expectations.

" After a short delay in advancing the observatory upon the levers, and in regulating the lens, we found our object and surveyed it. It was a dark narrow lake seventy miles long, bounded, on the east, north, and west, by red mountains of the same character as those surrounding the Valley of the Unicorn, from which it is distant to the south-west about 160 miles. This lake, like that valley, opens to the south upon a plain not more than ten miles wide, which is here encircled by a truly magnificent amphitheatre of the loftiest order of lunar hills. For a semicircle of six miles these hills are riven, from their brow to their base, as perpendicularly as the outer walls of the Colosseum at Rome ; but here exhibiting the sublime altitude of at least two thousand feet, in one smooth unbroken surface. How nature disposed of the huge mass which she thus prodigally carved out, I know not ; but certain it is that there are no fragments of it left upon the plain, which is a declivity without a single prominence except a billowy tract of woodland that runs in many a wild vagary of breadth and course to the margin of the lake. The tremendous height and expansion of this perpendicular mountain, with its bright crimson front contrasted with the fringe of forest on its brow, and the verdure of the open plain beneath, filled our canvass with a landscape unsurpassed in unique grandeur by any we had beheld. Our twenty-five miles perspective included this remarkable mountain, the plain, a part of the lake, and the last graduated sum-

mits of the range of hills by which the latter is nearly surrounded. We ardently wished that all the world could view a scene so strangely grand, and our pulse beat high with the hope of one day exhibiting it to our countrymen in some part of our native land. But we were at length compelled to destroy our picture, as a whole, for the purpose of magnifying its parts for scientific inspection. Our plain was of course immediately covered with the ruby front of this mighty amphitheatre, its tall figures, leaping cascades, and rugged caverns. As its almost interminable sweep was measured off upon the canvass, we frequently saw long lines of some yellow metal hanging from the crevices of the horizontal strata in wild net-work, or straight pendant branches. We of course concluded that this was virgin gold, and we had no assay-master to prove to the contrary. On searching the plain, over which we had observed the woods roving in all the shapes of clouds in the sky, we were again delighted with the discovery of animals. The first observed was a quadruped with an amazingly long neck, head like a sheep, bearing two long spiral horns, white as polished ivory, and standing in perpendicular parallel to each other. Its body was like that of the deer, but its fore-legs were most disproportionally long, and its tail, which was very bushy and of a snowy whiteness, curled high over its rump, and hung two or three feet by its side. Its colors were bright bay and white in brindled patches, clearly defined, but of no regular form. It was found only in pairs, in spaces between the woods, and we had no opportunity of witnessing its speed or habits. But a few minutes only elapsed before three specimens of another animal appeared, so well known to us all that we fairly laughed at the recognition of so familiar an acquaintance in so distant a land. They were neither more nor less than three good large sheep, which would not have disgraced the farms of Leicestershire, or the shambles of Leadenhall-market. With the utmost scrutiny, we could find no mark of distinction between these and those of our native soil; they had not even the appendage over the eyes, which I have described as common to lunar quadrupeds. Presently they appeared in great numbers, and on reducing the lenses, we found them in flocks over a great part

of the valley. I need not say how desirous we were of finding shepherds to these flocks, and even a man with blue apron and rolled up sleeves would have been a welcome sight to us, if not to the sheep; but they fed in peace, lords of their own pastures, without either protector or destroyer in human shape.

"We at length approached the level opening to the lake, where the valley narrows to a mile in width, and displays scenery on both sides picturesque and romantic beyond the powers of a prose description. Imagination, borne on the wings of poetry, could alone gather similes to portray the wild sublimity of this landscape, where dark behemoth crags stood over the brows of lofty precipices, as if a rampart in the sky; and forests seemed suspended in mid air. On the eastern side there was one soaring crag, crested with trees, which hung over in a curve like three-fourths of a Gothic arch, and being of a rich crimson color, its effect was most strange upon minds unaccustomed to the association of such grandeur with such beauty.

"But whilst gazing upon them in a perspective of about half a mile, we were thrilled with astonishment to perceive four successive flocks of large winged creatures, wholly unlike any kind of birds, descend with a slow even motion from the cliffs on the western side, and alight upon the plain. They were first noticed by Dr. Herschel, who exclaimed, 'Now, gentlemen, my theories against your proofs, which you have often found a pretty even bet, we have here something worth looking at: I was confident that if ever we found beings in human shape, it would be in this longitude, and that they would be provided by their Creator with some extraordinary powers of locomotion: first exchange for my number D.' This lens being soon introduced, gave us a fine half-mile distance, and we counted three parties of these creatures, of twelve, nine, and fifteen in each, walking erect towards a small wood near the base of the eastern precipices. Certainly they *were* like human beings, for their wings had now disappeared, and their attitude in walking was both erect and dignified. Having observed them at this distance for some minutes, we introduced lens H *z* which brought them to the apparent proximity of eighty yards; the highest clear magnitude we possessed until the latter end of

March, when we effected an improvement in the gas-burners. About half of the first party had passed beyond our canvass; but of all the others we had a perfectly distinct and deliberate view. They averaged four feet in height, were covered, except on the face, with short and glossy copper-colored hair, and had wings composed of a thin membrane, without hair, lying snugly upon their backs, from the top of the shoulders to the calves of the legs. The face, which was of a yellowish flesh color, was a slight improvement upon that of the large orang outang, being more open and intelligent in its expression, and having a much greater expansion of forehead. The mouth, however, was very prominent, though somewhat relieved by a thick beard upon the lower jaw, and by lips far more human than those of any species of the simia genus. In general symmetry of body and limbs they were infinitely superior to the orang outang; so much so, that, but for their long wings, Lieut. Drummond said they would look as well on a parade ground as some of the old cockney militia! The hair on the head was a darker color than that of the body, closely curled, but apparently not woolly, and arranged in two curious semicircles over the temples of the forehead. Their feet could only be seen as they were alternately lifted in walking; but, from what we could see of them in so transient a view, they appeared thin, and very protuberant at the heel.

"Whilst passing across the canvass, and whenever we afterwards saw them, these creatures were evidently engaged in conversation; their gesticulation, more particularly the varied action of their hands and arms, appeared impassioned and emphatic. We hence inferred that they were rational beings, and although not perhaps of so high an order as others which we discovered the next month on the shores of the Bay of Rainbows, that they were capable of producing works of art and contrivance. The next view we obtained of them was still more favorable. It was on the borders of a little lake, or expanded stream, which we then for the first time perceived running down the valley to a large lake, and having on its eastern margin a small wood.

"Some of these creatures had crossed this water and were

lying like spread eagles on the skirts of the wood. We could then perceive that they possessed wings of great expansion, and were similar in structure to those of the bat, being a semi-transparent membrane expanded in curvilineal divisions by means of straight radii, united at the back by the dorsal integuments. But what astonished us very much was the circumstance of this membrane being continued, from the shoulders to the legs, united all the way down, though gradually decreasing in width. The wings seemed completely under the command of volition, for those of the creatures whom we saw bathing in the water, spread them instantly to their full width, waved them as ducks do theirs to shake off the water, and then as instantly closed them again in a compact form. Our further observation of the habits of these creatures, who were of both sexes, led to results so very remarkable, that I prefer they should first be laid before the public in Dr. Herschel's own work, where I have reason to know they are fully and faithfully stated, however incredulously they may be received.— * * * * * The three families then almost simultaneously spread their wings, and were lost in the dark confines of the canvass before we had time to breathe from our paralyzing astonishment. We scientifically denominated them the Vespertilio-homo, or man-bat; and they are doubtless innocent and happy creatures, notwithstanding that some of their amusements would but ill comport with our terrestrial notions of decorum. The valley itself we called the Ruby Colosseum, in compliment to its stupendous southern boundary, the six mile sweep of precipices two thousand feet high. And the night, or rather morning, being far advanced, we postponed our tour to Petavius (No. 20), until another opportunity." We have, of course, faithfully obeyed Dr. Grant's private injunction to omit those highly curious passages in his correspondence which he wished us to suppress, although we do not perceive the force of the reason assigned for it. It is true, the omitted paragraphs contain facts which would be wholly incredible to readers who do not carefully examine the principles and capacity of the instrument with which these marvellous discoveries have been made; but so will nearly all of those which he has kindly permitted us to publish; and it was for this

reason that we considered the explicit description which we have given of the telescope so important a preliminary. From these, however, and other prohibited passages, which will be published by Dr. Herschel, with the certificates of the civil and military authorities of the colony, and of several Episcopal, Wesleyan, and other ministers, who, in the month of March last, were permitted, under stipulation of temporary secrecy, to visit the observatory, and become eye-witnesses of the wonders which they were requested to attest, we are confident his forthcoming volumes will be at once the most sublime in science, and the most intense in general interest, that ever issued from the press.

The night of the 14th displayed the moon in her mean libration, or full; but the somewhat humid state of the atmosphere being for several hours less favorable to a minute inspection than to a general survey of her surface, they were chiefly devoted to the latter purpose. But shortly after midnight the last veil of mist was dissipated, and the sky being as lucid as on the former evenings, the attention of the astronomers was arrested by the remarkable outlines of the spot marked Tycho, No. 18, in Blunt's lunar chart; and in this region they added treasures to human knowledge which angels might well desire to win. Many parts of the following extract will remain forever in the chronicles of time:—

"The surface of the moon, when viewed in her mean libration, even with telescopes of very limited power, exhibits three oceans of vast breadth and circumference, independently of seven large collections of water, which may be denominated seas. Of inferior waters, discoverable by the higher classes of instruments, and usually called lakes, the number is so great that no attempt has yet been made to count them. Indeed, such a task would be almost equal to that of enumerating the annular mountains which are found upon every part of her surface, whether composed of land or water. The largest of the three oceans occupies a considerable portion of the hemisphere between the line of her northern axis and that of her eastern equator, and even extends many degrees south of the latter. Throughout its eastern boundary, it so closely approaches that

of the lunar sphere, as to leave in many places merely a fringe of illuminated mountains, which are here, therefore, strongly contra-distinguished from the dark and shadowy aspect of the great deep. But peninsulas, promontories, capes, and islands, and a thousand other terrestrial figures, for which we can find no names in the poverty of *our* geographical nomenclature, are found expanding, sallying forth, or glowing in insular independence, through all the 'billowy boundlessness' of this magnificent ocean. One of the most remarkable of these is a promontory, without a name, I believe, in the lunar charts, which starts from an island district denominated Copernicus by the old astronomers, and abounding, as we eventually discovered, with great natural curiosities. This promontory is indeed most singular. Its northern extremity is shaped much like an imperial crown, having a swelling bow, divided and tied down in its centre by a band of hills which is united with its forehead band or base. The two open spaces formed by this division are two lakes, each eighty miles wide; and at the foot of these, divided from them by the band of hills last mentioned, is another lake, larger than the two put together, and nearly perfectly square. This one is followed, after another hilly division, by a lake of an irregular form; and this one yet again, by two narrow ones, divided longitudinally, which are attenuated northward to the main land. Thus this skeleton promontory of mountain ridges runs 396 miles into the ocean, with six capacious lakes, enclosed within its stony ribs. Blunt's excellent lunar chart gives this great work of nature with wonderful fidelity, and I think you might accompany my description with an engraving from it, much to your reader's satisfaction. (See plate 4.)

"Next to this, the most remarkable formation in this ocean is a strikingly brilliant annular mountain of immense altitude and circumference, standing 330 miles E.S.E., commonly known as Aristarchus (No. 12), and marked in the chart as a large mountain, with a great cavity in its centre. That cavity is now, as it was probably wont to be in ancient ages, a volcanic crater, awfully rivalling our Mounts Etna and Vesuvius in the most terrible epochs of their reign. Unfavorable as the state of the atmosphere was to close examination, we could

easily mark its illumination of the water over a circuit of sixty miles. If we had before retained any doubt of the power of lunar volcanoes to throw fragments of their craters so far beyond the moon's attraction that they would necessarily gravitate to this earth, and thus account for the multitude of massive aerolites which have fallen and been found upon our surface, the view which we had of Aristarchus would have set our scepticism forever at rest. This mountain, however, though standing 300 miles in the ocean, is not absolutely insular, for it is connected with the main land by four chains of mountains, which branch from it as a common centre.

The next great ocean is situated on the western side of the meridian line, divided nearly in the midst by the line of the equator, and is about 900 miles in north and south extent. It is marked C in the catalogue, and was fancifully called the Mare Tranquillitatis. It is rather two large seas than one ocean, for it is narrowed just under the equator by a strait not more than 100 miles wide. Only three annular islands of a large size, and quite detached from its shores, are to be found within it; though several sublime volcanoes exist on its northern boundary; one of the most stupendous of which is within 120 miles of the Mare Nectaris before mentioned. Immediately contiguous to this second great ocean, and separated from it only by a concatenation of dislocated continents and islands, is the third, marked D, and known as the Mare Serenitatis. It is nearly square, being about 330 miles in length and width. But it has one most extraordinary peculiarity, which is a perfectly straight ridge of hills, certainly not more than five miles wide, which starts in a direct line from its southern to its northern shore, dividing it exactly in the midst. This singular ridge is perfectly *sui generis*, being altogether unlike any mountain chain either on this earth or on the moon itself. It is so very keen, that its great concentration of the solar light renders it visible to small telescopes; but its character is so strikingly peculiar, that we could not resist the temptation to depart from our predetermined adherence to a general survey, and examine it particularly. Our lens G x brought it within the small distance of 800 yards, and its whole width of four or five miles snugly

within that of our canvass. Nothing that we had hitherto seen more highly excited our astonishment. Believe it or believe it not, it was one entire crystallization!—its edge, throughout its whole length of 340 miles, is an acute angle of solid quartz crystal, brilliant as a piece of Derbyshire spar just brought from a mine, and containing scarcely a fracture or a chasm from end to end! What a prodigious influence must our thirteen times larger globe have exercised upon this satellite, when an embryo in the womb of time, the passive subject of chemical affinity! We found that wonder and astonishment, as excited by objects in this distant world, were but modes and attributes of ignorance, which should give place to elevated expectations, and to reverential confidence in the illimitable power of the Creator.

"The dark expanse of waters to the south of the first great ocean has often been considered a fourth; but we found it to be merely a sea of the first class, entirely surrounded by land, and much more encumbered with promontories and islands than it has been exhibited in any lunar chart. One of its promontories runs from the vicinity of Pitatus (No. 19), in a slightly curved and very narrow line, to Bullialdus (No. 22), which is merely a circular head to it, 264 miles from its starting place. This is another mountainous ring, a marine volcano, nearly burnt out, and slumbering upon its cinders. But Pitatus, standing upon a bold cape of the southern shore, is apparently exulting in the might and majesty of its fires. The atmosphere being now quite free from vapor, we introduced the magnifiers to examine a large bright circle of hills which sweep close beside the western abutments of this flaming mountain. The hills were either of snow-white marble or semi-transparent crystal, we could not distinguish which, and they bounded another of those lovely green valleys, which, however monotonous in my descriptions, are of paradisaical beauty and fertility, and like primitive Eden in the bliss of their inhabitants. Dr. Herschel here again predicated another of his sagacious theories. He said the proximity of the flaming mountain, Bullialdus, must be so great a local convenience to dwellers in this valley during the long periodical absence of

solar light, as to render it a place of populous resort for the inhabitants of all the adjacent regions, more especially as its bulwark of hills afforded an infallible security against any volcanic eruption that could occur. We therefore applied our full power to explore it, and rich indeed was our reward.

"The very first object in this valley that appeared upon our canvass was a magnificent work of art. It was a temple—a fane of devotion, or of science, which, when consecrated to the Creator, *is* devotion of the loftiest order; for it exhibits his attributes purely free from the masquerade, attire, and blasphemous caricature of controversial creeds, and has the seal and signature of his own hand to sanction its aspirations. It was an equitriangular temple, built of polished sapphire, or of some resplendent blue stone, which, like it, displayed a myriad points of golden light twinkling and scintillating in the sunbeams. Our canvass, though fifty feet in diameter, was too limited to receive more than a sixth part of it at one view, and the first part that appeared was near the centre of one of its sides, being three square columns, six feet in diameter at its base, and gently tapering to a hight of seventy feet. The intercolumniations were each twelve feet. We instantly reduced our magnitude, so as to embrace the whole structure in one view, and then indeed it was most beautiful. The roof was composed of some yellow metal, and divided into three compartments, which were not triangular planes inclining to the centre, but subdivided, curbed, and separated, so as to present a mass of violently agitated flames rising from a common source of conflagration and terminating in wildly waving points. This design was too manifest, and too skilfully executed to be mistaken for a single moment. Through a few openings in these metallic flames we perceived a large sphere of a darker kind of metal nearly of a clouded copper color, which they enclosed and seemingly raged around, as if hieroglyphically consuming it. This was the roof; but upon each of the three corners there was a small sphere of apparently the same metal as the large centre one, and these rested upon a kind of cornice, quite new in any order of architecture with which we are acquainted, but nevertheless exceedingly graceful

and impressive. It was like a half-opened scroll, swelling off boldly from the roof, and hanging far over the walls in several convolutions. It was of the same metal as the flames, and on each side of the building it was open at both ends. The columns, six on each side, were simply plain shafts, without capitals or pedestals, or any description of ornament; nor was any perceived in other parts of the edifice. It was open on each side, and seemed to contain neither seats, altars, nor offerings; but it was a light and airy structure, nearly a hundred feet high from its white glistening floor to its glowing roof, and it stood upon a round green eminence on the eastern side of the valley. We afterwards, however, discovered two others, which were in every respect fac-similes of this one; but in neither did we perceive any visitants besides flocks of wild doves which alighted upon its lustrous pinnacles. Had the devotees of these temples gone the way of all living, or were the latter merely historical monuments? What did the ingenious builders mean by the globe surrounded by flames? Did they by this record any past calamity of *their* world, or predict any future one of *ours?* I by no means despair of ultimately solving not only these but a thousand other questions which present themselves respecting the objects in this planet; for not the millionth part of her surface has yet been explored, and we have been more desirous of collecting the greatest possible number of new facts, than of indulging in speculative theories, however seductive to the imagination.

"But we had not far to seek for inhabitants of this 'Vale of the Triads.' Immediately on the outer border of the wood which surrounded, at the distance of half a mile, the eminence on which the first of these temples stood, we saw several detached assemblies of beings whom we instantly recognized to be of the same species as our winged friends of the Ruby Colosseum near the lake Langrenus. Having adjusted the instrument for a minute examination, we found that nearly all the individuals in these groups were of a larger stature than the former specimens, less dark in color, and in *every respect* an improved variety of the race. They were chiefly engaged in eating a large yellow fruit like a gourd, sections of which they

divided with their fingers, and ate with rather uncouth voracity, throwing away the rind. A smaller red fruit, shaped like a cucumber, which we had often seen pendant from trees having a broad dark leaf, was also lying in heaps in the centre of several of the festive groups; but the only use they appeared to make of it was sucking its juice, after rolling it between the palms of their hands and nibbling off an end. They seemed eminently happy, and even polite, for we saw, in many instances, individuals sitting nearest these piles of fruit, select the largest and brightest specimens, and throw them archwise across the circle to some opposite friend or associate who had extracted the nutriment from those scattered around him, and which were frequently not a few. While thus engaged in their rural banquets, or in social converse, they were always seated with their knees flat upon the turf, and their feet brought evenly together in the form of a triangle. And for some mysterious reason or other this figure seemed to be an especial favorite among them; for we found that every group or social circle arranged itself in this shape before it dispersed, which was generally done at the signal of an individual who stepped into the centre and brought his hands over his head in an acute angle. At this signal each member of the company extended his arms forward so as to form an acute horizontal angle with the extremity of the fingers. But this was not the only proof we had that they were creatures of order and subordination. * * * * We had no opportunity of seeing them actually engaged in any work of industry or art; and so far as we could judge, they spent their happy hours in collecting various fruits in the woods, in eating, flying, bathing, and loitering about upon the summits of precipices. * * * * But although evidently the highest order of animals in this rich valley, they were not its only occupants. Most of the other animals which we had discovered elsewhere, in very distant regions, were collected here; and also at least eight or nine new species of quadrupeds. The most attractive of these was a tall white stag with lofty spreading antlers, black as ebony. We several times saw this elegant creature trot up to the seated parties of the semi-human beings I have described, and browse the herbage

close beside them, without the least manifestation of fear on its part or notice on theirs. The universal state of amity among all classes of lunar creatures, and the apparent absence of every carnivorous or ferocious species, gave us the most refined pleasure, and doubly endeared to us this lovely nocturnal companion of our larger, but less favored world. Ever again when I 'eye the blue vault and bless the *useful* light,' shall I recall the scenes of beauty, grandeur, and felicity, I have beheld upon her surface, not 'as *through* a glass darkly, but face to face;' and never shall I think of that line of our thrice noble poet,

> ——'Meek Diana's crest
> Sails through the azure air, an island of the blest,'

without exulting in my knowledge of its truth."

With the careful inspection of this instructive valley, and a scientific classification of its animal, vegetable, and mineral productions, the astronomers closed their labors for the night; labors rather mental than physical, and oppressive, from the extreme excitement which they naturally induced. A singular circumstance occurred the next day, which threw the telescope quite out of use for nearly a week, by which time the moon could be no longer observed that month. The great lens, which was usually lowered during the day, and placed horizontally, had, it is true, been lowered as usual, but had been inconsiderately left in a perpendicular position. Accordingly, shortly after sunrise the next morning, Dr. Herschel and his assistants, Dr. Grant and Messrs. Drummond and Home, who slept in a bungalow erected a short distance from the observatory circle, were awakened by the loud shouts of some Dutch farmers and domesticated Hottentots (who were passing with their oxen to agricultural labor), that the "big house" was on fire! Dr. Herschel leaped out of bed from his brief slumbers, and, sure enough, saw his observatory enveloped in a cloud of smoke.

Luckily it had been thickly covered, within and without, with a coat of Roman plaster, or it would inevitably have been destroyed with all its invaluable contents; but, as it was, a hole fifteen feet in circumference had been burnt completely through the "reflecting chamber," which was attached to the

side of the observatory nearest the lens, through the canvass field on which had been exhibited so many wonders that will ever live in the history of mankind, and through the outer wall. So fierce was the concentration of the solar rays through the gigantic lens, that a clump of trees standing in a line with them was set on fire, and the plaster of the observatory walls, all round the orifice, was vitrified to blue glass. The lens being almost immediately turned, and a brook of water being within a few hundred yards, the fire was soon extinguished, but the damage already done was not inconsiderable. The microscope lenses had fortunately been removed for the purpose of being cleaned, but several of the metallic reflectors were so fused as to be rendered useless. Masons and carpenters were procured from Cape Town with all possible dispatch, and in about a week the whole apparatus was again prepared for operation.

The moon being now invisible Dr. Herschel directed his inquiries to the primary planets of the system, and first to the planet Saturn. We need not say that this remarkable globe has for many ages been an object of the most ardent astronomical curiosity. The stupendous phenomenon of its double ring having baffled the scrutiny and conjecture of many generations of astronomers, was finally abandoned as inexplicable. It is well known that this planet is stationed in the system 900 millions of miles distant from the sun, and that having the immense diameter of 79,000 miles, it is more than nine hundred times larger than the earth. Its annual motion round the sun is not accomplished in less than twenty-nine and a half of our years, whilst its diurnal rotation upon its axis is accomplished in 10h. 16m., or considerably less than half a terrestrial day. It has not less than seven moons, the sixth and the seventh of which were discovered by the elder Herschel in 1789. It is thwarted by mysterious belts or bands of a yellowish tinge, and is surrounded by a double ring—the outer one of which is 204,000 miles in diameter. The outside diameter of the inner ring is 184,000 miles, and the breadth of the outer one being 7,200 miles, the space between them is 28,000 miles. The breadth of the inner ring is much greater than that of the other, being 20,000 miles; and its distance from the body of Saturn is more

than 30,000. These rings are opaque, but so thin that their edge has not until now been discovered. Sir John Herschel's most interesting discovery with regard to this planet is the demonstrated fact that these two rings are composed of the fragments of two destroyed worlds, formerly belonging to our solar system, and which, on being exploded, were gathered around the immense body of Saturn by the attraction of gravity, and yet kept from falling to its surface by the great centrifugal force created by its extraordinary rapidity on its axis. The inner ring was therefore the first of these destroyed worlds (the former station of which in the system is demonstrated in the argument which we subjoin), which was accordingly carried round by the rotary force, and spread forth in the manner we see. The outer ring is another world exploded in fragments, attracted by the law of gravity as in the former case, and kept from uniting with the inner ring by the centrifugal force of the latter. But the latter, having a slower rotation than the planet, has an inferior centrifugal force, and accordingly the space between the outer and inner ring is nearly ten times less than that between the inner ring and the body of Saturn. Having ascertained the mean density of the rings, as compared with the density of the planet, Sir John Herschel has been enabled to effect the following beautiful demonstration. [Which we omit, as too mathematical for popular comprehension.—*Ed. Sun.*]

Dr. Herschel clearly ascertained that these rings are composed of rocky strata, the skeletons of former globes, lying in a state of wild and ghastly confusion, but not devoid of mountains and seas. * * * * The belts across the body of Saturn he has discovered to be the smoke of a number of immense volcanoes, carried in these straight lines by the extreme velocity of the rotary motion. * * * * [And these also he has ascertained to be the belt of Jupiter.—But the portion of the work which is devoted to this subject, and to the other planets, as also that which describes the astronomer's discoveries among the stars, is comparatively uninteresting to general readers, however highly it might interest others of scientific taste and mathematical acquirements.—*Ed. Sun.*]

* * * * "It was not until the new moon of the month of

March, that the weather proved favorable to any continued series of lunar observations; and Dr. Herschel had been too enthusiastically absorbed in demonstrating his brilliant discoveries in the southern constellations, and in constructing tables and catalogues of his new stars, to avail himself of the few clear nights which intervened.

"On one of these, however, Mr. Drummond, myself, and Mr. Holmes, made those discoveries near the Bay of Rainbows, to which I have somewhere briefly alluded. The bay thus fancifully denominated is a part of the northern boundary of the first great ocean which I have lately described, and is marked in the chart with the letter O. The tract of country which we explored on this occasion is numbered 6, 5, 8, 7, in the catalogue, and the chief mountains to which these numbers are attached are severally named Atlas, Hercules, Heraclides Verus, and Heraclides Falsus. Still farther to the north of these is the island circle called Pythagoras, and numbered 1; and yet nearer the meridian line is the mountainous district marked R, and called the Land of Drought, and Q, the Land of Hoar Frost; and certainly the name of the latter, however theoretically bestowed, was not altogether inapplicable, for the tops of its very lofty mountains were evidently covered with snow, though the valleys surrounding them were teeming with the luxuriant fertility of midsummer. But the region which we first particularly inspected was that of Heraclides Falsus (No. 7), in which we found several new specimens of animals, all of which were horned and of a white or grey color; and the remains of three ancient triangular temples which had long been in ruins. We thence traversed the country southeastward, until we arrived at Atlas (No. 6), and it was in one of the noble valleys at the foot of this mountain that we found the very superior species of the Vespertilio-homo. In stature they did not exceed those last described, but they were of infinitely greater personal beauty, and appeared in our eyes scarcely less lovely than the general representations of angels by the more imaginative schools of painters. Their social economy seemed to be regulated by laws or ceremonies exactly like those prevailing in the Vale of the Triads, but their works of art were

more numerous, and displayed a proficiency of skill quite incredible to all except actual observers. I shall, therefore, let the first detailed account of them appear in Dr. Herschel's authenticated natural history of this planet."

[This concludes the Supplement, with the exception of forty pages of illustrative and mathematical notes, which would greatly enhance the size and price of this work, without commensurably adding to its general interest.—*Ed Sun.*]

APPENDIX.

THE MOON AS KNOWN AT THE PRESENT TIME.

"Ye sacred muses, with whose beauty fir'd,
My soul is ravish'd, and my brain inspir'd.
Whose priest I am, whose holy fillets wear;
Would you your poet's first petition hear;
Give me the ways of wandering stars to know:
The depths of heav'n above, and earth below.
Teach me the various labours of the moon,
And whence proceed th' eclipses of the sun.
Why flowing tides prevail upon the main,
And in what dark recess they shrink again.
What shakes the solid earth, what cause delays
The summer nights, and shortens winter days."

VIRGIL.

THE picture on the title-page is probably the best and minutest view of the moon, that has ever been laid before the public. Most of our readers are aware that the mountains and hollows of the moon have been accurately and thoroughly mapped by astronomers, and baptized by appropriate names. For the benefit of meritorious students of astronomical geography, we subjoin the names of all those which have been christened. At the present season it will amply repay the possessor of a small telescope to identify the several localities with the aid of the map.

In olden time the moon was a goddess. Whatever the ignorant mind of the time was incapable of grasping was supernatural. Thus arose the pale, chaste Deity of the Night, robed in virgin white, roaming dreamily under the partial shade of trees, loving to see her fair image reflected in streams, and shedding a complacent light on tender meetings. We are not heathens—far from it: but who among us has not

at some time or other paid homage to the Queen of Night*, and thanked her for the gentle light which has shown the way to some fair hand.

We say, in blunt scientific terms, that she—or it—is a satellite of the earth, suspended in her—or its—present position by the contrasted attraction of the sun and the earth. This is the unromantic version of the naked fact.

There was a time when the earth was an uncomfortable semi-incandescent mass, in the act of cooling off for practical purposes. The atmosphere was tropical throughout the globe. All things were intensely impregnated—or, as the philosophers say, supersaturated—with carbon. Between the dry land and the waters there was no division. There was no ocean, and consequently no continents. All was hot mud, with here and there a lake or a short river, and here and there a dry, parched, torrid eminence. In those days there were animals and plants, but no human beings. Both animals and plants were like the age in which they flourished—to our notions monstrous. Monsters were the rule, both in the vegetable and the animated world. Creatures were born, and grew to sizes which dwarf the elephant. Plants thrust their heads above the mud, and, in that carboniferous atmosphere, attained heights

* "As when the Moon,[1] refulgent lamp of night!
O'er heav'n's clear azure spreads her sacred light,
When not a breath disturbs the deep serene,
And not a cloud o'ercasts the solemn scene;
Around her throne the vivid planets roll,
And stars unnumber'd gild the glowing pole,
O'er the dark trees a yellower verdure shed,
And tip with silver ev'ry mountain's head;
Then shine the vales, the rocks in prospect rise,
A flood of glory bursts from all the skies."

HOMER.

The earth is accompanied by a MOON or satellite, whose distance is 237,000 miles, and diameter 2,160. Her surface is composed of hill and dale, of rocks and mountains, nearly two miles high, and of circular cavities, sometimes five miles in depth and forty in diameter. She possesses neither *rivers*, nor *lakes*, nor *seas*, and we cannot discover with the telescope any traces of living beings, or any monuments of their hands. Viewing the earth as we now do, as the *third* planet in order from the sun, can we doubt that it is a globe like the rest, poised in ether like them, and, like them, moving round the central luminary?

[1] *As when the moon, &c.* This comparison is inferior to none in *Homer*. It is the most beautiful night-piece that can be found in poetry. He presents you with a prospect of the heavens, the seas, and the earth; the stars shine, the air is serene, the world enlighten'd, and the moon mounted in glory.

which would have towered above the tallest trees of our forests. But in proportion to the rapidity of their growth was the brevity of their life; for these were the days of earthquakes and terrestrial convulsions. Probably no day elapsed without some earthquake or volcanic eruption.

The light of day was dull and obscured. Masses of opaque matter floated through the atmosphere as thickly as dust specks float through a ray of sunlight in a darkened room.* The hot air, thick and dull, hung a listless mist over the face of the earth, which was even then almost without form and void. When the sun went down, dense darkness covered the earth. There was no lesser light to rule the night; dim twinklings in the far distance, hardly piercing the pall which wrapped our planet, were the only contrasts to the Egyptian blackness of the dark hours.

But the internal fires which sprung from the vitals of the earth almost supplied the want of a nocturnal luminary. It is probable that there were but few spots on the globe which were out of view of some flaming volcano. We count the active volcanoes by integers. When we have enumerated Etna, Vesuvius, Hecla, Jorullo, Colima, and one or two others, we have reached the end of our list. In the days of Homer the volcanoes were counted by scores; in the carboniferous age they may have, must have, flourished by hundreds and thousands. That vast incandescent mass, of which the crust only had cooled, kept boiling up every few hours, and furiously pouring out the vials of its wrath upon an earth inhabited by transitory creatures. Go where the traveller may, he will still find traces of this terrible age. That tell-tale rock—"the trap"—is peculiar to no meridian; and from the Hudson's Bay territories nearly to Cape Magellan, from Spitzbergen to Borneo, either this, or some mountain range of volcanic origin, here with scoriæ disseminated through the more regular formations, there with copper or gold held in a native state in half-decayed quartz, tell a very legible story of the time when all the component parts of the earth were in a fluid state, and were thrown off by the boiling mass beneath as a kettle throws off froth and scum.

There came a day when the under crust could no longer bear the weight of the mass which, after being thrown off daily, returned, by the force of gravitation, to the surface of its parent. A time came when the

* For an account of the singular views which the ancients had entertained on this subject, see "The Theology of the Phœnicians," by *Sanchoniatho*, who flourished about the time of the Trojan war. Published in a collection of *Ancient Fragments*. New York. 1835.

incandescent and inchoate planet—if so daring a figure may be ventured —felt the necessity of unusually strenuous measures. It gathered all its fiery energies, and mustered all its fearful strength. The effect was universal, not local. With such bodies distances of 25,000 miles must be trifling, and the earth's meridian—a paltry 8000 miles—not worth mentioning. One can imagine the purpose and effort being common to the entire molten and raging mass.

It came at last. After throes of inconceivable agony, with a roar and a convulsion which must have destroyed every living thing then existent upon the face of the planet, in the midst of general chaos, confusion, and desolation, the earth relieved itself. It tore from its half-cooled surface immense masses, and projected them with monstrous force into space; not on one side alone, but on all. Lumps of earth four and five miles in thickness, and thousands of miles long and wide, were in an instant forced upwards with such force as to pass beyond the circle of the earth's attraction. These various masses, thus launched into space, soon felt the attraction of each other, and assembled together. They met, and, agreeably to the sublime law of celestial bodies, remained suspended in space at the point where the attraction of the earth meets that of the sun. That other celestial law which forbids the torpidity of any atom of matter compelled the aggregated mass to revolve, and the revolution forced the mass into a spherical shape.

Thus the moon came into being. An offshoot from the earth, it pays homage to its parent by revolving round it, and reflecting back to it a part of the sun's light during the period when that luminary is obscured to us. Had the force with which its substance was expelled from the body of the earth been less, it would have returned to our surface, just as those fragments of matter called aerolites do at regular intervals; had that force been greater, it would have entered upon the vast area which is the domain of the sun, and would have been attracted to that great cosmical body, and been fused by its intense heat. It was sent abroad with precisely the force necessary to sustain it *in equilibrio* between the earth and the sun, and hence it is "the lesser light which rules the night."

This is not the only service which it renders us. By its creation it caused great hollows in the surface of the earth. Into these hollows the waters which lay on the face of the deep naturally gathered, and became oceans, lakes, seas, and rivers. The cavities drained the earth of the moisture which had rendered it unfit for the habitation of the higher order of vertebrated creatures. Thus by degrees were formed the great

Atlantic and Pacific, the Northern and the Southern oceans, leaving here and there tracts of cool, dry land for man to inhabit at the word of his Creator. Nor did the office of the moon stop here. While it was upheld in space by the attraction of the earth, it returned the compliment by exercising a reciprocal attraction upon the waters for which it had created beds. With the beautiful regularity which is the characteristic of heavenly bodies, it affected them at uniform intervals, causing the tides to flow and to ebb, and to vibrate between the spring and the neap flow. Lastly, it relieved the earth of a vast quantity of superincumbent matter, equal, in fact, to over one-fiftieth of the whole bulk of the planet. One must imagine the earth in the condition of a gentleman who has dined copiously, and whose interior is troubled by an unusual burden; the convulsion which led to the creation of the moon is similar to the effect of the dose which the gentleman, if he be wise, will instantly take.

In departing from us, and setting up for herself, the moon forgot some articles of baggage which were essential to her future comfort and prosperity. Among these were air and water. How we came by these two useful commodities it were hard to say.

This is made quite certain by the discoveries of astronomers. Rains, dews, oceans, lakes, hail, snow, clouds, are all unknown to the moon. Nothing shields its surface from the burning rays of the sun. Wherever the light of that fierce luminary penetrates the moon's surface is incessantly hot.

Of volcanic origin, the moon is true to its descent. It is full of volcanoes, most of which, however, perhaps from a conviction of the uselessness of further action—there being nothing to destroy, and no one even to see their explosions—are now silent and torpid. But they wrought out their destiny so long and so faithfully, that the surface of the moon is frightfully disfigured and uneven. Switzerland is a prairie compared to the smoothest part of the moon's surface. It is nothing but incessant mountain and hollow. Lunar Alps and Rocky Mountains intersect every few miles of the surface. The Himalayas would be unnoticed among the gigantic ranges which ornament the lunar superficies. And the projections, mighty as they are, are but trifling in comparison with the hollows. It would seem as though the moon, with apish weakness, had tried to imitate the earth in throwing off space for rivers and oceans —forgetting that it contained no water to fill the cavities. Astronomers have made the most extraordinary discoveries in reference to these lunar hollows. Some of them appear to be about fifty miles deep, and a hun-

dred miles or so wide, with precipitous sides. Mitchell has vividly described these terrible places. Those who have looked over a precipice a few hundred feet in depth may perhaps form some rude idea of what it must be to gaze down into a hole fifty miles deep—so deep that the bottom would almost escape the eye, were there an intervening atmosphere—a great, monstrous cave, with no vegetation either on the borders or on the top, or on the sides or on the bottom; no life of any kind, not even the least sound, to break the endless monotony of silence—everywhere dull, warm scoriæ, lava, and stones of volcanic origin. But even these are the smallest of the lunar cavities. Latterly, acute astronomers, with improved instruments, have gazed into holes in the moon's surface, and estimated them to be no less than two hundred and fifty and three hundred miles deep, with fissures in them through which the sunlight penetrated.

Fancy the scene! Well may it have been termed the abomination of desolation! Surely this fair earth, with all its gloomy places and all its dreary scenes, contains nothing so overwhelming in its terrible despair as the moon. And who, gazing at its mild white face as it emerges from the cover of a cloud, would deem it so sad and desolate a sphere?

There are no "men in the moon." There cannot be, for they could not exist without air and water. 'Tis a pity, for the sight of this planet of ours, thirteen times the size which the moon appears to us, as fair, and bright, and shining as our nightly luminary, would be a sight worth seeing.

Science has made such progress, and common sense has so far kept pace with it, that the old idea that this was the only inhabited sphere in the universe is now completely exploded. There is no reason to believe that our planet is the only one in our solar system which is devoted to a useful career; nor is there any ground for imagining that our sun is the only one, of the myriad of suns we see every night, which gives light, and heat, and happiness to human creatures. On the contrary, the supreme wisdom of the Deity affords a fair presumption that this little planet of ours is but as a grain of sand among the worlds which have been created for the glory of God, and that each planet after its kind is fitted for the habitation of creatures whose office and purpose it is to thank and bless Him for their existence. Moons may be an exception for a time.

Of all this we know but little, and can only conjecture vaguely. As science advances, we may have telescopic instruments so superior to those now in use that we shall be able to decipher the moon's surface as

plainly as a distant shore on our own planet. But visits thither must ever remain as impossible as they are at present. The story of Hans Pfall will remain a brilliant imagination to the end of time.

"In consequence of the moon having no atmosphere, or but a very thin one, all celestial objects must be seen with very great distinctness. The earth, when full, appears to an inhabitant of the moon thirteen times as large as the moon appears to us; that is, its diameter is about $3\frac{6}{10}$ times as large as our apparent lunar diameter. It is always on the same part of the heaven, when seen from the same part of the moon. M. Quetelet, in his *Astronomie Elémentaire*, Paris, 1826, a very good work, which ought to be translated, has the following remarks on the appearance of the earth at the moon, which we would rather quote than vouch for, though they may possibly be well founded.

"Our vast continents, our seas, even our forests are visible to them; they perceive the enormous piles of ice collected at the poles, and the girdle of vegetation which extends on both sides of the equator; as well as the clouds which float over our heads, and sometimes hide us from them. The burning of a town or forest could not escape them, and if they had good optical instruments, they could even see the building of a new town, or the sailing of a fleet."

The lunar day, as we shall afterwards see, is equivalent to our actual month of $29\frac{1}{2}$ days: though the rotation of the moon on her axis is performed in the sidereal month of 27 days 8 hours nearly. Hence the inhabitant of the moon sees the sun for $14\frac{3}{4}$ of our days together, which time is followed by a night of the same duration. Of course the existence of any animal like man is impossible there, as well on this account as on that of the want of an atmosphere.

The phases which the earth presents to the moon are similar in appearance to those which the moon presents to the earth, but in a different order. Thus, when it is new moon at the earth, it is full earth at the moon: and the contrary. When the moon is in her first quarter, the earth is in its third quarter, and so on; while half-moon at the earth is accompanied by half-earth at the moon.

There is no branch of science better fitted to be made the leading subject of general instruction than that which relates to the planetary and sidereal universe. The truths which it reveals are so startling in their nature, and apparently so far beyond the reach of human intelligence, that men of high literary name have confessed their incapacity to understand them, and their inability to believe them. There are few, indeed, we fear, who really believe that they sojourn on a revolving

globe, and that each day and year of life is measured by its revolutions. There are few who believe that the great luminary of the firmament, whose restless activity they daily witness, is an immovable star, controlling, by its solid mass, the primary planets of our system, and forming, as it were, the gnomon of the great dial which measures the thread of life and the tenure of empires. Fewer still believe that each of the million of stars—those atoms of light which the telescope can scarcely descry—are the centres of planetary systems that may equal or surpass our own; and still smaller is the number who believe that the solid pavement of the globe upon which we nightly slumber is an elastic crust, imprisoning fires and forces which have often burst forth in tremendous energy, and are, at this very instant, struggling to escape—now finding an outlet in volcanic fires—now heaving and shaking the earth —now upraising islands and continents, and gathering strength perhaps for some final outburst which may shatter our earth in pieces, or change its form, or scatter its waters over the land. And yet these are truths than which there is nothing truer, and nothing more worthy of our study.

In order to learn, then, what is the constitution, and what has been or may be the probable history of the various worlds in our firmament, we must study the constitution and physical history of our own. The men of limited reason who believed that the earth was created and launched into its ethereal course when man was summoned to its occupation, must have either denied altogether the existence of our solar system, or have regarded all its planets as coeval with their own, and as but the ministers to its convenience. Science, however, has now corrected this error, and liberated the pious mind from its embarrassments. The Palæontologist—the student of ancient life—has demonstrated, by evidence not to be disputed, that the earth had been inhabited by animals and adorned with plants during immeasurable cycles of time antecedent to the creation of man—that when the volcano, the earthquake, and the flood, had destroyed and buried them, nobler forms of life were created to undergo the same fiery ordeal:—and that, by a series of successive creations and catastrophes, the earth was prepared for the residence of man, and the rich materials in its bosom elaborated for his use, and thrown within his grasp. In the age of our own globe, then, we see the age of its brother planets, and in the antiquity of our own system we see the antiquity of the other systems of the universe. In our catastrophes, too, we recognise theirs, and in our advancing knowledge and progressive civilization, we witness the development of the universal

mind—the march of the immortal spirit to its final destiny of glory or of shame.

The following are the names which have been given to the mountains and valleys, or hollows, in the moon, and which are referred to in the accompanying picture [See title page].

MOUNTAINS.

1. The Apennines.
2. The Caucasus.
3. The Alps.
4. Taurus.
5. Hæmus.
6. The Altai Mountains.
7. The Cordilleras.
8. The Riphæ Mountains.
9. The Carpathians.
10. The Hercynian Mountains.

HOLLOWS, OR VALLEYS.

A. The Crisian Sea.
B. The Sea of Fertility (!!).
C. The Sea of Nectar.
D. The Tranquil Sea.
E. The Serene Sea.
F. The Sea of Dreams.
G. The Sea of Death.
H. The Dreamy Marsh.
I. The Cold Sea.
K. The Sea of Vapors.
L. The Middle Bay.
M. The Sea of Clouds.
N. The Sea of Mist.
O. The Bay of Epidemics.
P. The Stormy Ocean.
Q. The Showery Sea.
R. The Sea of Rainbows.
S. The Sea of Dews.
T. Humboldt's Sea.

As will be seen, astronomers have done what they could to relieve the dreariness of nature by a free indulgence in fanciful names.

Dr. Chalmers, speaking of the advantages derived from the discovery of the telescope and microscope, says, "The one led me to see a system in every star. The other leads me to see a world in every atom. The one taught me that this mighty globe, with the whole burden of its people, and of its countries, is but a grain of sand on the high field of immensity. The other teaches me that every grain of sand may harbor within it the tribes and families of a busy population. The one told me of the insignificance of the world I tread upon. The other redeems it from all its insignificance; for it tells me that in the leaves of every forest, and in the flowers of every garden, and in the waters of every rivulet, there are worlds teeming with life, and numberless as are the glories of the firmament. The one has suggested to me that beyond

and above all that is visible to man, there may lie fields of creation which sweep immeasurably along, and carry the impress of the Almighty's hand to the remotest scenes of the universe. The other suggests to me, that within and beneath all that minuteness which the aided eye of man has been able to explore, there may lie a region of invisibles; and that, could we draw aside the mysterious curtain which shrouds it from our senses, we might there see a theatre of as many wonders as astronomy has unfolded; a universe within the compass of a point so small, as to elude all the powers of the microscope, but where the wonder-working God finds room for the exercise of all his attributes, where he can raise another mechanism of worlds, and fill and animate them all with the evidences of his glory."

Opinions of the American Press Respecting the Foregoing Discovery.

"Herschel's Great Discoveries.—We are too much pleased with the remarks of the sensible, candid, and scientific portions of the public press upon the extracts which we have published relative to these wonders of the age, to direct our attention very severely to-day to that sceptical class of our cotemporaries to whom none of these attributes can be ascribed. Consummate ignorance is always incredulous to the higher order of scientific discoveries, because it cannot possibly comprehend them. Its mental thorax is quite capacious enough to swallow any dogmas, however great, that are given upon the authority of names; but it strains most perilously to receive the great truths of reason and science. We scarcely ever knew a very ignorant person who would believe in the existence of those myriads of invisible beings which inhabit a drop of water, and every grain of dust, until he had actually beheld them through the microscope by which they are developed. Yet these very persons will readily believe in the divinity of Matthias the prophet, and in the most improbable credenda of extravagant systems of faith. The *Journal of Commerce*, for instance, says it cannot believe in these great discoveries of Dr. Herschel, yet it believes and defends the innocence of the murderer Avery. These who in a former age imprisoned Galileo for asserting *his* great discoveries with the telescope, and determined upon sentencing him to be burnt alive, nevertheless believed that Simon Magus actually flew in the air by the aid of the devil, and that when that

aid was withdrawn he fell to the ground and broke his neck. The great mechanical discoverer, Worcester, obtained no credence for his theories in his day, though they are now being continually demonstrated by practical operation. Happily, however, those who impudently and ignorantly deny the great discoveries of Herschel, are chiefly to be found among those whose faith or whose scepticism, would never be received as a guide for the opinions of other men. From among that portion of the public press whose intelligence and acquirements render them competent judges of the great scientific questions now before the community, we extract the following frank declarations of their opinions."—*New York Sun*, Sep. 1, 1835.

"No article, we believe, has appeared for years, that will command so general a perusal and publication. Sir John has added a stock of knowledge to the present age that will immortalize his name, and place it high on the page of science."—*Daily Advertiser.*

"Discoveries in the Moon.—We commence to-day the publication of an interesting article which is stated to have been copied from the *Edinburgh Journal of Science*, and which made its first appearance here in a cotemporary journal of this city. It appears to carry intrinsic evidence of being an authentic document."—*Mercantile Advertiser.*

"Stupendous Discovery in Astronomy.—We have read with unspeakable emotions of pleasure and astonishment, an article from the last *Edinburgh Scientific Journal*, containing an account of the recent discoveries of Sir John Herschel at the Cape of Good Hope."—*Albany Daily Advertiser.*

"It is quite proper that the *Sun* should be the means of shedding so much light on the *Moon.* That there should be winged people in the Moon does not strike us as more wonderful than the existence of such a race of beings on earth; and that there does or did exist such a race rests on the evidence of that most veracious of voyagers and circumstantial of chroniclers, Peter Wilkins, whose celebrated work not only gives an account of the general appearance and habits of a most interesting tribe of flying Indians, but also of all those more delicate and engaging traits which the author was enabled to discover by reason of the conjugal relations he entered into with one of the females of the winged tribe."—*N. Y. Evening Post.*

"We think we can trace in it marks of transatlantic origin."—*N. Y. Commercial Advertiser.*

"The writer (Dr. Andrew Grant) displays the most extensive and accurate knowledge of astronomy, and the description of Sir John's

recently improved instruments, the principle on which the inestimable improvements were founded, the account of the wonderful discoveries in the moon, &c., are all probable and plausible, and have an air of intense verisimilitude."—*N. Y. Times.*

"GREAT ASTRONOMICAL DISCOVERIES!—By the late arrivals from England there has been received in this country a supplement to the *Edinburgh Journal of Science* containing intelligence of the most astounding interest from Prof. Herschel's observatory at the Cape of Good Hope. . . . . The promulgation of these discoveries creates a new era in astronomy and science generally."—*New Yorker.*

"Our enterprising neighbors of the *Sun*, we are pleased to learn, are likely to enjoy a rich reward from the late *lunar* discoveries. They deserve all they receive from the public—'they are worthy.'"—*N. Y. Spirit of '76.*

"After all, however, our doubts and incredulity may be a wrong to the learned astronomer, and the circumstances of this wonderful discovery may be correct. Let us do him justice, and allow him to tell his story in his own way."—*N. Y. Sunday News.*

"The article is said to be an extract from a supplement to the *Edinburgh Journal of Science.* It sets forth difficulties encountered by Sir John, on obtaining his glass castings for his great telescope, with magnifying powers of 42,000. *The account, excepting the magnifying power, has been before published*" [*i. e.*, in the Supplement to the *Edinburgh Journal of Science.*—Ed. *Sun*].—*U. S. Gazette.*

"It is not worth while for us to express an opinion as to the truth or falsity of the narrative, as our readers can, after an attentive perusal of the whole story, decide for themselves. Whether true or false, the article is written with consummate ability, and possesses intense interest."—*Philadelphia Inquirer.*

"These are but a handful of the innumerable certificates of credence, and of complimentary testimonials with which the universal press of the country is loading our tables. Indeed, we find very few of the public papers express any other opinion. We have named the *Journal of Commerce* as an exception, because it not only ignorantly doubted the authenticity of the discoveries, but ill-naturedly said that we had fabricated them for the purpose of making a noise and drawing attention to our paper.

"Col. Webb of the *Courier and Inquirer* has said nothing upon the subject; but he only feels the more, and we are this moment assured that he has made arrangements with the proprietors of the Charleston

steam-packets to take the splendid boat William Gibbons of that line, and charter her for the Cape of Good Hope, whither he is going with all his family—including Hoskin.

"We yesterday extracted from the celebrated Supplement, a mathematical problem demonstrating an entirely new, and the only true method of measuring the height of the lunar mountains. We were not then aware of its great importance as a demonstration, also, of the authenticity of the great discoveries. But several eminent mathematicians have since called and assured us, that it is the greatest mathematical discovery of the present age. Now, that problem was either predicated by us, or by some other person, who has thereby made the greatest of all modern discoveries in mathematical astronomy. We did not make it, for we know knothing of mathematics whatever; therefore, it was made by the only person to whom it can rationally be ascribed, namely, Herschel the astronomer, its only avowed and undeniable author."—*Editor of the Sun.*

THE STORY OF The Sun.

A NEWSPAPER IS THE MOST NEARLY HUMAN OF ALL INANIMATE THINGS—
"THE STORY OF THE SUN" IS A ROMANCE FASCINATING,
ILLUMINATING, DELIGHTFUL

By Frank M. O'Brien

EDITORIAL NOTE—This is the second of a series of articles narrating the history of the New York *Sun*, and giving a vital, intimate view of New York life during more than eighty eventful years. The first article, printed last month, told of the founding of the *Sun* by Benjamin H. Day in September, 1833, of its rapid rise to success, and of the stirring days when Horace Greeley, William Cullen Bryant, and James Watson Webb were among the active journalists of New York.

THE young man whom Day met at the murder trial in White Plains was Richard Adams Locke, a reporter who was destined to kick up more dust than perhaps any other man of his profession. As he comes on the stage, we must let his predecessor, George W. Wisner, pass into the wings.

Wisner was a good man, as a reporter, as a writer of editorial articles, and as part owner of the paper. His campaign for Abolition irritated Mr. Day at first, but the young man's motives were so pure and his articles so logical that Day recognized the justice of the cause, even as he realized the foolish methods employed by some of the Abolitionists. Wisner set the face of the *Sun* against slavery, and Day kept it so, but there were minor matters of policy upon which the partners never agreed, never could agree.

When Wisner's health became poor, in the summer of 1835, he expressed a desire to get away from New York. Mr. Day paid him five thousand dollars for his interest in the paper — a large sum in those days, considering the fact that Wisner had won his share with no capital except his pen. Wisner went West and settled at Pontiac, Michigan. There his health improved, his fortune increased, and he was at one time a member of the Michigan Legislature.

When Day found that Locke was the best reporter attending the trial of Matthias the Prophet, he hired him to write a series of articles on the religious fakir. These, the first "feature stories" that ever appeared in the *Sun*, were printed on the front page.

A few weeks later, while the Matthias articles were still being sold on the streets in pamphlet form, Locke went to Day and told him that his boss, Colonel Webb of the *Courier and Enquirer*, had discharged him for working for the *Sun* "on the side." Wisner was about to leave the paper, and Day was glad to hire

Locke, for he needed a good editorial writer. Twelve dollars a week was the alluring wage, and Locke accepted it.

THE AUTHOR OF THE MOON HOAX

Locke was then thirty-five—ten years senior to his employer. Let his contemporary, Edgar Allan Poe, describe him:

> He is about five feet seven inches in height, symmetrically formed; there is an air of distinction about his whole person—the *air noble* of genius. His face is strongly pitted by the smallpox, and, perhaps from the same cause, there is a marked obliquity in the eyes; a certain calm, clear *luminousness,* however, about these latter amply compensates for the defect, and the forehead is truly beautiful in its intellectuality. I am acquainted with no person possessing so fine a forehead as Mr. Locke.

Locke was nine years older than Poe, who at this time had most of his fame ahead of him. Poe was quick to recognize the quality of Locke's writings; indeed, the poet saw, perhaps more clearly than others of that period, that America was full of good writers—a fact of which the general public was neglectful. This was Poe's tribute to Locke's literary gift:

> His prose style is noticeable for its concision, luminosity, completeness — each quality in its proper place. He has that *method* so generally characteristic of genius proper. Everything he writes is a model in its peculiar way, serving just the purposes intended and nothing to spare.

The *Sun's* new writer was a collateral descendant of John Locke, the English philosopher of the seventeenth century. Born in New York in 1800, he was educated by his mother and by private tutors until he was nineteen, when he went to England and entered Cambridge. While still a student he contributed to the *Bee,* the *Imperial Magazine,* and other English publications. In his political beliefs he was thoroughly American, and when he left Cambridge he had the hardihood to start the London *Republican,* the title of which describes its purpose. This was a failure, for London declined to warm to the theories of American democracy, no matter how scholarly their expression.

Abandoning the *Republican,* young Locke devoted himself to literature and science. He ran a periodical called the *Cornucopia* for about six months, but it was not a financial success, and in 1830 he returned to New York for good and all. Colonel Webb saw his merits, and put him at work on his paper.

Locke could write almost anything. In Cambridge and in Fleet Street he had picked up a wonderful store of general information. He could turn out prose or poetry, politics or pathos, anecdotes or astronomy.

While he lived in London, Locke was a regular reader of the Edinburgh *New Philosophical Journal,* and he brought some copies of it to America. One of these, an issue of 1826, contained an article by Dr. Thomas Dick, of Dundee, a pious man, but inclined to speculate on the possibilities of the universe. In this article Dr. Dick suggested the feasibility of communicating with the moon by means of great stone symbols on the face of the earth. The people of the moon—if there were any—would fathom the diagrams and reply in a similar way. Dr. Dick explained afterward that he wrote this piece with the idea of satirizing a certain coterie of eccentric German astronomers.

Now it happened that Sir John Frederick William Herschel, the greatest astronomer of his time, and the son of the celebrated astronomer Sir William Herschel, went to South Africa in January, 1834, and established an observatory at Feldhausen, near Cape Town, with the intention of completing his survey of the sidereal heavens by examining the southern skies as he had swept the northern, thus to make the first telescopic survey of the whole surface of the visible heavens.

Locke knew about Sir John and his mission. The Matthias case had blown over, the big fire in Fulton Street was almost forgotten, and things were a bit dull on the island of Manhattan. The newspapers were in a state of armed

truce. As Locke and his fellow journalists gathered at the American Hotel bar for their after-dinner brandy, it is probable that there was nothing, not even the great sloth recently arrived at the American Museum, to excite a good argument.

PREPARING THE WAY FOR THE HOAX

Locke needed money, for his salary of twelve dollars a week could ill support the fine gentleman that he was; so he laid a plan before Mr. Day. It was a plot as well as a plan, and the first sly angle of the plot appeared on the second page of the *Sun* on August 21, 1835:

CELESTIAL DISCOVERIES — The Edinburgh *Courant* says—"We have just learnt from an eminent publisher in this city that Sir John Herschel, at the Cape of Good Hope, has made some astronomical discoveries of the most wonderful description, by means of an immense telescope of an entirely new principle."

Nothing further appeared until Tuesday, August 25, when three columns of the *Sun's* first page took the newspaper and scientific worlds by the ears. Those were not the days of big type. The *Sun's* heading read:

GREAT ASTRONOMICAL DISCOVERIES.

LATELY MADE

BY SIR JOHN HERSCHEL, LL.D., F.R.S., &c.

At the Cape of Good Hope.

[*From Supplement to the Edinburgh Journal of Science.*]

It may as well be said here that although there had been an Edinburgh *Journal of Science,* it ceased to exist several years before 1835. The periodical to which Dr. Dick, of Dundee, contributed his moon theories was, in a way, the successor to the *Journal of Science,* but it was called the *New Philosophical Journal.* The likeness of names was not great, but enough to cause some confusion. It is also noteworthy that the sly Locke credited to a supplement, rather than to the *Journal of Science* itself, the revelations which he that day began to pour before the eyes of *Sun* readers. Thus he started:

In this unusual addition to our *Journal* we have the happiness of making known to the British public, and thence to the whole civilized world, recent discoveries in astronomy which will build an imperishable monument to the age in which we live, and confer upon the present generation of the human race proud distinction through all future time. It has been poetically said that the stars of heaven are the hereditary regalia of man as the intellectual sovereign of the animal creation. He may now fold the zodiac around him with a loftier consciousness of his mental supremacy.

After solemnly dwelling on the awe which mortal man must feel upon peering into the secrets of the sky, the article declared that Sir John "paused several hours before he commenced his observations, that he might prepare his own mind for discoveries which he knew would fill the minds of myriads of his fellow men with astonishment." It continued:

And well might he pause! From the hour the first human pair opened their eyes to the glories of the blue firmament above them, there has been no accession to human knowledge at all comparable in sublime interest to that which he has been the honored agent in supplying. Well might he pause! He was about to become the sole depository of wondrous secrets which had been hid from the eyes of all men that had lived since the birth of time.

At the end of a half-column of glorification, the writer got down to brass tacks:

To render our enthusiasm intelligible, we will state at once that by means of a telescope, of vast dimensions and an entirely new principle, the younger Herschel, at his observatory in the southern hemisphere, has already made the most extraordinary discoveries in every planet of our solar system; has discovered planets in other solar systems; has obtained a distinct view of objects in the moon, fully equal to that which the unaided eye commands of terrestrial objects at the distance of one hundred yards; has affirmatively settled the question whether this satellite be inhabited, and by what orders of beings; has firmly established a new theory of cometary phenomena; and has solved or corrected nearly every leading problem of mathematical astronomy.

And where was the *Journal of Science* getting this mine of astronomical revela-

tion for its supplement? The mystery is explained at once:

> We are indebted to the devoted friendship of Dr. Andrew Grant, the pupil of the elder, and for several years past the inseparable coadjutor of the younger Herschel. The amanuensis of the latter at the Cape of Good Hope, and the indefatigable superintendent of his telescope during the whole period of its construction and operations, Dr. Grant has been able to supply us with intelligence equal in general interest at least to that which Dr. Herschel himself has transmitted to the Royal Society. For permission to indulge his friendship in communicating this invaluable information to us, Dr. Grant and ourselves are indebted to the magnanimity of Dr. Herschel, who, far above all mercenary considerations, has thus signally honored and rewarded his fellow laborer in the field of science.

Regarding the illustrations which, according to the implications of the text, accompanied the supplement, the writer was specific. Most of them, he stated, were copies of "drawings taken in the observatory by Herbert Home, Esq., who accompanied the last powerful series of reflectors from London to the Cape. The engraving of the belts of Jupiter is a reduced copy of an imperial folio drawing by Dr. Herschel himself. The segment of the inner ring of Saturn is from a large drawing by Dr. Grant."

SOMETHING NEW IN TELESCOPY

A history of Sir William Herschel's work and a description of his telescopes took up a column of the *Sun,* and on top of this came the details—as the *Journal* printed them — of Sir John's plans to outdo his father by revolutionary methods and a greater telescope. Sir John, it appeared, was in conference with Sir David Brewster:

> After a few minutes' silent thought, Sir John diffidently inquired whether it would not be possible to effect a *transfusion of artificial light through the focal object of vision!* Sir David, somewhat startled at the originality of the idea, paused a while, and then hesitatingly referred to the refrangibility of rays and the angle of incidence. Sir John, grown more confident, adduced the example of the Newtonian reflector, in which the refrangibility was corrected by the second speculum and the angle of incidence restored by the third.
>
> "And," continued he, "why cannot the illuminated microscope, say the hydro-oxygen, be applied to render distinct and, if necessary, even to magnify, the focal object?"
>
> Sir David sprang from his chair in an ecstasy of conviction, and, leaping half-way to the ceiling, exclaimed:
>
> "Thou art the man!"

Details of the casting of a great lens came next. It was twenty-four feet in diameter, and weighed nearly fifteen thousand pounds after it was polished; its estimated magnifying-power was forty-two thousand times. As he saw it safely started on its way to Africa, Sir John "expressed confidence in his ultimate ability to study even the entomology of the moon, in case she contained insects upon her surface."

Thus ended the first instalment of the story. Where had the *Sun* got the *Journal of Science* supplement? An editorial article answered that "it was very politely furnished us by a medical gentleman immediately from Scotland, in consequence of a paragraph which appeared on Friday last from the Edinburgh *Courant.*" The article added:

> The portion which we publish to-day is introductory to celestial discoveries of higher and more universal interest than any, in any science yet known to the human race. Now indeed it may be said that we live in an age of discovery.

It cannot be said that the whole town buzzed with excitement that day. Perhaps this first instalment was a bit over the heads of most readers; it was so technical, so foreign. But in Nassau and Ann Streets, wherever two newspapermen were gathered together, there was buzzing enough. What was coming next? Why hadn't they thought to subscribe to the Edinburgh *Journal of Science,* with its wonderful supplement?

As Mr. Day and his new writer, Mr. Locke, dropped into Tammany Hall for their afternoon refreshment, doubtless envious eyes were cast upon them. Per-

haps they drank to "a medical gentleman immediately from Scotland."

THE SECOND INSTALMENT OF THE HOAX

Nearly four columns of the revelations appeared on the following day—August 26, 1835. This time the reading public came trooping into camp, for the *Sun's* reprint of the *Journal of Science* supplement got beyond the stage of preliminaries and predictions, and began to tell of what was to be seen on the moon. Scientists and newspapermen appreciated the detailed description of the mammoth telescope and the work of placing it, but the public, like a child, wanted the moon—and got it. Let us plunge in at about the point where the public plunged:

The specimen of lunar vegetation, however, which they had already seen, had decided a question of too exciting an interest to induce them to retard its exit. It had demonstrated that the moon has an atmosphere constituted similarly to our own, and capable of sustaining organized and, therefore, most probably, animal life.

"The trees," says Dr. Grant, "for a period of ten minutes were of one unvaried kind, and unlike any I have seen except the largest class of yews in the English churchyards, which they in some respects resemble. These were followed by a level green plain which, as measured by the painted circle on our canvas of forty-nine feet, must have been more than half a mile in breadth."

The article had explained that, by means of a great reflector, the lunar views were thrown upon a big canvas screen behind the telescope.

Then appeared as fine a forest of firs, unequivocal firs, as I have ever seen cherished in the bosom of my native mountains. Wearied with the long continuance of these, we greatly reduced the magnifying power of the microscope without eclipsing either of the reflectors, and immediately perceived that we had been insensibly descending, as it were, a mountainous district of highly diversified and romantic character, and that we were on the verge of a lake, or inland sea; but of what relative locality or extent, we were yet too greatly magnified to determine.

On introducing the feeblest achromatic lens we possessed, we found that the water, whose boundary we had just discovered, answered in general outline to the Mare Nubicum of Riccoli. Fairer shores never angel coasted on a tour of pleasure. A beach of brilliant white sand, girt with wild, castellated rocks, apparently of green marble, varied at chasms, occurring every two or three hundred feet, with grotesque blocks of chalk or gypsum, and feathered and festooned at the summits with the clustering foliage of unknown trees, moved along the bright wall of our apartment until we were speechless with admiration.

A column farther on, in a wonderful valley of this wonderful moon, life at last burst upon the seers:

In the shade of the woods on the south-eastern side we beheld continuous herds of brown quadrupeds, having all the external characteristics of the bison, but more diminutive than any species of the *bos* genus in our natural history. Its tail was like that of our *bos grunniens;* but in its semicircular horns, the hump on its shoulders, the depth of its dewlap, and the length of its shaggy hair, it closely resembled the species to which I have compared it.

It had, however, one widely distinctive feature, which we afterward found common to nearly every lunar quadruped we have discovered; namely, a remarkable fleshy appendage over the eyes, crossing the whole breadth of the forehead and united to the ears. We could most distinctly perceive this hairy veil, which was shaped like the upper front outline of the cap known to the ladies as Mary Queen of Scots cap, lifted and lowered by means of the ears. It immediately occurred to the acute mind of Dr. Herschel that this was a providential contrivance to protect the eyes of the animal from the great extremes of light and darkness to which all the inhabitants of our side of the moon are periodically subjected.

The next animal perceived would be classed on earth as a monster. It was of a bluish lead color, about the size of a goat, with a head and beard like him, and a *single horn,* slightly inclined forward from the perpendicular. The female was destitute of the horn and beard, but had a much longer tail. It was gregarious, and chiefly abounded on the acclivitous glades of the woods. In elegance of symmetry it rivaled the antelope, and like him it seemed an agile, sprightly creature, running with great speed and springing from the green turf with all the unaccountable antics of the young lamb or kitten.

This beautiful creature afforded us the most exquisite amusement. The mimicry of its movements upon our white-painted canvas was as faithful and luminous as that of animals within a few yards of a camera obscura when seen

pictured upon its tympan. Frequently, when attempting to cut our fingers upon its beard, it would suddenly bound away into oblivion, as if conscious of our earthly impertinence; but then others would appear, whom we could not prevent nibbling the herbage, say or do what we would to them.

So, at last, the people of earth knew something concrete about the live things of the moon. Goats with beards were there, and every New Yorker knew goats, for they fed upon the rocky hills of Harlem. And the moon had birds, too:

On examining the center of this delightful valley we found a large, branching river, abounding with lovely islands and water-birds of numerous kinds. A species of gray pelican was the most numerous, but black and white cranes, with unreasonably long legs and bill, were also quite common. We watched their piscivorous experiments a long time in hopes of catching sight of a lunar fish; but, although we were not gratified in this respect, we could easily guess the purpose with which they plunged their long necks so deeply beneath the water. Near the upper extremity of one of these islands we obtained a glimpse of a strange amphibious creature of a spherical form, which rolled with great velocity across the pebbly beach, and was lost sight of in the strong current which set off from this angle of the island.

At this point clouds intervened, and the Herschel party had to call it a day. But it had been a big day, and nobody who read the *Sun* wondered that the astronomers tossed off "congratulatory bumpers of the best 'East India particular,' and named this place of wonders the Valley of the Unicorn." So ended the *Sun* story of August 26, but an editorial paragraph assured the patrons of the paper that on the morrow there would be a treat even richer.

THE RECEPTION OF THE HOAX

What did the other papers say? In the language of a later and less elegant period, they ate it up — some eagerly, some grudgingly, some a bit dubiously, but they ate it, either in crumbs or in hunks. The *Daily Advertiser* declared:

No article has appeared for years that will command so general a perusal and publication. Sir John has added a stock of knowledge to the present age that will immortalize his name and place it high on the page of science.

The *Mercantile Advertiser,* knowing that its lofty readers were unlikely to see the moon revelations in the lowly *Sun,* hastened to begin reprinting the articles *in toto,* with the remark that the document appeared to have intrinsic evidence of authenticity.

The *Times,* a daily then only a year old, and destined to live only eighteen months more—later, of course, the title was used by a successful daily—said that everything in the *Sun* story was probable and plausible, and had an "air of intense verisimilitude."

The New York *Sunday News* advised the incredulous to be patient:

Our doubts and incredulity may be a wrong to the learned astronomer, and the circumstances of this wonderful discovery may be correct.

The *Courier and Enquirer* said nothing at all. Like the *Journal of Commerce,* it hated the *Sun* for a lucky upstart. Both of these sixpenny respectables stood silent, with their axes behind their backs. Their own readers, the Livingstons and the Stuyvesants, got not a line about the moon from the blanket sheets, but they sent down into the kitchen and borrowed the *Sun* from the domestics, on the shallow pretext of wishing to discover whether their employees were reading a moral newspaper—as indeed they were.

The *Herald,* then about four months old, said not a word about the moon story. In fact, that was a period in which it said nothing at all about any subject, for the fire of that summer had unfortunately wiped out its plant. On the very days when the moon stories appeared, Mr. Bennett stood cracking his knuckles in front of his new establishment, the basement of 202 Broadway, trying to hurry the men who were installing a double-cylinder press. Being a wise person, he advertised his progress in the *Sun.* It may have vexed him to see the circula-

tion of the *Sun*—which he had imitated in character and price—bound higher and higher as he stood helpless.

A THIRD BUDGET OF LUNAR MARVELS

The third instalment of the literary treasure so obligingly imported by the "medical gentleman immediately from Scotland" introduced to *Sun* readers new and important regions of the moon—the Vagabond Mountains, the Lake of Death, craters of extinct volcanoes twenty-eight hundred feet high, and twelve luxuriant forests divided by open plains "in which waved an ocean of verdure, and which were probably prairies like those of North America." The details were satisfying:

> Dr. Herschel has classified not less than thirty-eight species of forest trees and nearly twice this number of plants, found in this tract alone, which are widely different to those found in more equatorial latitudes. Of animals he classified nine species of mammalia and five of oviparia. Among the former is a small kind of reindeer, the elk, the moose, the horned bear, and the biped beaver.
>
> The last resembles the beaver of the earth in every other respect than its destitution of a tail and its invariable habit of walking upon only two feet. It carries its young in its arms, like a human being, and walks with an easy, gliding motion. Its huts are constructed better and higher than those of many tribes of human savages, and from the appearance of smoke in nearly all of them there is no doubt of its being acquainted with the use of fire.

The largest lake described was two hundred and sixty-six miles long and one hundred and ninety-three wide, shaped like the Bay of Bengal, and studded with volcanic islands. One island in a large bay was pinnacled with quartz crystals as brilliant as fire. Near by roamed zebras three feet high. Golden and blue pheasants strutted about. The beach was covered with shell-fish. Dr. Grant did not say whether the fire-making beavers ever held a clambake there.

The *Sun* of Friday, August 28, 1835, was a notable issue. Not yet two years old, Mr. Day's newspaper had the satisfaction of announcing that it had achieved the largest circulation of any daily in the world. It had, it said, 15,440 regular subscribers in New York and 700 in Brooklyn, and it sold 2,000 in the streets and 1,220 out of town—a grand total of 19,360 copies, as against the 17,000 circulation of the London *Times*. The double-cylinder Napier press in the building at Nassau and Spruce Streets — the corner where the *Tribune* is to-day, and to which the *Sun* had moved on August 3—had to run ten hours a day to satisfy the public demand. People waited with more or less patience until three o'clock in the afternoon to read about the moon.

THE FIRST SIGHT OF THE MAN-BATS

That very issue contained the most sensational instalment of all the moon series, for through that mystic chain which included Dr. Grant, the supplement of the Edinburgh *Journal of Science,* the "medical gentleman immediately from Scotland," and the *Sun,* public curiosity as to the presence of human creatures on the orb of night was satisfied at last. The astronomers were looking upon the cliffs and crags of a new part of the moon:

> But whilst gazing upon them in a perspective of about half a mile, we were thrilled with astonishment to perceive four successive flocks of large winged creatures, wholly unlike any kind of birds, descend with a slow, even motion from the cliffs on the western side and alight upon the plain. They were first noticed by Dr. Herschel, who exclaimed:
>
> "Now, gentlemen, my theories against your proofs, which you have often found a pretty even bet, we have here something worth looking at. I was confident that if ever we found beings in human shape it would be in this longitude, and that they would be provided by their Creator with some extraordinary powers of locomotion. First, exchange for my Number D."
>
> This lens, being soon introduced, gave us a fine half-mile distance; and we counted three parties of these creatures, of twelve, nine, and fifteen in each, walking erect toward a small wood near the base of the eastern precipices. Certainly they were like human beings, for their wings had now disappeared, and their attitude in walking was both erect and dignified.
>
> Having observed them at this distance for some minutes, we introduced lens H.z., which brought them to the apparent proximity of

eighty yards—the highest clear magnitude we possessed until the latter end of March, when we effected an improvement in the gas burners.

About half of the first party had passed beyond our canvas; but of all the others we had a perfectly distinct and deliberate view. They averaged four feet in height, were covered, except on the face, with short and glossy copper-colored hair, and had wings composed of a thin membrane, without hair, lying snugly upon their backs, from the top of the shoulders to the calves of the legs.

The face, which was of a yellowish flesh-color, was a slight improvement upon that of the large orang-utan, being more open and intelligent in its expression, and having a much greater expanse of forehead. The mouth, however, was very prominent, though somewhat relieved by a thick beard upon the lower jaw, and by lips far more human than those of any species of the *Simia* genus.

In general symmetry of body and limbs they were infinitely superior to the orang-utan; so much so that, but for their long wings, Lieutenant Drummond said they would look as well on a parade-ground as some of the old cockney militia. The hair on the head was a darker color than that of the body, closely curled, but apparently not woolly, and arranged in two curious semicircles over the temples of the forehead. Their feet could only be seen as they were alternately lifted in walking; but from what we could see of them in so transient a view, they appeared thin and very protuberant at the heel.

Whilst passing across the canvas, and whenever we afterward saw them, these creatures were evidently engaged in conversation; their gesticulation, more particularly the varied action of the hands and arms, appeared impassioned and emphatic. We hence inferred that they were rational beings, and, although not perhaps of so high an order as others which we discovered the next month on the shores of the Bay of Rainbows, that they were capable of producing works of art and contrivance.

The next view we obtained of them was still more favorable. It was on the borders of a little lake, or expanded stream, which we then for the first time perceived running down the valley to the large lake, and having on its eastern margin a small wood. Some of these creatures had crossed this water and were lying like spread eagles on the skirts of the wood.

We could then perceive that their wings possessed great expansion, and were similar in structure to those of the bat, being a semi-transparent membrane expanded in curvilineal divisions by means of straight radii, united at the back by the dorsal integuments. But what astonished us very much was the circumstance of this membrane being continued from the shoulders to the legs, united all the way down, though gradually decreasing in width. The wings seemed completely under the command of volition, for those of the creatures whom we saw bathing in the water spread them instantly to their full width, waved them as ducks do theirs to shake off the water, and then as instantly closed them again in a compact form.

Our further observation of the habits of these creatures, who were of both sexes, led to results so very remarkable that I prefer they should be first laid before the public in Dr. Herschel's own work, where I have reason to know that they are fully and faithfully stated, however incredulously they may be received. . . .

The three families then almost simultaneously spread their wings, and were lost in the dark confines of the canvas before we had time to breathe from our paralyzing astonishment. We scientifically denominated them the *vespertilio-homo,* or man-bat; and they are doubtless innocent and happy creatures, notwithstanding some of their amusements would but ill comport with our terrestrial notions of decorum.

So ended the account, in Dr. Grant's words, of that fateful day. The editor of the supplement, perhaps a cousin of the "medical gentleman immediately arrived from Scotland," added that although he had of course faithfully obeyed Dr. Grant's injunction to omit "these highly curious passages," he did not "clearly perceive the force of the reasons assigned for it," and he added:

> From these, however, and other prohibited passages, which will be published by Dr. Herschel with the certificates of the civil and military authorities of the colony, and of several Episcopal, Wesleyan, and other ministers who, in the month of March last, were permitted under the stipulation of temporary secrecy to visit the observatory and become eye-witnesses of the wonders which they were requested to attest, we are confident his forthcoming volumes will be at once the most sublime in science and the most intense in general interest that ever issued from the press.

New York now stopped about all discussion of human slavery, the high cost of living — apples cost as much as four cents apiece in Wall Street — and other familiar topics, and devoted its talking hours to the man-bats of the moon. The *Sun* was stormed by people who wanted back numbers of the stories, and flooded

with demands by mail. As the text of the *Journal of Science* article indicated that the original narrative had been illustrated, there was a cry for pictures.

Mr. Day was busy with the paper and its overworked press, but he gave Mr. Locke a free hand, and that scholar took to Norris & Baker, lithographers, in the Union Building, Wall Street, the drawings which had been entrusted to his care by the "medical gentleman immediately from Scotland." Mr. Baker, described by the *Sun* as quite the most talented lithographic artist of the city, worked day and night on his delightful task, that the illustrations might be ready when the *Sun's* press should have turned out, in the hours when it was not printing *Suns,* a pamphlet containing the astronomical discoveries.

"Dr. Herschel's great work," said the *Sun,* "is preparing for publication at ten guineas sterling, or fifty dollars; and we shall give all the popular substance of it for twelve or thirteen cents." The pamphlets were to be sold two for a quarter; the lithographs at twenty-five cents for the set.

Most newspapers that mentioned the discovery of human creatures on the moon were credulous. The *Evening Post,* edited by William Cullen Bryant and Fitz-Greene Halleck — "the chanting cherubs of the *Post,*" as Colonel Webb was wont to call them—only skirted the edge of doubt:

> That there should be winged people in the moon does not strike us as more wonderful than the existence of such a race of beings on earth; and that there does or did exist such a race rests on the evidence of that most veracious of voyagers, *Peter Wilkins,* whose celebrated work not only gives an account of the general appearance and habits of a most interesting tribe of flying Indians, but also of those more delicate and engaging traits which the author was enabled to discover by reason of the conjugal relations he entered into with one of the females of the winged tribe.

Peter Wilkins was the hero of Robert Paltock's imaginative book, "The Life and Adventures of Peter Wilkins, a Cornish Man," published in London in 1750. Paltock's winged people, said Southey, were "the most beautiful creatures of imagination that were ever devised."

THE WONDROUS TEMPLE OF THE MOON

The instalment of the discoveries printed on August 29 revealed to the reader the great Temple of the Moon, built of polished sapphire, with a roof of some yellow metal, supported by columns seventy feet high and six feet in diameter:

> It was open on all sides, and seemed to contain neither seats, altars, nor offerings, but it was a light and airy structure, nearly a hundred feet high from its white, glistening floor to the glowing roof, and it stood upon a round, green eminence on the eastern side of the valley. We afterward, however, discovered two others which were in every respect facsimiles of this one; but in neither did we perceive any visitants except flocks of wild doves, which alighted on its lustrous pinnacles.
>
> Had the devotees of these temples gone the way of all living, or were the latter merely historical monuments? What did the ingenious builders mean by the globe surrounded with flames? Did they, by this, record any past calamity of *their* world, or predict any future one of *ours?* I by no means despair of ultimately solving not only these, but a thousand other questions which present themselves respecting the object in this planet; for not the millionth part of her surface has yet been explored, and we have been more desirous of collecting the greatest possible number of new facts than of indulging in speculative theories, however seductive to the imagination.

The conclusion of this astounding narrative, which totaled eleven thousand words, was printed on August 31. In the valley of the temple a new set of man-bats was found:

> We had no opportunity of seeing them actually engaged in any work of industry or art; and, so far as we could judge, they spent their happy hours in collecting various fruits in the woods, in eating, flying, bathing, and loitering about upon the summits of precipices.

One night, when the astronomers finished work, they neglectfully left the

telescope in a perpendicular position. The risen sun burned a hole fifteen feet in circumference through the reflecting chamber, and ruined part of the observatory. When the damage was repaired, the moon was invisible, and so Dr. Herschel turned his attention to Saturn. Much of the discoveries here were technical, as the *Sun* assured its readers, and the narrative came to an end. An editorial note added:

> This concludes the supplement with the exception of forty pages of illustrative and mathematical notes, which would greatly enhance the size and price of this work without commensurably adding to its general interest. In order that our readers may judge for themselves whether we have withheld from them any matter of general comprehension and interest, we insert one of the notes from those pages of the supplement which we thought it useless to reprint; and it may be considered a fair sample of the remainder. For ourselves, we know nothing of mathematics beyond counting dollars and cents, but to geometricians the following new method of measuring the height of the lunar mountains, adopted by Sir John Herschel, may be quite interesting.

BAFFLED TRUTH-SEEKERS FROM YALE

Perhaps the pretended method of measuring lunar mountains was not interesting to laymen, but it may have been the cause of an intellectual tumult at Yale. At all events, a deputation from that college hurried to the steamboat and came to New York to see the wonderful supplement. The collegians saw Mr. Day, and voiced their desire.

"Surely," he replied, "you do not doubt that we have the supplement in our possession? I suppose the magazine is somewhere up-stairs, but I consider it almost an insult that you should ask to see it."

On their way out the Yale men heard, perhaps from the "devil," that one Locke was interested in the matter of the moon, that he had handled the supplement, and that he was to be seen at the foot of the stairs, smoking his cigar and gazing across City Hall Park. They advanced upon him, and he, less brusk than Mr. Day, told the scientific pilgrims that the supplement was in the hands of a printer in William Street — giving the name and address.

As the Yale men disappeared in the direction of the printery, Locke started for the same goal, and more rapidly. When the Yalensians arrived, the printer, primed by Locke, told them that the precious pamphlet had just been sent to another shop, where certain proof-reading was to be done. And so they went from post to pillar until the hour came for their return to New Haven. It would not do to linger in New York, for Professors Denison Olmsted and Elias Loomis were that very day getting their first peep at Halley's comet, about to make the regular appearance with which it favors the earth every seventy-six years.

But Yale was not the only part of intellectual New England to be deeply interested in the moon and its bat-men. The *Gazette* of Hampshire, Massachusetts, insisted that Edward Everett, who was then running for Governor, had these astronomical discoveries in mind when he declared that "we know not how soon the mind, in its researches into the labyrinth of nature, would grasp some clue which would lead to a new universe and change the aspect of the world."

Harriet Martineau, who was touring America at the time, wrote in her "Sketches of Western Travel" that the ladies of Springfield, Massachusetts, subscribed to a fund to send missionaries to the benighted luminary. When the *Sun* articles reached Paris, they were at once translated into illustrated pamphlets, and the caricaturists of the Paris newspapers drew pictures of the man-bats going through the streets singing "*Au Clair de la Lune.*" London, Edinburgh, and Glasgow made haste to issue editions of the work.

Meanwhile, of course, Sir John Herschel was busy with his telescope at the Cape, all unaware of his expanded fame in the north. Caleb Weeks, of Jamaica, Long Island, the Adam Forepaugh of his

day, was setting out for South Africa to get a supply of giraffes for his menagerie, and he had the honor of laying in the great astronomer's hand a clean copy of the pamphlet. To say that Sir John was amazed at the *Sun's* enterprise would be putting it mildly. When he had read the story through, he went to Caleb Weeks and said that he was overcome; that he never could hope to live up to the fame that had been heaped upon him.

HOW THE SECRET LEAKED OUT

In New York, meanwhile, Richard Adams Locke had spilled the beans. There was a reporter named Finn, once employed by the *Sun,* but later a scribe for the *Journal of Commerce.* He and Locke were friends. One afternoon Gerard Hallock, who was David Hale's partner in the proprietorship of the *Journal of Commerce,* called Finn to his office and told him to get extra copies of the *Sun* containing the moon story, as the *Journal* had decided, in justice to its readers, that it must reprint it.

Perhaps at the *Sun* office, perhaps in the tap-room of the Washington Hotel, Finn met Locke, and they went socially about to public places. Finn told Locke of the work on which he was engaged, and said that, as the moon story was already being put into type at the *Journal* office, it was likely that it would be printed on the morrow.

"Don't print it right away," said Locke. "I wrote it myself."

The next day the *Journal,* instead of being silently grateful for the warning, denounced the alleged discoveries as a hoax. Mr. Bennett, who by this time had the *Herald* once more in running order, not only cried "Hoax!" but named Locke as the author.

Probably Locke was glad that the suspense was over. He is said to have told a friend that he had not intended the story as a hoax, but as satire.

"It is quite evident," he said, as he saw the whole country take the marvelous narrative seriously, "that it is an abortive satire; and I am the best self-hoaxed man in the whole community."

But while the *Sun's* rivals denounced the hoax, the *Sun* was not quick to admit that it had gulled not only its own readers but almost all the scientific world. Barring the casual conversation between Locke and Finn, there was no evidence plain enough to convince the layman that it was a hoax. The *Sun* fenced lightly and skilfully with all controverters. On September 16, more than two weeks after the conclusion of the story, it printed a long editorial article on the subject of the authenticity of the discoveries, mentioning the wide-spread interest that had been displayed in them:

> Most of those who incredulously regard the whole narrative as a hoax are generously enthusiastic in panegyrizing not only what they are pleased to denominate its ingenuity and talent, but also its useful effect in diverting the public mind, for a while, from that bitter apple of discord, the abolition of slavery, which still unhappily threatens to turn the milk of human kindness into rancorous gall. That the astronomical discoveries have had this effect is obvious from our exchange papers. Who knows, therefore, whether these discoveries in the moon, with the visions of the blissful harmony of her inhabitants which they have revealed, may not have had the effect of reproving the discords of a country which might be happy as a paradise, which has valleys not less lovely than those of the Ruby Colosseum, of the Unicorn, or of the Triads; and which has not inferior facilities for social intercourse to those possessed by the *vespertiliones-homines,* or any other *homines* whatever?
>
> Some persons of little faith but great good nature, who consider the "moon story," as it is vulgarly called, an adroit fiction of our own, are quite of the opinion that this was the amiable moral which the writer had in view. Other readers, however, construe the whole as an elaborate satire upon the monstrous fabrications of the political press of the country and the various genera and species of its party editors. In the blue goat with the single horn, mentioned as it is in connexion with the royal arms of England, many persons fancy they perceive the characteristics of a notorious foreigner who is the supervising editor of one of our largest morning papers.
>
> We confess that this idea of intended satire somewhat shook our own faith in the genuineness of the extracts from the Edinburgh *Journal*

of Science with which a gentleman connected with our office furnished us as "from a medical gentleman immediately from Scotland."

Certain correspondents have been urging us to come out and confess the whole to be a hoax; but this we can by no means do until we have the testimony of the English or Scotch papers to corroborate such a declaration. In the mean time let every reader of the account examine it and enjoy his own opinion. Many intelligent and scientific persons will believe it true, and will continue to do so to their lives' end; whilst the skepticism of others would not be removed though they were in Dr. Herschel's observatory itself.

THE MOON HOAX ON THE STAGE

The New York showmen of that day were keen for novelty, and the moon story helped them to it. Mr. Hannington, who ran the diorama in the City Saloon —which was not a barroom, but an amusement house—on Broadway opposite St. Paul's Church, put on "The Lunar Discoveries; a Brilliant Illustration of the Scientific Observation of the Surface of the Moon, to Which Will Be Added the Reported Lunar Observations of Sir John Herschel." Hannington had been showing "The Deluge" and "The Burning of Moscow," but the wonders of the moon proved to be far more attractive to his patrons. The *Sun* approved of this moral spectacle:

> Hannington forever and still years afterward, say we! His panorama of the lunar discoveries, in connexion with the beautiful dioramas, are far superior to any other exhibition in this country.

Not less popular than Hannington's panorama was an extravaganza put on by Thomas Hamblin at the Bowery Theater, and called "Moonshine, or Lunar Discoveries." A *Sun* man went to review it, and had to stand up; but he was patient enough to stay, and he wrote this about the show:

> It is quite evident that Hamblin does not believe a word of the whole story, or he would never have taken the liberties with it which he has. The wings of the man-bats and lady-bats, who are of an orange color and look like angels in the jaundice, are well contrived for effect; and the dialogue is highly witty and pungent. Major Jack Downing's blowing up a whole flock of winged lunarians with a combustible bundle of Abolition tracts, after vainly endeavoring to catch a long aim at them with his rifle, is capital; as are also his puns and jokes upon the splendid scenery of the Ruby Colosseum. Take it altogether, it is the most amusing thing that has been on these boards for a long time.

Thus the moon eclipsed the regular stars of the New York stage. Even Mrs. Duff, the most pathetic *Isabella* that ever appeared in "The Fatal Marriage," saw her audiences thin out at the Franklin Theater. Sol Smith's drolleries in "The Lying Valet," at the Park Theater, could not rouse the laughter that the burlesque man-bats caused at the Bowery.

POE AND LOCKE—A CURIOUS PARALLEL

All this time there was a disappointed man in Baltimore; disappointed because the moon stories had caused him to abandon one of the most ambitious stories he had attempted. This was Edgar Allan Poe, and the story he dropped was "Hans Pfaall."

In the spring of 1835 the Harpers issued an edition of Sir John Herschel's "Treatise on Astronomy," and Poe, who read it, was deeply interested in the chapter on the possibility of future lunar investigations:

> The theme excited my fancy, and I longed to give free rein to it in depicting my day-dreams about the scenery of the moon; in short, I longed to write a story embodying these dreams. The obvious difficulty, of course, was that of accounting for the narrator's acquaintance with the satellite; and the equally obvious mode of surmounting the difficulty was the supposition of an extraordinary telescope.

Poe spoke of this ambition to John Pendleton Kennedy, of Baltimore, already the author of "Swallow Barn," and later to have the honor of writing, as the result of a jest by Thackeray, the fourth chapter of the second volume of "The Virginians." Kennedy assured Poe that the mechanics of telescope construction were

so fixed that it would be impossible to impart verisimilitude to a tale based on a superefficient telescope. So Poe resorted to other means of bringing the moon close to the reader's eye:

> I fell back upon a style half plausible, half bantering, and resolved to give what interest I could to an actual passage from the earth to the moon, describing the lunar scenery as if surveyed and personally examined by the narrator.

Poe wrote the first part of "Hans Pfaall," and published it in the *Southern Literary Messenger,* of which he was then editor, at Richmond, Virginia. Three weeks afterward the first instalment of Locke's moon story appeared in the *Sun.* At the moment Poe believed that his idea had been kidnaped:

> No sooner had I seen the paper than I understood the jest, which not for a moment could I doubt had been suggested by my own *jeu d'esprit.* Some of the New York journals—the *Transcript,* among others—saw the matter in the same light, and published the moon story side by side with "Hans Pfaall," thinking that the author of the one had been detected in the author of the other.
>
> Although the details are, with some exceptions, very dissimilar, still I maintain that the general features of the two compositions are nearly identical. Both are hoaxes—although one is in a tone of mere banter, the other of downright earnest; both hoaxes are on one subject, astronomy; both on the same point of that subject, the moon; both professed to have derived exclusive information from a foreign country; and both attempt to give plausibly by minuteness of scientific detail. Add to all this, that nothing of a similar nature had ever been attempted before these two hoaxes, the one of which followed immediately upon the heels of the other.
>
> Having stated the case, however, in this form, I am bound to do Mr. Locke the justice to say that he denies having seen my article prior to the publication of his own; I am bound to add, also, that I believe him.

Nor can any unbiased person who reads, for purpose of comparison, the "Astronomical Discoveries" and "Hans Pfaall" suspect that Locke based his hoax on the story of the Rotterdam debtor who blew his creditors to bits and sailed to the moon in a balloon. Chalk and cheese are much more alike than these two products of genius.

Poe may have intended to fall back upon "a style half plausible, half bantering," as he described it, but there is not the slightest plausibility about "Hans Pfaall." It is as near to humor as the great, dark mind could get. "Mere banter," as he later described it, is better. The very episode of the dripping pitcher of water, used to wake *Hans* at an altitude where even alcohol would freeze, is enough proof, if proof at all were necessary, to strip the tale of its last shred of verisimilitude. No child of twelve would believe in *Hans,* while Locke's fictitious "Dr. Grant" deceived nine-tenths — the estimate is Poe's—of those who read the narrative of the great doings at the Cape of Good Hope.

Locke had spoiled a promising tale for Poe—who tore up the second instalment of "Hans Pfaall" when he "found that he could add very little to the minute and authentic account of Sir John Herschel" —but the poet took pleasure, in later years, in picking the *Sun's* moon story to bits.

"That the public were misled, even for an instant," Poe declared in his critical essay on Locke's writings, "merely proves the gross ignorance which, ten or twelve years ago, was so prevalent on astronomical topics."

According to Locke's own description of the telescope, said Poe, it could not have brought the moon nearer than five miles; yet Sir John—Locke's Sir John—saw flowers and described the eyes of birds. Locke had an ocean on the moon, although it had been established beyond question that the visible side of the moon is dry. The most ridiculous thing about the moon story, said Poe, was that the narrator described the entire bodies of the man-bats, whereas, if they were seen at all by an observer on the earth, they would manifestly appear as if walking heels up and head down, after the fashion of flies on a ceiling.

And yet the hoax, Poe admits, "was, upon the whole, the greatest hit in the way of sensation — of merely popular sensation — ever made by any similar fiction either in America or Europe." Whether Locke intended it as satire or not — a debatable point — it was a hoax of the first water. It deceived more persons, and for a longer time, than any other fake ever written; and, as the *Sun* pointed out, it hurt nobody—except, perhaps, the feelings of Dr. Dick, of Dundee —and it took the public mind away from less agreeable matters. Some of the wounded scientists roared, but the public, particularly the New York public, took the exposure of Locke's literary villainy just as Sir John Herschel accepted it—with a grin.

EARLIER SUGGESTIONS OF THE STORY

As for the inspiration of the moon story, the record is nebulous. If Poe was really grieved at his first thought that Locke had taken from him the main imaginative idea—that the moon was inhabited—then Poe was oversensitive or uninformed, for that idea was at least two centuries old.

Francis Godwin, an English bishop and author, who was born in 1562, and who died just two centuries before the *Sun* was first printed, wrote "The Man in the Moone, or a Discourse of a Voyage Thither by Domingo Gonsales, the Speedy Messenger." This was published in London in 1638, three years after the author's death.

In the same year there appeared a book called "The Discovery of a World in the Moone," which contained arguments to prove the moon habitable. It was written by John Wilkins — no relative of the fictitious *Peter* of Paltock's story, but a young English clergyman who later became Bishop of Chester, and who was the first secretary of the Royal Society. Two years later Wilkins added to his "Discovery of a World" a "Discourse Concerning the Possibility of a Passage Thither."

Cyrano de Bergerac, he of the long nose and the passion for poetry and dueling, later to be immortalized by Rostand, read these products of two Englishmen's fancy, and about 1650 he turned out his joyful "Histoire Comique des États et Empires de la Lune." But Bergerac had also been influenced by Dante and by Lucian, the latter being the supposed inspiration of the fanciful narratives of Rabelais and Swift. Perhaps these writers influenced Godwin and Wilkins also; so the trail, zigzagged and ramifying, goes back to the second century. It is hard to indict a man for being inspired, and in the case of the moon story there is no evidence of plagiarism. If "Hans Pfaall" were to be compared with Locke's story for hoaxing qualities, it would only suffer by the comparison. It would appear as the youthful product of a tyro, as against the cunning work of an artist of almost devilish ingenuity.

Is there any doubt that the moon hoax was the sole work of Richard Adams Locke? So far as concerns the record of the *Sun*, the comments of Locke's American contemporaries, and the belief of Benjamin H. Day, expressed in 1883 in a talk with Edward P. Mitchell, the answer must be in the negative. Yet it must be set down, as a literary curiosity at least, that it has been believed in France and by at least one English antiquary of repute that the moon hoax was the work of a Frenchman — Jean Nicolas Nicollet, the astronomer.

THE CAREER OF JEAN NICOLLET

Nicollet was born at Cluses, in Savoy, in 1786. First a cowherd, he did not learn to read until he was twelve. Once at school his progress was rapid, and at nineteen he became preceptor of mathematics at Chambry. He went to Paris, where in 1817 he was appointed secretary-librarian of the Observatory, and he studied astronomy with Laplace, who refers to Nicollet's assistance in his works. In 1823 he was appointed to the government bureau of longitudes, and at the

same time was professor of mathematics in the College of Louis le Grand.

He became a master of English, and through this knowledge and his own mathematical genius he was able to assemble, for the use of the French life-insurance companies, all that was known, and much that he himself discovered, of actuarial methods; this being incorporated in his letter to M. Outrequin on "Assurances Having for Their Basis the Probable Duration of Human Life." He also wrote "Memoirs upon the Measure of an Arc of Parallel Midway Between the Pole and the Equator" (1826), and "Course of Mathematics for the Use of Mariners" (1830).

In 1831 Nicollet failed in speculation, losing not only his own fortune but that of others. He came to the United States, arriving early in 1832. It is probable that he was in New York, but there is no evidence as to the length of his stay. It is known, however, that he was impoverished, and that he was assisted by Bishop Chanche, of Natchez, to go on with his chosen work—an exploration of the Mississippi and its tributaries. He made astronomical and barometrical observations, determined the geographical position and elevation of many important points, and studied Indian lore.

The United States government was so well pleased with Nicollet's work that it sent him to the Far West for further investigations, with Lieutenant John C. Frémont as assistant. His "Geology of the Upper Mississippi Region and of the Cretaceous Formation of the Upper Missouri" was one of the results of his journeys. After this he tried, through letters, to regain his lost standing in France by seeking election to the Paris Academy of Sciences, but he was blackballed, and, broken-hearted, he died in Washington in September, 1843.

The Englishman who believed that Nicollet was the author of the moon hoax was Augustus De Morgan, father of the late William De Morgan, the novelist, and himself a distinguished mathematician and litterateur. He was professor of mathematics at University College, London, at the time when the moon pamphlet first appeared in England. His "Budget of Paradoxes," an interesting collection of literary curiosities and puzzles, which he had written, but not carefully assembled, was published in 1872, the year after his death.

DE MORGAN'S NOTES ON NICOLLET

Two fragments, printed separately in this volume, refer to the moon hoax. The first is this:

"Some Account of the Great Astronomical Discoveries Lately Made by Sir John Herschel at the Cape of Good Hope."—Second Edition, London, 12mo, 1836.

This is a curious hoax, evidently written by a person versed in astronomy and clever at introducing probable circumstances and undesigned coincidences. It first appeared in a newspaper. It makes Sir J. Herschel discover men, animals, *et cetera*, in the moon, of which much detail is given. There seems to have been a French edition, the original, and English editions in America, whence the work came into Britain; but whether the French was published in America or at Paris I do not know. There is no doubt that it was produced in the United States by M. Nicollet, an astronomer, once of Paris, and a fugitive of some kind.

About him I have heard two stories. First, that he fled to America with funds not his own, and that this book was a mere device to raise the wind. Secondly, that he was a protégé of Laplace, and of the Polignac party, and also an outspoken man. That after the Revolution he was so obnoxious to the republican party that he judged it prudent to quit France; which he did in debt, leaving money for his creditors, but not enough, with M. Bouvard. In America he connected himself with an assurance office. The moon story was written, and sent to France, chiefly with the intention of entrapping M. Arago, Nicollet's especial foe, into the belief of it. And those who narrate this version of the story wind up by saying that M. Arago *was* entrapped, and circulated the wonders through Paris until a letter from Nicollet to M. Bouvard explained the hoax.

I have no personal knowledge of either story; but as the poor man had to endure the first, it is but right that the second should be told with it.

The second fragment reads as follows:

"The Moon Hoax; or, the Discovery That the Moon Has a Vast Population of Human Beings." By Richard Adams Locke.—New York, 1859.

This is a reprint of the hoax already mentioned. I suppose "R. A. Locke" is the name assumed by M. Nicollet. The publisher informs us that when the hoax first appeared day by day in a morning newspaper, the circulation increased fivefold, and the paper obtained a permanent footing. Besides this, an edition of sixty thousand was sold off in less than one month.

This discovery was also published under the name of A. R. Grant. Sohnke's "Bibliotheca Mathematica" confounds this Grant with Professor R. Grant of Glasgow, the author of the "History of Physical Astronomy," who is accordingly made to guarantee the discoveries in the moon. I hope Adams Locke will not merge in J. C. Adams, the codiscoverer of Neptune. Sohnke gives the titles of three French translations of "The Moon Hoax" at Paris, of one at Bordeaux, and of Italian translations at Parma, Palermo, and Milan.

A correspondent, who is evidently fully master of details, which he has given at length, informs me that "The Moon Hoax" first appeared in the New York *Sun,* of which R. A. Locke was editor. It so much resembled a story then recently published by Edgar A. Poe, in a Southern paper, "Adventures of Hans Pfaall," that some New York journals published the two side by side. Mr. Locke, when he left the New York *Sun,* started another paper, and discovered the manuscript of Mungo Park; but this did not deceive. The *Sun,* however, continued its career, and had a great success in an account of a balloon voyage from England to America, in seventy-five hours, by Mr. Monck Mason, Mr. Harrison Ainsworth, and others.

I have no doubt that M. Nicollet was the author of "The Moon Hoax," written in a way which marks the practised observatory astronomer beyond all doubt, and by evidence seen in the most minute details. Nicollet had an eye to Europe. I suppose that he took Poe's story and made it a basis for his own. Mr. Locke, it would seem, when he attempted a fabrication for himself, did not succeed.

In his remark that "there seems to have been a French edition, the original," Augustus De Morgan was undoubtedly misled, for every authority consultable agrees that the French pamphlets were merely translations of the story originally printed in the *Sun;* and De Morgan had learned this when he wrote his second note on the subject.

The M. Arago whom De Morgan believes Nicollet sought to entrap was Dominique François Arago, the celebrated astronomer. In 1830, as a reward for his many accomplishments, he was made perpetual secretary of the Paris Academy of Sciences, and in the following year — the year of Nicollet's fall from grace — he was elected to the Chamber of Deputies. As to the intimation that Arago was really misled by the moon story, it is unlikely. W. N. Griggs, a contemporary of Locke, insists in a memoir of that journalist that the narrative was read by Arago to the members of the Academy, and was received with mingled denunciation and laughter. But hoaxing Arago in a matter of astronomy would have been a difficult feat. Surely the discrepancies pointed out by Poe would have been noticed immediately.

It is, however, easy to understand De Morgan's belief that Nicollet was the author of the moon story. Much of the narrative, particularly parts which have here been omitted, is made up of technicalities which could have come only from the pen of a man versed in the intricacies of astronomical science. It seems unlikely that Locke, clever student though he was, could have set down these involved demonstrations entirely from his own knowledge of astronomy. They were not put into the story to interest *Sun* readers, for they are far over the layman's head, but for the purpose of adding verisimilitude to a yarn which, stripped of the technical trimmings, would have been pretty bald.

It was plain to De Morgan that Nicollet was one of the few men alive in 1835 who could have woven the scientific fabric in which the hoax was disguised. It was also apparent to him that Nicollet, jealous of the popularity of Arago, might have had a motive for launching a satire, if not a hoax. And then there was Nicollet's presence in America at the time of the moon story's publication, Nicollet's knowl-

edge of English, and Nicollet's poverty. The coincidences are interesting, if nothing more.

FRENCH COMMENTS ON THE MOON HOAX

Let us see what the French said about Nicollet and the story that came to the *Sun* from "a medical gentleman immediately from Scotland." In a sketch of Nicollet printed in the "Biographie Universelle" (Michaud, Paris, 1884), the following appears:

> There has been attributed to him an article which appeared in the daily papers of France, and which, in the form of a letter dated from the United States, spoke of an improvement in the telescope invented by the learned astronomer Herschel, who was then at the Cape of Good Hope. It has been generally and with much probability attributed to Nicollet.
>
> With the aid of this admirable improvement Herschel was supposed to have succeeded in discovering on the surface of the moon live beings, buildings of various kinds, and a multitude of other interesting things. The description of these objects and the ingenious method employed by the English astronomer to attain his purpose was so detailed, and covered with a veneer of science so skilfully applied, that the general public was startled by the announcement of the discovery, of which North America hastened to send us the news.
>
> It has even been said that several astronomers and physicists of our country were taken in for a moment. That seems hardly probable to us. It was easy to perceive that it was a hoax written by a learned and mischievous person.

The "Nouvelle Biographie Générale" (Paris, 1862), says of Nicollet:

> He is believed to be the author of the anonymous pamphlet which appeared in 1836 on the discoveries in the moon made by Herschel at the Cape of Good Hope.

Cruel, consistent Locke, never to have written down the details of the conception and birth of the best invention that ever spoofed the world! He leaves history to wonder whether it be possible that, with one word added, the French biographer was right, and that it was "a hoax written by a learned and *a* mischievous person." Certain it is that Nicollet never wrote all of the moon story; certain, too, that Locke wrote much, if not all of it. The calculations of the angles of reflection might have been Nicollet's, but the blue unicorn is the unicorn of Locke.

No man can say when the germ of the story first took shape. It might have been designed at any time after Herschel laid the plans for his voyage to the Cape of Good Hope, and that was at least two years before it appeared in the *Sun*. Was Nicollet in New York then, and did he and Locke lay their heads together across a table at the American Hotel and plan the great deceit?

There was one head full of figures and the stars; another crammed with the imagination that brought forth the fire-making biped beavers and the fascinating, if indecorous, human bats. If they never met, more is the pity. Whether they met, none can say. Go to ask the ghosts of the American Hotel, and you find it gone, and in its place the Woolworth Building, earth's spear leveled at the laughing moon.

Whatever happened, the credit must rest with Richard Adams Locke. Even if the technical embellishments of the moon story were borrowed, still his was the genius that builded the great temple, made flowers to bloom in the lunar valleys, and grew the filmy wings on the *vespertilio-homo*. His was the art that caused the bricklayer of Cherry Street to sit late beside his candle, spelling out the rare story with joyous labor. It must have been a reward to Locke, even to the last of his seventy years, to know that he had made people read newspapers who never had read them before; for that is what he really accomplished by this huge, complex lie.

"From the epoch of the hoax," wrote Poe, "the *Sun* shone with unmitigated splendor. Its success firmly established the 'penny system' throughout the country, and (through the *Sun*) consequently we are indebted to the genius of Mr. Locke for one of the most important steps ever yet taken in the pathway of human progress."

(To be continued in the July number of MUNSEY'S MAGAZINE)

The Regicide

BY HAROLD TITUS

Author of "The Shadow of the Petticoat," "A Four-Handed Game," etc.

FROM his father, the slate-gray color, the spindly, wire-muscled legs, the lineal delicacy, the nose of a greyhound; from his mother, the complex cross which developed the thin, scraggly feathering along belly and tail, the straight back, the thickened neck, the widened chest, and the collie ears; from old man Waters, an appreciation of his own abilities and shortcomings.

"Shag," the man would whine, fingering the cool muzzle, "Shag, you never will git to run jacks! Rabbits change direction too fast for your j'ints. You jus' naturally can't make 'em slip quick enough"—with a disparaging shake of his gray head.

Then the little green eyes would fire, and Waters would cackle:

"But, by holy smoke, you're goin' to make a wolf-dog, a wolf-runnin' fool; git the Big 'Un some day, mebby. You got what none of these others got—you got th' steam; you can run to thunder an' back without showin' it!"

Old man Waters lived on a ranch within an hour's easy ride of Gray Hair, Oklahoma. His fenced area totaled thirty acres, and the space not devoted to buildings was entirely in wheat, which returned a meager but sufficient annual revenue and required but little attention.

This last was the essential point. Old man Waters was so busy with his dogs that he had no leisure for ranching. He went in for dogs whole-heartedly; Lord bless you, yes! At the ranch he kept from a dozen to eighteen or twenty, and that was merely a starter

"Shucks, I can't recollect," he'd reply to a request for specific information. "Last time I counted, it was somewhere between fifty an' sixty or so."

His hounds were scattered widely over the prairie country. When the rabbits became scarce, or he grew tired of one place, he could ride in any direction and pick up a half-dozen greyhounds and a trailer or so that he had left with some distant rancher, run them to his heart's content, and return home—or go on to another dog depository.

Every one in the country knew Waters; none was his intimate. He was too much occupied with his dogs to form close human attachments. Frequently some one else rode beside him as he led his pack to the open prairie, where the trail-hounds nosed out the long-eared jacks for their speedier companions to chase; but when Waters was not talking to his dogs he was talking about them, so these contacts with men never ripened into friendships.

Occasionally he went quietly through the strips of oak that broke the rolling open, watching for wolves. At those times he strove to avoid company, for coyotes are more cunning than rabbits, and his casual companions could not take the sport with sufficient seriousness.

More than ever he was determined to be alone on his wolf-hunting when he came to know the Big 'Un — a great, gaunt beast, heavier by pounds than any prairie-wolf Waters had ever known, less of a skulker, more likely to turn and fight, and faster than his kind. Many times Waters sent the pick of his pack

COMPOSITE DRAWING FROM PHOTOGRAPHS OF THE CORONA.
Colored from observations made with color chart, August 30, 1905.

Our Moon.

Of all the secondary planets the earth's satellite is by far the most interesting and important. The moon completes her circuit around the earth in a period whose mean or average length is 27 days 7 hours 43.2 minutes; but in consequence of her motion in common with the earth around the sun, the mean duration of the lunar month, that is, the time from new moon to new moon, is 29 days 12 hours 44.05 minutes, which is called the moon's synodical period. If the earth were motionless in space the moon's orbit would be nearly an ellipse, having the earth in one of the foci; hence her distance from the earth varies during the course of a lunar month. Her mean distance from the earth is 238,850 miles. Her maximum distance, however, may reach 252,830 miles, and the least distance to which she can approach the earth is 221,520 miles. Her diameter is 2,162 miles, and if we deduct from her distance from the earth the sum of the two radii of the earth and moon, viz., 3,962 and 1,081 miles respectively, we shall have for the nearest approach of the surfaces of the two bodies 216,477 miles. Her orbit is a very intricate one, because the earth in moving around the sun carries the moon along with it; hence the latter is sometimes within and sometimes without the earth's orbit. Its form is that of a serpentine curve, always *concave* toward the sun, and inclined to the plane of the earth's orbit at an angle of 5° 9′, in consequence of which our satellite appears sometimes above and sometimes below the plane of the earth's orbit, through which she passes twice in a revolution. These points or positions are called nodes, and no two consecutive nodes occupy positions diametrically opposite on the lunar orbit. The nodes have a retrograde motion, which causes them to make an entire revolution in 18 years, 218 days, 21 hours, 22 minutes and 46 seconds. This motion was well known to the ancients, who called it the Saros, and was made use of by them in roughly predicting eclipses.

The moon always presents the same face to us, as is evident from the permanency of the various markings on its surface. This circumstance proves that with respect to the earth she revolves on an axis, and the time of rotation is exactly equal to the time of revolution around the earth, viz., 27.32166 days. The moon's axis is not perpendicular to the plane of her orbit, but deviates therefrom by an angle of about 6° 41′. In consequence of this fact, and of the inclination of the lunar orbit to that of the ecliptic, the poles of the moon lean alternately to and from the earth. When the north pole leans toward the earth we see somewhat more of the region surrounding it, and somewhat less when it leans the contrary way. This displacement is known by the name of libration in latitude.

The moon's motion on her axis is uniform, but her angular velocity in her orbit is subject to slight variations by reason of the form of her orbit; hence it happens that we sometimes see a little more of the eastern or western edge at one time than at another. This phenomenon is known as libration in longitude.

The moon's surface contains about 14,685,000 square miles, or nearly four times the area of Europe. Her volume is 1-49 and her mass 1-81 that of the earth, and hence her density is about 3-5 that of the earth, or about 3 2-5 that of water. At the lunar surface gravity is only 3-20 of what it is at the earth, and therefore a body which weighs 20 pounds here would weigh only 3 pounds there.

The centre of gravity of the earth and moon, or the point about which they both actually revolve in their course around the sun, lies *within* the earth; it is 1,063 miles below the surface.

The attractive force of the moon acting on th water of our oceans is mainly instrumental in raising them into protuberances or tides in such a manner as to give the total mass a spheroidal figure whose principal axis would continually coincide with the line joining the centres of the earth and moon, but in consequence of the resistance which this movement of the water encounters from continents and islands, as well as from the liquid molecules themselves, the tidal wave can never arrive at any place until about one hour after the moon has crossed the meridian of the place.

The moon has no atmosphere and no water. The suddenness with which stars are occulted by the moon is regarded as a conclusive proof that a lunar atmosphere does not exist, and the spectroscope furnishes negative evidence of the same character.

In remote ages the lunar surface was the theatre of violent volcanic action, being elevated into cones and ridges exceeding 20.000 feet high, and at other places rent into furrows or depressions of corresponding depth. The lunar volcanoes are now extinct. A profound silence reigns over the desolate and rugged surface. It is a dead world, utterly unfit to support animal or vegetable life.

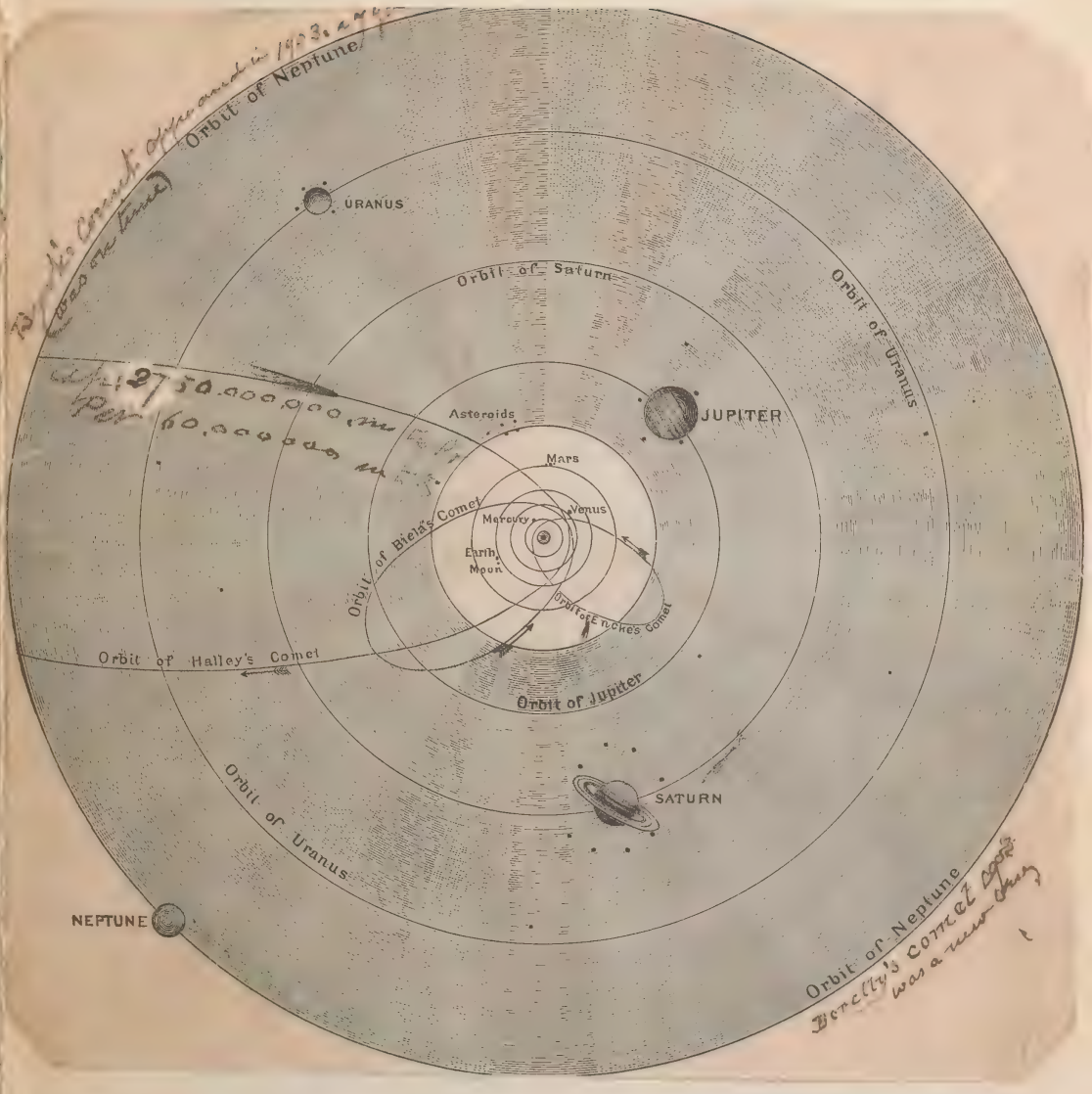
VASCO DA GAMA.

From "The History of North America.")

spite of his legendary personal ugliness—pale, round, ungainly face, sallow complexion, eruptive skin, huge rubicund nose, pinkish-blue eyes and reddish-yellow hair, he was able to charm women by his incisive speech, nicely turned compliments and keen wit. Sainte-Beuve was an ardent admirer of the late Princess Mathilde, through whose influence he was made a Senator by Napoleon III. He fell desperately in love with the daughter of General Pellétier, but the young girl could never be reconciled to his unattractive personal appearance. After this he is stated to have had a desperate flirtation with Mme. Adèle Hugo. He has become the literary curiosity of the day, and books bearing upon his inner life are eagerly read.

The Librarie Chaix has in press "Les Maîtres de l'Affiche," a cleverly illustrated work descriptive of the street posters of Jules Chéret, Willette, Steinlein, Léandre and Crafty. The same firm is about to issue "Les Maîtres du Dessin," by Roger Marx, inspector general of ... arts, a book of especial interest to art ...

... w books of travel this


Orbit of Neptune
URANUS
Orbit of Saturn
Orbit of Uranus
JUPITER
Asteroids
Mars
Orbit of Biela's Comet
Mercury
Venus
Earth
Moon
Orbit of Encke's Comet
Orbit of Halley's Comet
Orbit of Jupiter
SATURN
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NEPTUNE
Orbit of Neptune

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Elements of the Solar System.

Name of Planet.	Mean Daily Motion.	Sidereal Revolution—Days.	Distance from the Sun. Astronomical Units. Mean.	Greatest.	Least.	In Miles.
	"					
Mercury	14732.420	87.96925	0.387099	0.466693	0.307505	35,951,105
Venus	5767.6696	224.70080	0.723331	0.728260	0.718402	67,193,688
Earth	3548.192	365.25636	1.000000	1.016746	0.983254	92,894,800
Mars	1886.5182	686.97987	1.523688	1.665877	1.381499	141,542,690
Jupiter	299.1256	4332.6284	5.202803	5.454395	4.951211	483,313,340
Saturn	120.4548	10759.2225	9.538838	10.071570	9.006106	886,108,900
Uranus	42.2308	30688.5022	19.190978	20.094454	18.287502	1,782,742,060
Neptune	21.530	60178.3060	30.070672	30.327506	29.813838	2,788,764,300

Name of Planet.	Eccentricity of Orbit.	Synodical Revolution—Days.	Inclination of Orbit to Ecliptic.	Orbital Velocity Miles Per Second.
			° ′ ″	
Mercury	0.2056167	115,877	7 0 11.2	29.55
Venus	0.0068150	583,920	3 23 37.5	22.61
Earth	0.0167460	.....	. .. ...	18.38
Mars	0.0933198	779,936	1 51 1.0	15.00
Jupiter	0.0483570	398,866	1 18 29.1	8.06
Saturn	0.0558482	378,090	2 29 30.6	5.94
Uranus	0.0470781	369,650	0 46 21.9	4.20
Neptune	0.0085410	367,482	1 46 41.2	3.35

Name of Planet.	Mean Longitude at the Epoch.*	Mean Longitude of the Perihelion.*	Annual Sidereal Motion.	Mean Longitude of the Ascending Node.	Annual Sidereal Motion.	Light at Perihelion.	Light at Aphelion.
	° ′ ″	° ′ ″	″	° ′ ″	″		
Mercury	115 4 3.26	76 5 10.9	+ 5.7	47 17 17.4	— 7.6	10.58	4.59
Venus	165 4 20.94	130 19 58.0	+ 0.4	75 53 15.5	—17.9	1.94	1.91
Earth	99 47 20.22	101 25 37.7	+11.6	. .. ..	. .	1.03	0.97
Mars	70 45 5.47	334 26 21.8	+15.9	48 52 42.6	—22.2	0.52	0.36
Jupiter	242 24 21.96	12 54 18.0	+ 7.6	99 33 33.3	—13.9	0.041	0.034
Saturn	53 23 10.90	91 19 26.1	+20.2	112 53 17.7	—18.9	0.012	0.010
Uranus	294 57 2.33	169 14 25.8	+ 7.4	73 33 2.1	—32.0	0.003	0.0025
Neptune	111 24 32.14	43 51 38.2	—18.9	130 48 38.9	—10.7	0.001	0.001

*Epoch 1912 January 0d Greenwich mean time.

Sun and Planets.	Semi-diameter. At Unit Distance.	At Mean Least Distance.	In Miles (Mean).	Volume. ⊕ = 1	Mass. ⊕ = 1	Density. ⊕ = 1	Axial Rotation.	Gravity at Surface. ⊕ = 1
	′ ″	″					D. H. M. S.	
Sun	15 59.6	.....	432183.68	1303371.8	329390	0.2527	25 7 48 0	27.6057
Mercury	3.34	5.45	1504.24	0.054955	0.054898	0.99895	24 5 ?	.37979
Venus	8.55	30.90	3850.67	0.921875	0.807328	0.87574	23 21 ?	.85236
Earth	.....	.....	.....	1.000000	1.000000	1.00000	23 56 4.09	1.00000
Mars	5.05	9.64	2274.37	0.189953	0.106478	0.56055	24 37 23	.32222
Jupiter	1 37.16	23.12	43758.03	1352.809	314.4985	0.23247	9 55 20	2.57115
Saturn	1 21.17	9.55	36558.86	788.934	94.0684	0.11923	10 14 24	1.10175
Uranus	33.5	1.84	15096.43	55.550	14.4033	0.25928	Unknown.	.98932
Neptune	38.7	1.33	17411.54	85.224	16.7199	0.19619	Unknown.	.86338

Drawn by Harvey Ellis. Half-tone plate engraved by C. W. Chadwick

THE MAKING OF THE UNIVERSE

BY JOHN HENRY FREESE

Observer at the Harvard College Observatory[1]

AFTER looking through a telescope of high power at such objects in the heavens as nebulæ and star-clusters, or perhaps at the "mountains on the moon," visitors at the Harvard Observatory always marvel at their delicacy of definition and general magnificence, and often make the inquiry: "Do stars change, and is any order of change discernible?" In the present article I shall consider this question.

Under my analysis, the inquiry means, Has the nebular hypothesis been proved or disproved in the light of facts disclosed by recent astronomical research? Great thinkers of the past have thought that the sun and its planets, including the earth, existed long ago in a diffused nebulous state, rotating on its axis, from which the sun and its planets have evolved by the natural forces of attraction and condensation. At the present time this theory is widely accepted among astronomers.

Sir William Herschel, the renowned English astronomer and indefatigable explorer of the stellar realm, extended the aforementioned nebular hypothesis beyond our solar system. His great intellect conceived the evolution of the stellar universe in a manner that has received striking confirmation from recent stellar photographs.

Let us consider whether the nebular theory applies to all the stars, or, as the visitor puts it, do real changes take place in the stars, and can we discern the order of change? Do these "unnumbered sparks" grow up from an infancy, live a life, and then undergo extinction and dissolution, only to be recreated by the forces of nature?

Changes may be of position, of form, and of composition, though these divisions are closely related.

Detecting changes of the position of stars with reference to one another involves an exceedingly nice observation and calculation, but numerous independent researches have confirmed the general principle that the stars in the constellations of Hercules and Lyra are apparently spreading, and those on the opposite side of the celestial sphere are growing nearer together. It was Sir William Herschel who made this great discovery, and he argued from it that our solar system is moving rapidly through space toward Hercules, an analogous apparent motion being that of groves of trees, when a person moves from one grove toward another, in which case the trees behind him seem to be growing nearer together, and those before him seem separating farther apart. Aside from these general changes, occasioned by the translation of our solar system in space, it is certain that many of the stars are moving irregularly in reference to one another,—some this way, some that,—stars near together tending to move in the same direction. One star, known as No. 1830 Groombridge's Catalogue, moves ten degrees in five thousand years; Arcturus moves five degrees in ten thousand years, both being extraordinarily great changes from the astronomical point of view. Professor Arthur Searle of the Harvard Observatory has recently detected a star having a very large proper motion, and such new discoveries are becoming commoner every day.

Many stars show a tremendous velocity

[1] The illustrations are mainly reproductions from prints made by the writer, being his interpretation of negatives made under the direction of Edward C. Pickering, Director of the Harvard College Observatory.

FIGURE 1. A RICH FIELD OF STARS. FROM A PLATE COVERING ONLY FIVE SQUARE DEGREES, BUT SHOWING OVER 400,000 STARS BY ACTUAL COUNT

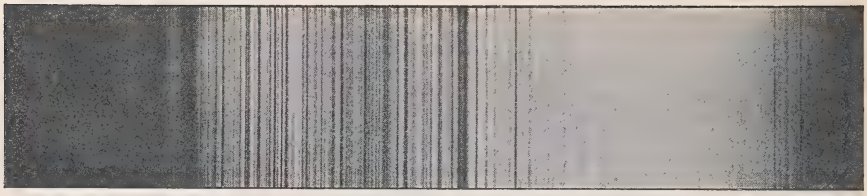


FIGURE 2. SPECTRUM OF ALPHA BOÖTES

in the line of sight, some moving toward, others away from, the earth. Sir William Huggins discovered the ingenious means of detecting this phenomenon by the spectroscope. A single point of light passed through a prism gives what is called a spectrum. When spread out by a cylindrical lens, or by a trail on a photographic plate, this appears as a ribbon of light crossed by certain lines. These lines stand for certain chemical elements—hydrogen, calcium, and so on. Figure 2 shows a spectrum of the star Alpha Boötes, photographed at the Harvard Observatory. The lines crossing the band of light shift their position as the body moves nearer or farther from the observer, and the amount of change can be measured, and the movement in the line of sight can be detected and estimated.

Changes in form and composition I shall discuss together, and endeavor to work out a definite cycle of evolution.

As a starting-point in this endless chain of stellar evolution, conceive the existence of a vast amount of molecular matter, or perhaps gaseous atoms, much diffused in space, and too remote and infinitesimal to be perceived by any human agencies of discernment. Space is filled with such atoms, and they are continually changing their position with respect to one another. Changes in this mass of "star-dust" are exceedingly slow, for thousands of years are but momentary in the scale of cosmic time. At length, however, mutual gravitation brings the atoms near together, and simultaneously, uninterruptedly, and with increasing activity, mutual pressure and increase of temperature bring about chemical union. At length these united molecules, by combining with one another again and again, aggregate into irregular, spiral, and annular clouds of nebulæ. It is the steady pull of gravity which overcomes atomic repulsion and compels mutual approach

FIGURE 3. THE GREAT NEBULA IN ORION

FIGURE 4. THE TRIFID NEBULA

of the particles. Figure 3 shows one of the earlier forms of nebulæ. Here I believe a tremendous collision between stars in all probability took place many ages ago. The colliding bodies may have been bright stars, but more likely were stars cooled and darkened by radiation and contraction. Then atomic concentration began, and has continued until a nebula of enormous extent

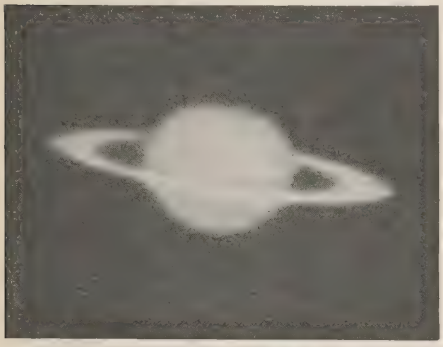


FIGURE 5. THE PLANET SATURN.

is established, the more or less homogeneous mass probably rotating around a common center of gravity. Continued condensation and centripetal action cause accelerated motion, while, on account of the centrifugal force, division of the nebula may take place, as is shown in Figure 4. Here, in a later stage, the nebula is seen divided into two parts, and the larger component shows unmistakable evidence of an approaching division into three parts. There are various forms of concentration, just as we observe the same phenomena in sky-clouds and dust-clouds. Such forms depend upon the shape of the nebula, its density, motion, size, etc. The photographs themselves are self-explicable, indicating that the form really depends upon the accident of creation, whether by collision of stars or by the attractive accumulation of star-stuff. The whole nebula may revolve, throwing off outer rings, as is shown in Figure 5, which represents the planet Saturn, and in Figure 6, which shows the planet Jupiter. These photographs give autobiographical evidence, the latter of the existence of attached rings in ages long gone by, while the rings of Saturn remain clearly intact. The bands upon Jupiter's surface and the rings of Saturn may be

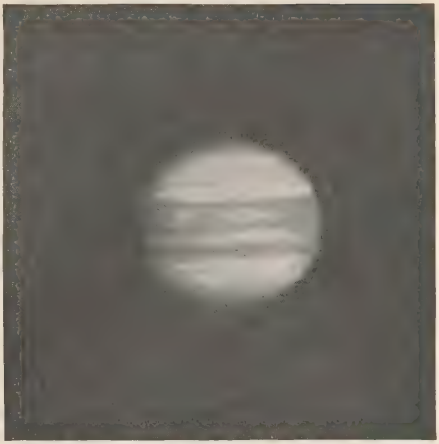


FIGURE 6. THE PLANET JUPITER

seen clearly with a telescope of low power. Figure 7 shows a more extended state of condensation, and is not easily interpreted. Here groups of stars are shown surrounded by nebulous clouds. Gradually the nebulous matter is absorbed, and the perpetual recurrence of curves and lines of equal stars regularly interspersed, having strikingly similar configuration and being self-delineated on the photographic plates just

FIGURE 7. NEBULA IN CARINA

FIGURE 8. GREAT NEBULA IN ANDROMEDA

By courtesy of Dr. Isaac Roberts of England

connected with nebulous matter, adds proof to this hypothesis. Figure 8 shows the nebula in Andromeda, its spiral formation appearing quite clearly. Here, notwithstanding the unfavorable inclination of the axis of the spiral, we see a strong central nucleus encompassed by dark bands, showing divisions between symmetrical bands or rings of nebulous matter, the center of which must be many times larger than our whole solar system. Figures 9 and 10 show two other examples of spiral nebulæ, and these nebulæ are profusely distributed throughout the heavens, and they almost all show strong central nuclei, the outer portions being more or less broken up, from which innumerable nebulous wisps extend outward—in all making a strong pictorial argument, tending to show that large star-clusters are the result of the convolutions of spiral nebulæ. Probably the outside of nebulæ breaks up first, and so we find many with uniform stars on the outside, but with centers which cannot be resolved by telescopes of the highest power. Figure 11 shows a cluster in process of condensation, the outside being condensed into the stars, and the nucleus being unresolvable. Figure 12 shows a cluster which can be resolved almost wholly. In all probability this was once a spiral nebula, and we see it in a much condensed state, looking along the axis of the spiral—looking into the cone, as it were. Figure 13 shows

the group of stars known as the Pleiades, it being a condensation almost consummated, a faint nebula only remaining around the newly formed stars.

Thus we have viewed the transformation of nebulæ into stars. To complete the cycle of evolution by understanding the change from stars into nebulæ is most perplexing. But the spectroscope comes to our aid. With the spectroscope we can

FIGURE 9. GREAT SPIRAL NEBULA IN HYDRA

quite certainly determine star-temperatures, which gives us an indication of the star's age. This is done by an analysis of the star's spectrum, a star-spectrum being shown in Figure 2. Sirius and other bluish-white stars give spectra crossed by heavy hydrogen lines, indicating a high temperature of the dense primordial matter and its envelopment in hydrogen gas of high temperature. This stage I conceive as an early one in stellar life. As condensation and radiation progress, the gaseous star grows brighter, as may happen to a star as explained by Lane's law. In Capella and other stars having spectra resembling our sun, the carbon and metallic lines are conspicuous and numerous, indicating a much more condensed state than Sirius, and recording the extensive dissipation of energy in the form of light and heat. These stars may be called middle-aged. In Aldebaran and other of the lighter-red

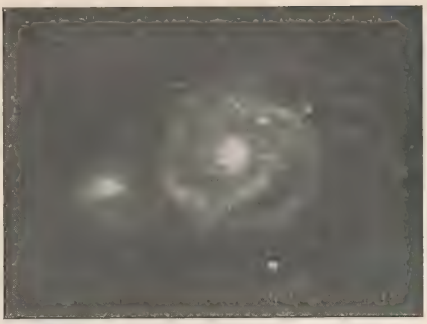


FIGURE 10. GREAT SPIRAL NEBULA IN CANES MAJORES

stars, the spectra are crossed by faint metallic lines and dark bands, faint toward the red end of the spectrum. In other deep dark-red stars the metallic lines are faint, and the dark bands are faint toward the violet end of the spectrum, these two latter stages, in my opinion, being the last stage toward total extinction of light.

Stars, after gradually absorbing all surrounding nebulous particles, at the end of the transition from a gaseous state sink in temperature. Like our sun, they gradually cool off, and sometime become dark and dead. This, to my mind, is also proved by the fact that so many stars are apparently cooling off, varying extensively in the amount of light-emission, which irregularity has not as yet been adequately explained. At present there are a great many long-period variable stars, many of which I have observed myself. These stars are periodically compared with the stars near them of apparently constant magnitude, the comparison stars being of graded degrees

FIGURE 11. CLUSTER IN HERCULES

FIGURE 12. CLUSTER IN CENTAURUS

of brightness and perhaps being lettered from A to K, A being the brightest, and K several magnitudes fainter. At maximum brightness, a star may be as bright as A or B, and at minimum as faint as K, an unquestioned change of several magnitudes in brightness. I believe that in time to come, perhaps not for many centuries, the course of variation of all stars, apart from the cycles of variation now so easily fixed, will be found rising or falling, and unquestionably determined to be at some stage in cosmic life or in the cycle of evolution as revealed by the spectroscope. Extensive variation, I believe, is a symptom of extreme decadence, dark-redness being a prelude to extinction. Becoming dark and of smaller and smaller mass affects velocity and increases perturbations of motion, and they become at length more and more irregular. Then it must follow that collisions and grazings of stars occur. Figure 14 shows the recent "new star in Perseus" as photographed at the Yerkes Observatory. It is the most perfectly observed of all "new stars," and is an instance where, in all probability, either a small body or small nebula collided with a similar body or a tremendous internal explosion took place. It blazed out in February, 1901, at a place where no star had previously been observed, and has ever since been subsiding. Besides this one, astronomical history has recorded at least fifteen similar instances.

But you ask, "Why do not bright stars collide, since they are so thick?" To this I say that, from the astronomical point of view, stars are not thick, but are separated by vast distances in space, and, further,

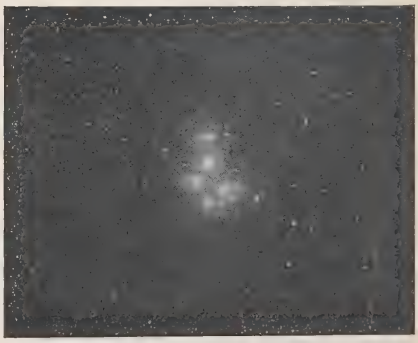


FIGURE 13. THE PLEIADES

that our universe has existed for such an infinitely long time—for millions and millions of ages—that it has reached a high degree of stability, and, by the theory of chances, such collisions are extremely unlikely, though they must occasionally occur.

This primary diffusion of molecules is not only brought about by collisions of stars themselves, but by the collision and disintegration of comets and meteors, and by volcanic action and star-explosions and the incessant chemical action going on in space.

Extraordinary as it may seem, two hundred tons of meteors fall upon the earth daily, working tremendous geological and chemical effect in a long period.

FIGURE 14. THE "NEW STAR IN PERSEUS"
By courtesy of Mr. G. W. Ritchey, the Yerkes Observatory

GREAT NEBULA IN ANDROMEDA.

Photographed with the two-foot reflecting Telescope of the Yerkes Observatory (Ritchey).

FIG. 9. THE SOLAR CORONA.
Photographed by Yerkes Observatory Eclipse Expedition, May 28, 1900 (Barnard and Ritchey).

predominates in a very striking manner over the other elements. The spectral lines of such elements as iron, magnesium, sodium and cal-

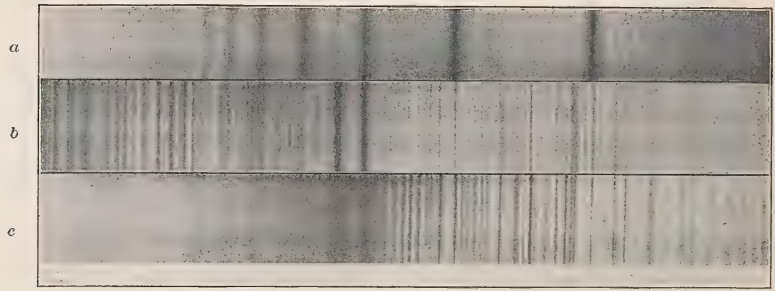


FIG. 8.

CHARACTERISTIC SPECTRA OF (*a*) WHITE, (*b*) YELLOW, AND (*c*) RED STARS (HUGGINS).

cium, rise into prominence as the hydrogen lines fade. Meanwhile the light of the star undergoes a change of color, completely losing its bluish cast and assuming a distinctly yellow hue. There can be little if any doubt that our own sun once passed through the successive stages which are represented by the spectra shown in Fig. 8. The time which has elapsed since it acquired its present size and density as the result of the condensation of the great nebula in which the earth and the other planets also had their origin, covers many millions of years. It is fortunate for the study of stellar evolution that the stages through which the sun once passed are all exemplified in existing stars, which for unknown

Our Moon.

Of all the secondary planets the earth's satellite is by far the most interesting and important. The moon completes her circuit around the earth in a period whose mean or average length is 27 days 7 hours 43. 2 minutes; but in consequence of her motion in common with the earth around the sun, the mean duration of the lunar month, that is, the time from new moon to new moon, is 29 days 12 hours 44. 05 minutes, which is called the moon's synodical period. If the earth were motionless in space the moon's orbit would be nearly an ellipse, having the earth in one of the foci; hence her distance from the earth varies during the course of a lunar month. Her mean distance from the earth is 238,850 miles. Her maximum distance, however, may reach 252.830 miles, and the least distance to which she can approach the earth is 221.520 miles. Her diameter is 2,162 miles, and if we deduct from her distance from the earth the sum of the two radii of the earth and moon, viz., 3,962 and 1,081 miles, respectively, we shall have for the nearest approach of the surfaces of the two bodies 216,477 miles. Her orbit is a very intricate one, because the earth in moving around the sun carries the moon along with it; hence the latter is sometimes within and sometimes without the earth's orbit. Its form is that of a serpentine curve, always *concave* toward the sun, and inclined to the plane of the earth's orbit at an angle of 5° 9′, in consequence of which our satellite appears sometimes above and sometimes below the plane of the earth's orbit, through which she passes twice in a revolution. These points or positions are called nodes, and no two consecutive nodes occupy positions diametrically opposite on the lunar orbit. The nodes have a retrograde motion, which causes them to make an entire revolution in 18 years, 218 days, 21 hours, 22 minutes and 46 seconds. This motion was well known to the ancients, who called it the Saros, and was made use of by them in roughly predicting eclipses.

The moon always presents the same face to us, as is evident from the permanency of the various markings on its surface. This circumstance proves that with respect to the earth she revolves on an axis, and the time of rotation is exactly equal to the time of revolution around the earth, viz., 27.32166 days. The moon's axis is not perpendicular to the plane of her orbit, but deviates therefrom by an angle of about 6° 41′. In consequence of this fact, and of the inclination of the lunar orbit to that of the ecliptic, the poles of the moon lean alternately to and from the earth. When the north pole leans toward the earth we see somewhat more of the region surrounding it, and somewhat less when it leans the contrary way. This displacement is known by the name of libration in latitude.

The moon's motion on her axis is uniform, but her angular velocity in her orbit is subject to slight variations by reason of the form of her orbit; hence it happens that we sometimes see a little more of the eastern or western edge at one time than at another. This phenomenon is known as libration in longitude.

The moon's surface contains about 14,685,000 square miles, or nearly four times the area of Europe. Her volume is 1-49 and her mass 1-81 that of the earth, and hence her density is about 3-5 that of the earth, or about 3 2-5 that of water. At the lunar surface gravity is only 3-20 of what it is at the earth, and therefore a body which weighs 20 pounds here would weigh only 3 pounds there.

The centre of gravity of the earth and moon, or the point about which they both actually revolve in their course around the sun, lies *within* the earth; it is 1,063 miles below the surface.

The attractive force of the moon acting on the water of our oceans is mainly instrumental in raising them into protuberances or tides in such a manner as to give the total mass a spheroidal figure whose principal axis would continually coincide with the line joining the centres of the earth and moon, but in consequence of the resistance which this movement of the water encounters from continents and islands, as well as from the liquid molecules themselves, the tidal wave can never arrive at any place until about one hour after the moon has crossed the meridian of the place.

The moon has no atmosphere and no water. The suddenness with which stars are occulted by the moon is regarded as a conclusive proof that a lunar atmosphere does not exist, and the spectroscope furnishes negative evidence of the same character.

In remote ages the lunar surface was the theatre of violent volcanic action, being elevated into cones and ridges exceeding 20,000 feet high, and at other places rent into furrows or depressions of corresponding depth. The lunar volcanoes are now extinct. A profound silence reigns over the desolate and rugged surface. It is a dead world, utterly unfit to support animal or vegetable life.

THE EARTH'S ATMOSPHERE.

The earth's sensible atmosphere is generally supposed to extend some forty miles in height, probably further, but becoming at only a few miles from the surface of too great a tenuity to support life. The condition and motions of this aerial ocean play a most important part in the determination of climate, modifying, by absorbing, the otherwise intense heat of the sun, and, when laden with clouds, hindering the earth from radiating its acquired heat into space. — *Whitaker*

The Moon's Phases, 1913.

1913.	Phase.	Day.	Boston.	New York.	Washington.	Charleston.	Chicago.
			H. M.	H. M.	H. M.	H. M.	H. M.
January.	New Moon.	7	5 44 A.M.	5 33 A.M.	5 20 A.M.	5 9 A.M.	4 39 A.M.
	First Quarter.	15	11 17 A.M.	11 6 A.M.	10 53 A.M.	10 42 A.M.	10 11 A.M.
	Full Moon.	22	10 56 A.M.	10 44 A.M.	10 32 A.M.	10 21 A.M.	9 50 A.M.
	Last Quarter.	29	2 50 A.M.	2 38 A.M.	2 26 A.M.	2 14 A.M.	1 43 A.M.
February.	New Moon.	6	12 38 A.M.	12 26 A.M.	12 14 A.M.	12 2 A.M.	5d 11 31 P.M.
	First Quarter.	14	3 50 A.M.	3 38 A.M.	3 26 A.M.	3 13 A.M.	2 42 A.M.
	Full Moon.	20	9 19 P.M.	9 8 P.M.	8 55 P.M.	8 44 P.M.	8 13 P.M.
	Last Quarter.	27	4 31 P.M.	4 20 P.M.	4 7 P.M.	3 56 P.M.	3 25 P.M.
March	New Moon.	7	7 38 P.M.	7 27 P.M.	7 14 P.M.	7 3 P.M.	6 32 P.M.
	First Quarter.	15	4 14 P.M.	4 2 P.M.	3 50 P.M.	3 38 P.M.	3 8 P.M.
	Full Moon.	22	7 12 A.M.	7 0 A.M.	6 48 A.M.	6 37 A.M.	6 6 A.M.
	Last Quarter.	29	8 13 A.M.	8 2 A.M.	7 50 A.M.	7 38 A.M.	7 7 A.M.
April.	New Moon.	6	1 4 P.M.	12 52 P.M.	12 40 P.M.	12 29 P.M.	11 58 A.M.
	First Quarter.	14	12 55 A.M.	12 43 A.M.	12 31 A.M.	12 20 A.M.	13d 11 49 P.M.
	Full Moon.	20	4 48 P.M.	4 37 P.M.	4 24 P.M.	4 13 P.M.	3 42 P.M.
	Last Quarter.	28	1 25 A.M.	1 13 A.M.	1 1 A.M.	12 50 A.M.	12 19 A.M.
May.	New Moon.	6	3 40 A.M.	3 29 A.M.	3 16 A.M.	3 5 A.M.	2 34 A.M.
	First Quarter.	13	7 1 A.M.	6 49 A.M.	6 37 A.M.	6 25 A.M.	5 54 A.M.
	Full Moon.	20	2 34 A.M.	2 22 A.M.	2 10 A.M.	1 59 A.M.	1 28 A.M.
	Last Quarter.	27	7 19 P.M.	7 8 P.M.	6 55 P.M.	6 44 P.M.	6 13 P.M.
June.	New Moon.	4	3 13 P.M.	3 1 P.M.	2 49 P.M.	2 38 P.M.	2 6 P.M.
	First Quarter.	11	11 53 A.M.	11 42 A.M.	11 29 A.M.	11 19 A.M.	10 47 A.M.
	Full Moon.	18	1 9 P.M.	12 58 P.M.	12 45 P.M.	12 34 P.M.	12 3 P.M.
	Last Quarter.	26	12 57 P.M.	12 45 P.M.	12 33 P.M.	12 21 P.M.	11 50 A.M.
July.	New Moon.	4	12 22 A.M.	12 10 A.M.	3d 11 58 P.M.	3d 11 47 P.M.	3d 11 16 P.M.
	First Quarter.	10	4 53 P.M.	4 42 P.M.	4 29 P.M.	4 18 P.M.	3 47 P.M.
	Full Moon.	18	1 22 A.M.	1 11 A.M.	12 58 A.M.	12 47 A.M.	12 16 A.M.
	Last Quarter.	26	5 14 A.M.	5 3 A.M.	4 51 A.M.	4 39 A.M.	4 8 A.M.
August.	New Moon.	2	8 14 A.M.	8 2 A.M.	7 50 A.M.	7 39 A.M.	7 8 A.M.
	First Quarter.	8	11 17 P.M.	11 5 P.M.	10 53 P.M.	10 42 P.M.	10 11 P.M.
	Full Moon.	16	3 43 P.M.	3 31 P.M.	3 19 P.M.	3 8 P.M.	2 37 P.M.
	Last Quarter.	24	7 33 P.M.	7 22 P.M.	7 10 P.M.	6 58 P.M.	6 27 P.M.
	New Moon.	31	3 54 P.M.	3 42 P.M.	3 30 P.M.	3 19 P.M.	2 48 P.M.
Septem'r.	First Quarter.	7	8 21 A.M.	8 10 A.M.	7 58 A.M.	7 46 A.M.	7 15 A.M.
	Full Moon.	15	8 2 A.M.	7 50 A.M.	7 38 A.M.	7 26 A.M.	6 55 A.M.
	Last Quarter.	23	7 46 A.M.	7 34 A.M.	7 22 A.M.	7 11 A.M.	6 39 A.M.
	New Moon.	30	12 13 A.M.	12 1 A.M.	29d 11 49 P.M.	29d 11 37 P.M.	29d 11 6 P.M.
ober.	First Quarter.	6	9 2 P.M.	8 50 P.M.	8 38 P.M.	8 27 P.M.	7 56 P.M.
	Full Moon.	15	1 23 A.M.	1 11 A.M.	12 59 A.M.	12 47 A.M.	12 16 A.M.
	[illegible]	[illegible]	6 9 P.M.	5 57 P.M.	5 45 P.M.	5 34 P.M.	5 3 P.M.

devote a very small amount of time to the subject. As you doubtless know, the essential feature of a star spectroscope is the prism or train of prisms by which the star light is divided into its constituent parts. After passing through the prisms the light of the star is spread out into a long band, which shows all the colors of the rainbow, beginning

FIG. 7.

SPIRAL NEBULA IN CANES VENATICI.

Photographed with the two-foot reflecting telescope of the Yerkes Observatory (Ritchey).

with red at one end and passing through orange, yellow, green and blue, to violet at the other. This band is crossed by lines, and the problem of the spectroscopist is to interpret the meaning of these lines. If the lines are dark he knows that the light of the star after originat-

ing in an interior incandescent body has passed through a mass of cooler vapors, and that during its transmission some of the light has suffered absorption. If, on the other hand, the lines are bright, he knows that the region where they are produced is hotter than that lying below. Thus a single glance at the spectrum of a star is sufficient to give important information regarding the physical condition of its atmosphere.

But the spectral lines are able to tell a far more complete story of stellar conditions. If their exact position in the spectrum can be measured it becomes possible to determine the chemical composition of the star's atmosphere. And here the spectroscopist may be said to have the advantage of the archeologist, in that the key to stellar hieroglyphs is a master key, capable of interpreting not merely the language of a single people or a single age, but of laying bare the secrets of the most distant portions of the universe and applying with equal force to the primitive and to the most highly developed forms of celestial phenomena. If we take a piece of iron wire and turn it into vapor in the intense heat of an electric arc lamp we find that the light which the glowing iron vapor emits, when spread out into a spectrum by a prism, consists of a series of lines characteristically spaced and always occupying the same relative positions. In the same way every other element when transformed into vapor by a sufficiently intense heat emits characteristic radiations, consisting of groups of lines occupying definite positions in the spectrum. It is thus easy to see how the presence of iron vapor can be detected in the atmosphere of Sirius or in that of the sun. In the spectrum of each of these stars we find a group of lines occupying the same relative positions as the lines furnished by the iron vapor in an electric arc. Hydrogen gives an even more characteristic group of lines, which grow closer and closer together as we pass from the red end of the spectrum toward the violet. This group occurs in the spectra of thousands of stars and serves as an important guide in determining a star's place in a general scheme of stellar evolution.

The practical means of carrying out this method of research may be illustrated by a reference to the stellar spectroscope employed with the 40-inch Yerkes telescope. The spectroscope is rigidly attached to the lower end of the telescope tube. The image of a star formed by the 40-inch lens passes into the spectroscope through a slit about one one-thousandth of an inch wide. After analysis by a train of three prisms an image of the resulting spectrum is formed by a suitable lens upon a photographic plate. In making the photograph it is only necessary to keep the image of a star exactly on the slit throughout the exposure, which may occupy from one minute to several hours, the duration depending upon the brightness of the star.

Richard Adams Locke

Engraved by W.T Fry.

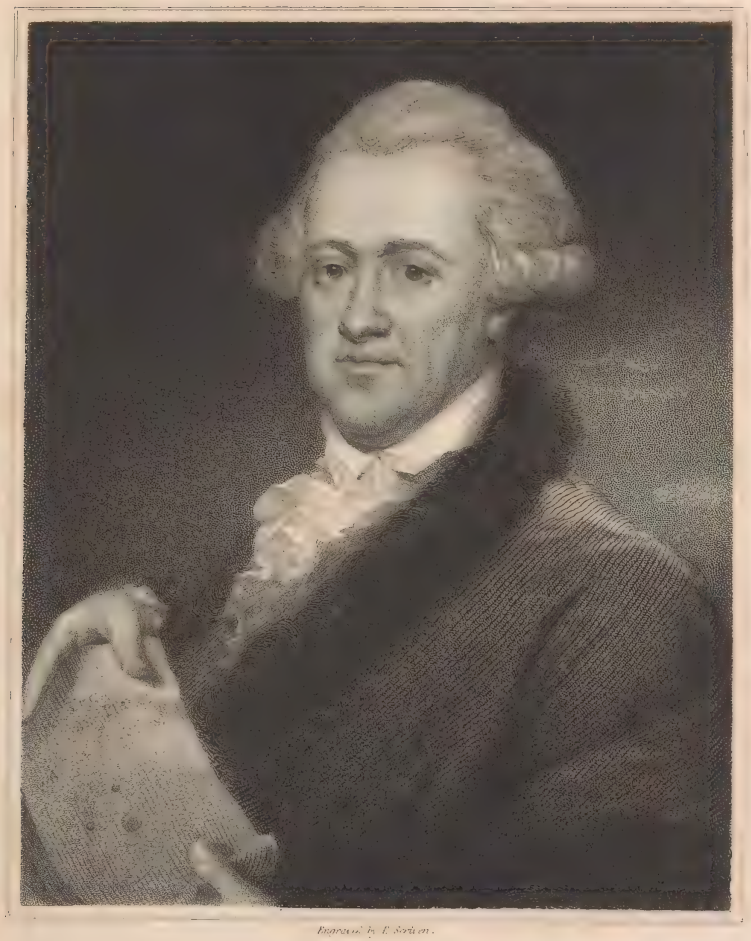
SIR ISAAC NEWTON.

OB.1727.

FROM THE ORIGINAL OF KNELLER, IN THE COLLECTION OF

THE RIGHT HON^BLE THE EARL OF EGREMONT.

London, Published May 1, 1829, by Harding & Lepard, Pall Mall East



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SIR W. HERSCHELL.

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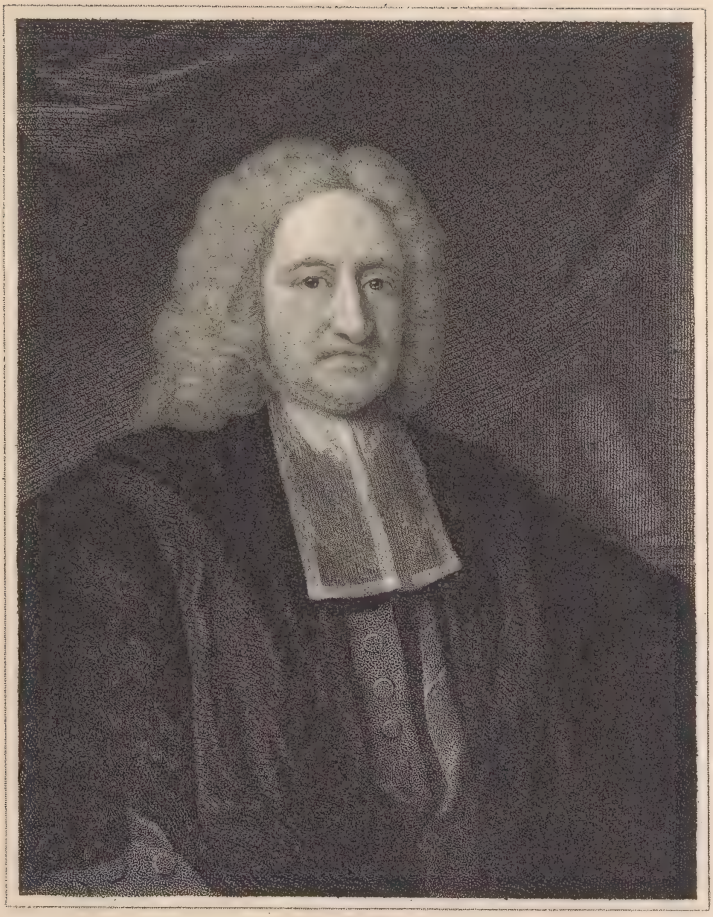
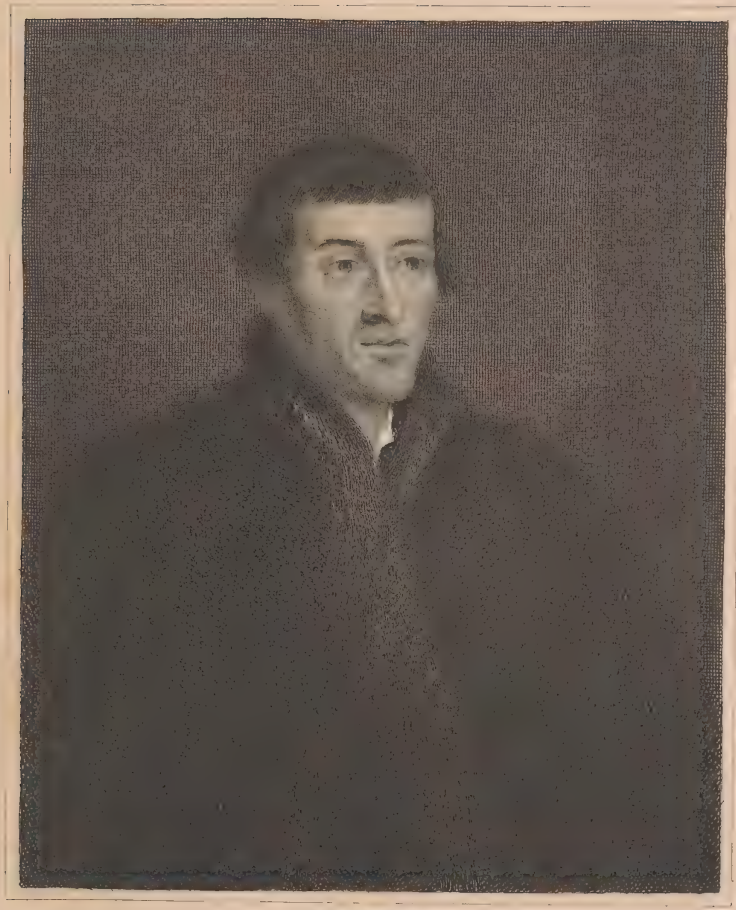


HALLEY



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NICOLAO COPERNICO

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JOHN KEPLER

David Brewster LL.D. F.R.S.

Portrait Gallery of Hogg's Weekly Instructor.

Nature April 25th 1881

Robert Wilhelm Bunsen

Engraved by C. H. Jeens

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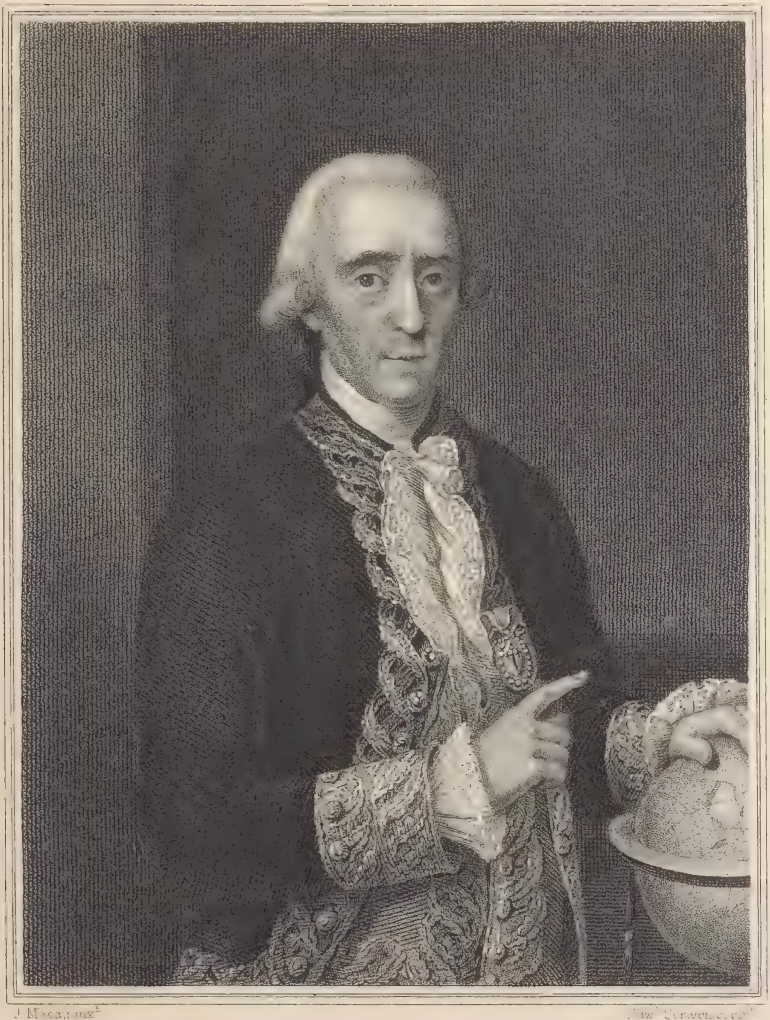

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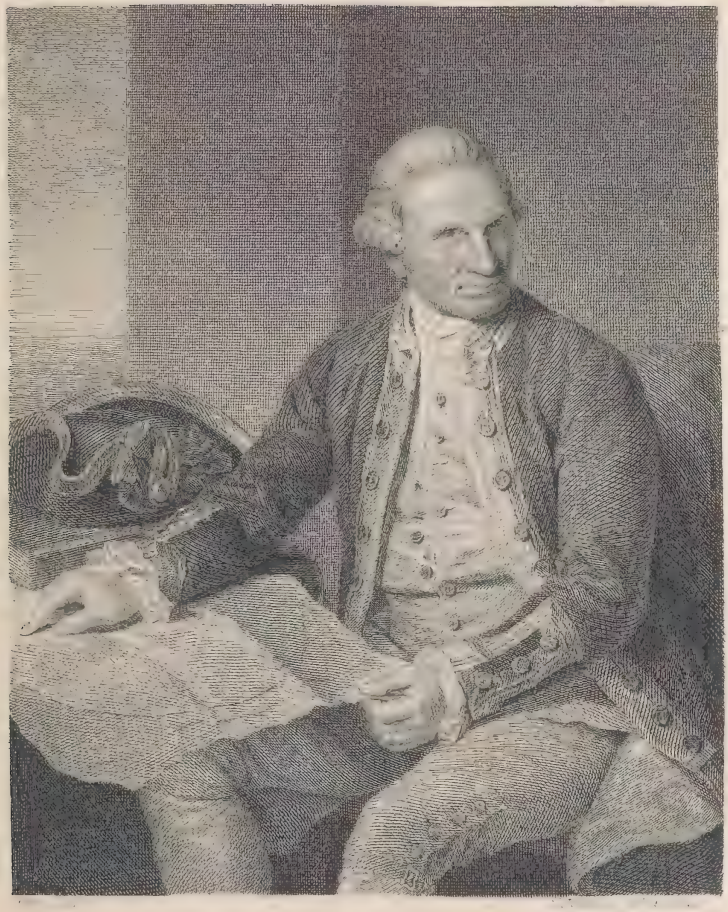

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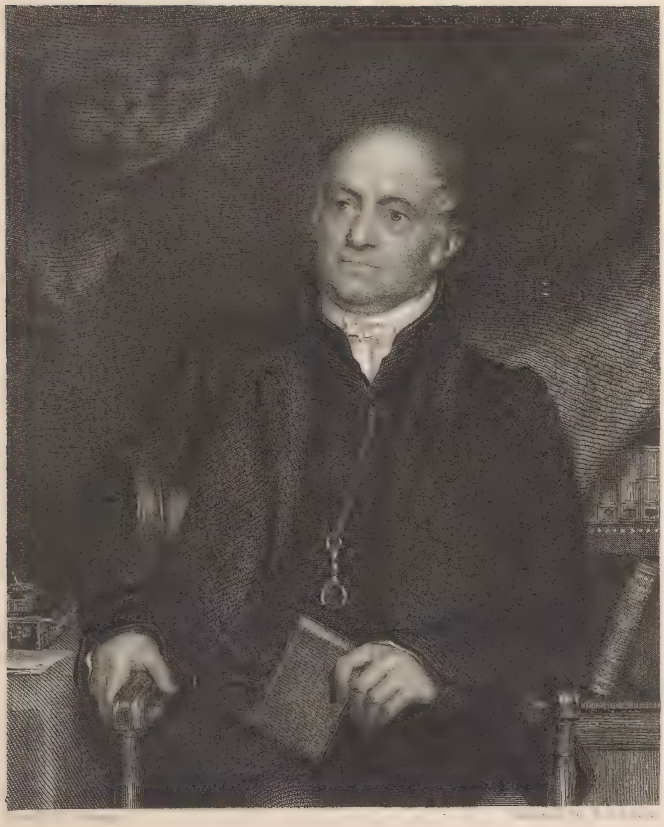
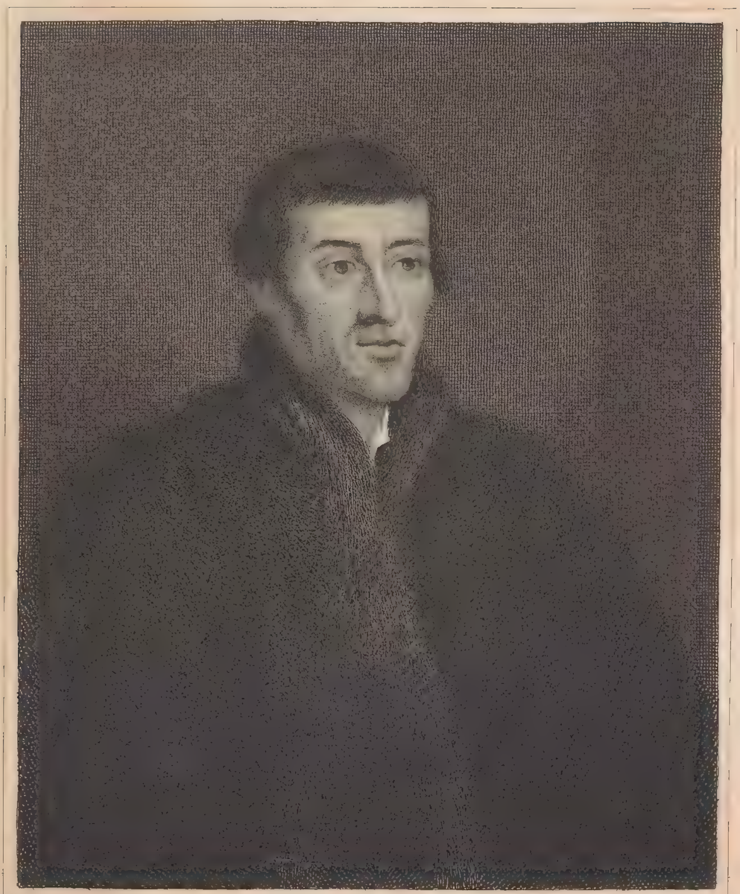


OLINTHUS GREGORY, LLD FRAS &c

Olinthus Gregory



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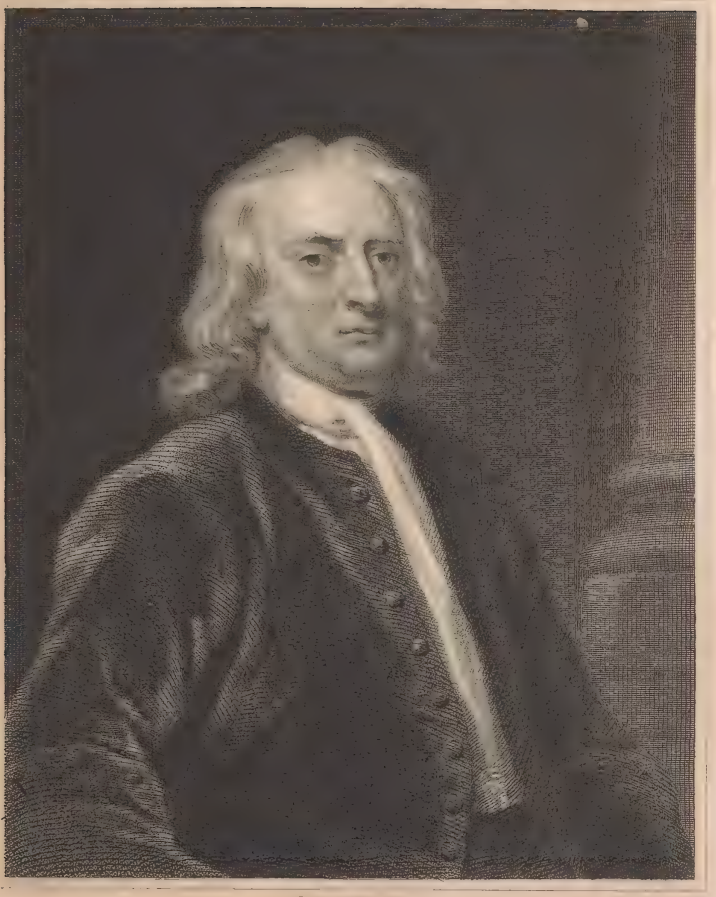

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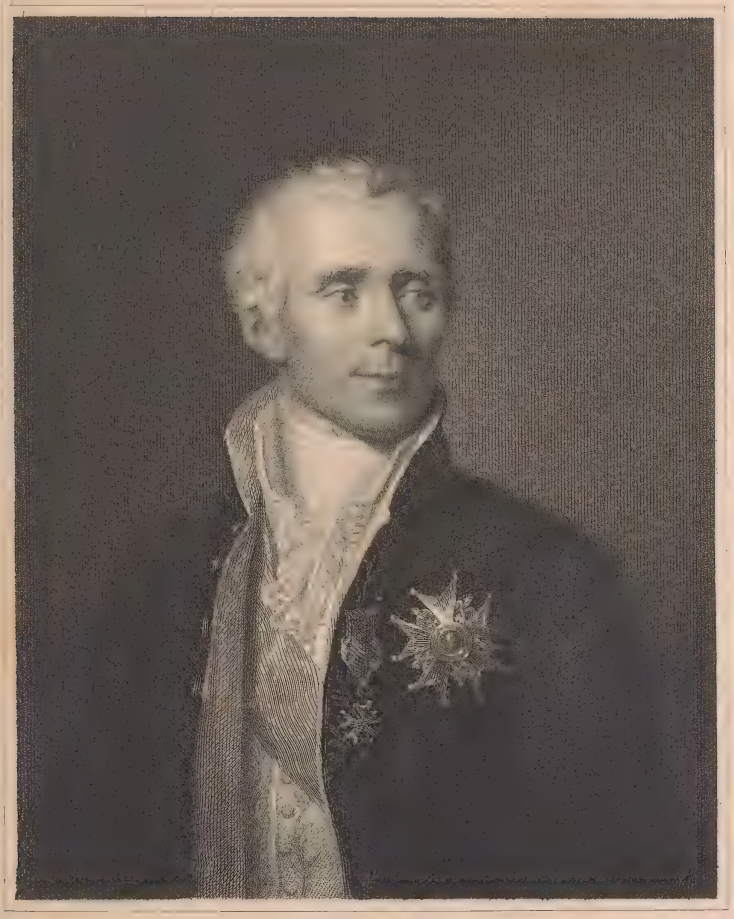

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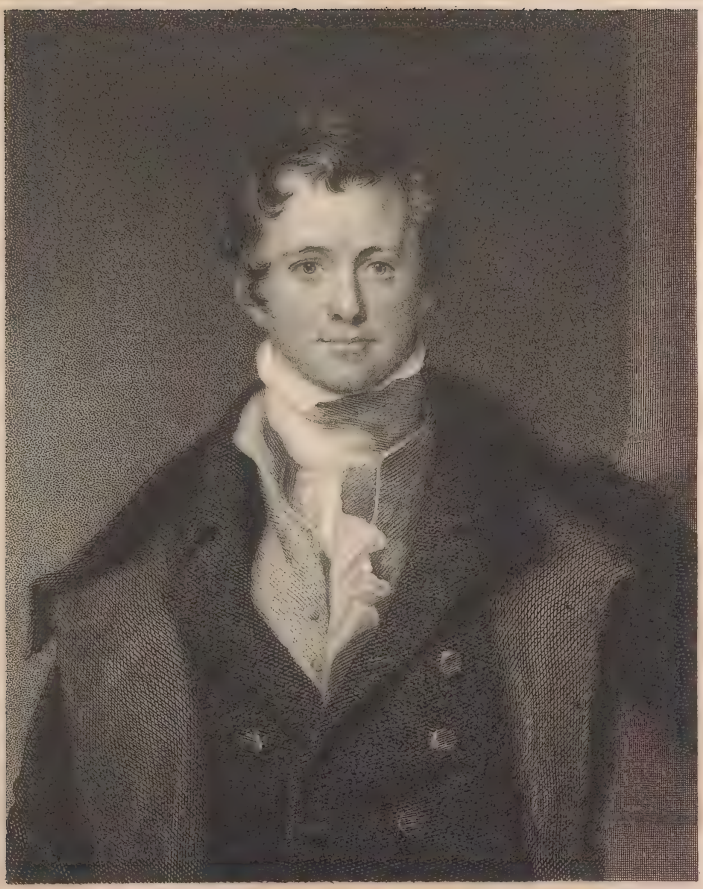
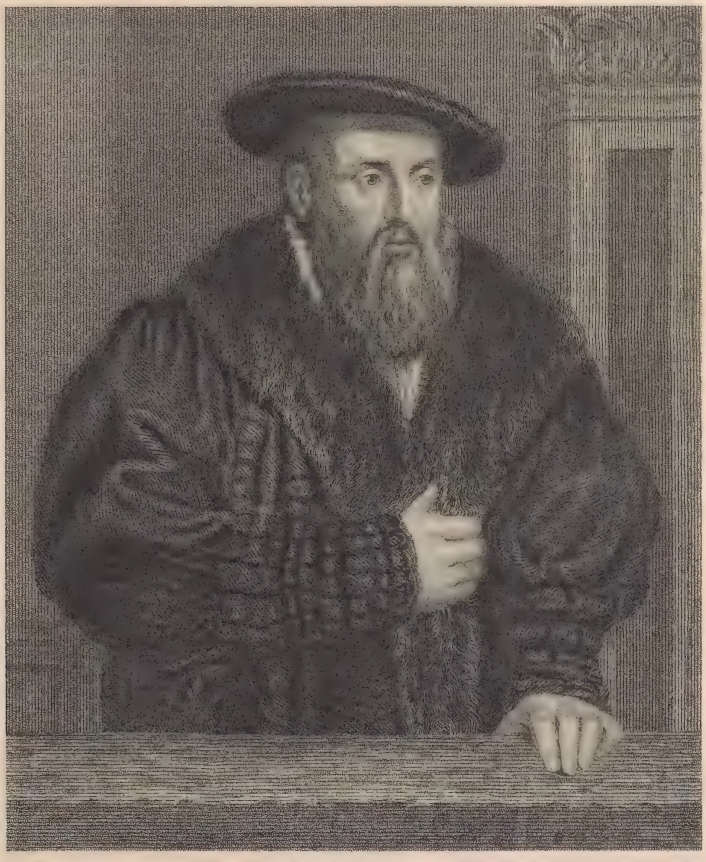
GALILEO GALILEI.



SIR HUMPHREY DAVY



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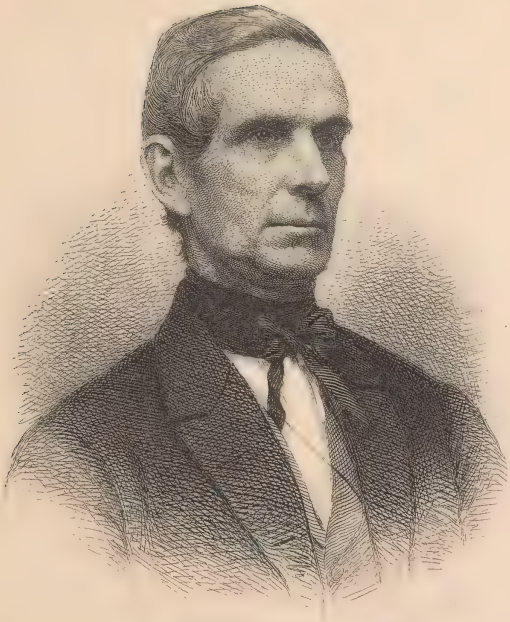
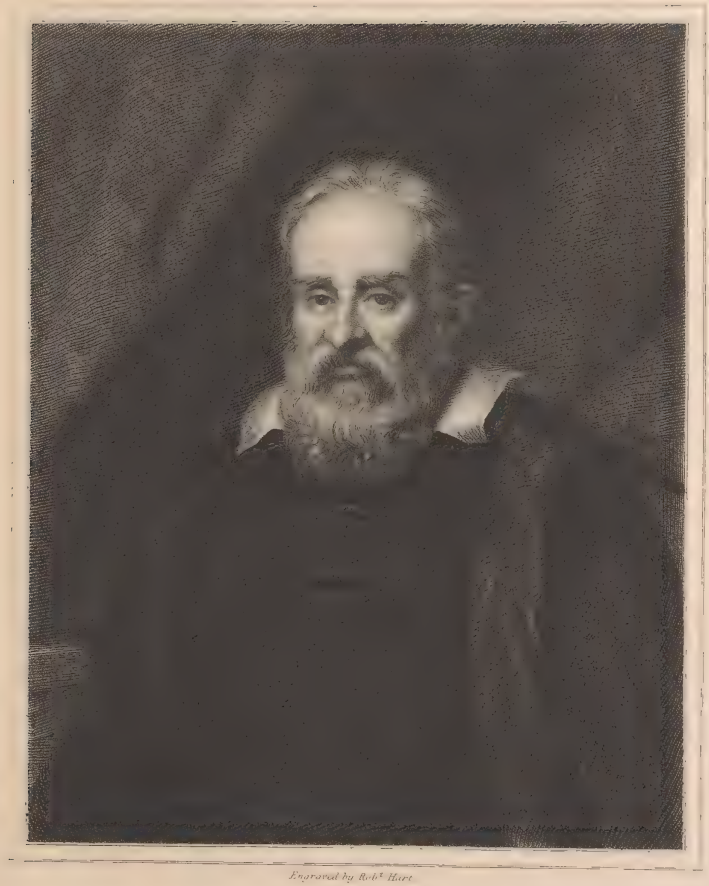
PROFESSOR JOHN PLAYFAIR.



William Gowans.



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GALILEO.

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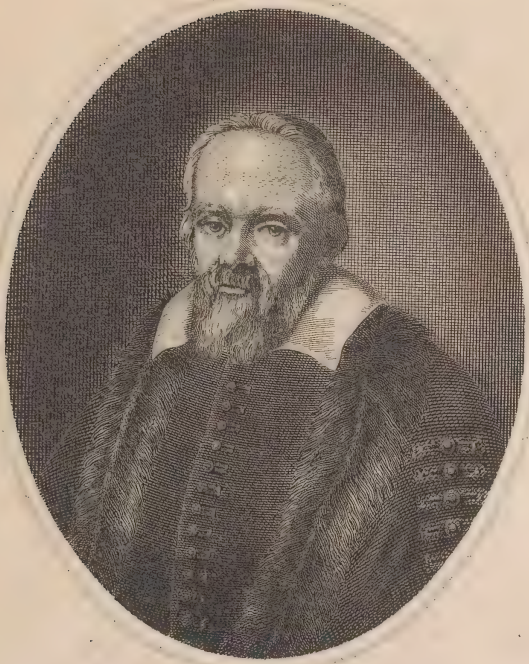
TYCHO BRAHE.



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GALILEO GALILEI.

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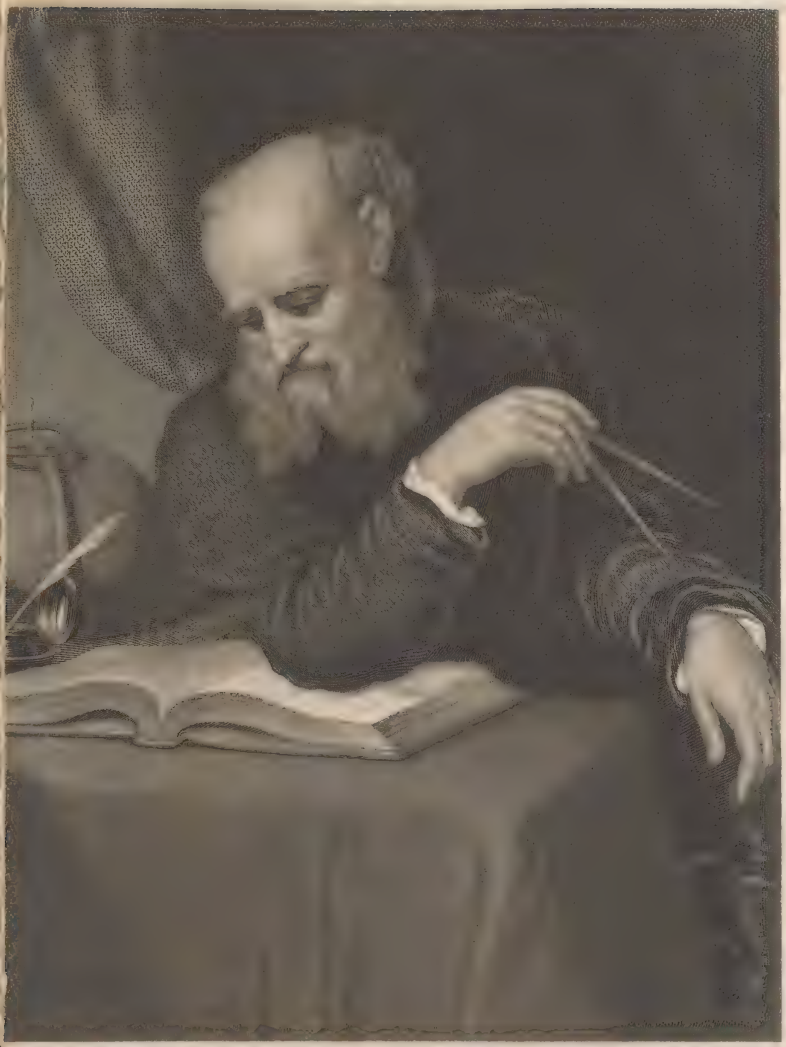

ENGRAVED BY SAMUEL SHARPLESS. THE ORIGINAL BY H.W. WYATT

GALILEO

Water Measures.

WEIGHT OF WATER.

1	cubic inch	.03617	pound.	1	cylindrical foot	6.0	U. S. gals.
12	cubic inches	.434	pound.	2.282	cylindrical feet	112.0	pounds.
1	cubic foot (salt)	64.3	pounds.	45.64	cylindrical feet	2240.0	pounds.
1	cubic foot (fresh)	62.5	pounds.	1	imperial gallon	10.0	pounds.
1	cubic foot	7.48052	U. S. gals.	11.2	imperial gallons	112.0	pounds.
1.8	cubic feet	112.0	pounds.	224	imperial gallons	2240.0	pounds.
35.84	cubic feet	2240.0	pounds.	1	U. S. gallon	8.355	pounds.
1	cylindrical inch	.02842	pound.	13.44	U. S. gallons	112.0	pounds.
12	cylindrical inches	.341	pound.	268.8	U. S. gallons	2240.0	pounds.
1	cylindrical foot	49.10	pounds.				

NOTE.—The centre of pressure of a body of water is at two-thirds the depth from the surface.

THEORETICAL VELOCITY OF WATER IN FEET PER SECOND.

Head, Feet.	Velocity, Feet per Second.	Head, Feet.	Velocity, Feet per Second.	Head, Feet.	Velocity, Feet per Second.	Head, Feet.	Velocity, Feet per Second.
10	25.4	25	40.1	55	59.5	85	74.0
12	27.8	30	43.9	60	62.1	90	76.1
15	31.1	35	47.4	65	64.7	95	78.2
18	34.0	40	50.7	70	67.1	100	80.3
20	35.9	45	53.8	75	69.5	125	89.7
22	37.6	50	56.7	80	71.8	150	98.3

PRESSURE OF WATER PER SQUARE INCH AT DIFFERENT ELEVATIONS.

Height in Feet.	Pressure.	Height in Feet.	Pressure.	Height in Feet.	Pressure.	Height in Feet.	Pressure.
6	2.60	35	15.16	90	38.98	160	69.31
8	3.40	40	17.32	100	43.31	170	73.64
10	4.33	45	19.49	110	47.64	180	77.97
15	6.49	50	21.65	120	51.98	190	82.30
20	8.66	60	25.99	130	56.31	200	86.63
25	10.82	70	30.32	140	60.64	215	93.14
30	12.99	80	34.65	150	64.97	230	99.63

Temperature of Steam

ATMOSPHERIC PRESSURE 14.7 DEGREES IN FAHRENHEIT SCALE.

Pressure Per Sq. Inch.	Degrees of Temperature.	Pressure Per Sq. Inch.	Degrees of Temperature.	Pressure Per Sq. Inch.	Degrees of Temperature.	Pressure Per Sq. Inch.	Degrees of Temperature.
1	216.3	12	244.3	32	277.0	80	323.9
2	219.4	14	248.3	34	279.6	85	327.6
3	222.4	16	252.1	40	286.9	90	331.1
4	225.2	18	255.7	45	292.5	95	334.5
5	227.9	20	259.2	50	297.8	100	337.8
6	230.5	22	262.5	55	302.7	105	341.0
7	233.0	24	265.6	60	307.4	110	344.0
8	235.4	26	268.6	65	311.8	115	347.0
9	237.7	28	271.5	70	316.0	120	350.0
10	240.0	30	274.3	75	320.0	125	352.8

Steam flows into atmosphere at the rate of 650 feet per second.

Tensile Strength of Materials.

WEIGHT OF POWER REQUIRED TO TEAR ASUNDER ONE SQUARE INCH.

Materials.	Lbs. Avoir.	Materials.	Lbs. Avoir.	Materials.	Lbs. Avoir.	Materials.	Lbs. Avoir.
Brass	42,000	Iron, rivets, Am.	53,300	Tin 10, Antimony 1	11,000	Slate	12,000
" yellow	18,000	" " Eng.	65,000	Zinc	3,500	Ash	14,000
Bronze, greatest	56,788	" Wire, Am.	78,600	" sheet	16,000	Beech	11,500
" least	17,698	" Wrought wire	103,000	Brick, fire	65	Cedar	11,400
Copper, bolt	36,800	Lead, cast	1,800	" inferior	100	Chestnut, sweet	10,500
" cast Am.	24,250	" milled	3,320	" well burned	750	Cypress	6,000
" rolled	36,000	" wire	2,580	Cement, bluestone	77	Deal, Christiana	12,400
" wire	61,200	Platinum, Wire	53,000	" hydraulic	234	Elm	13,400
" wrought	34,000	Silver, cast	40,000	" Portland, 6 mo	414	Fir, strongest	12,000
Gold, cast	20,000	Steel, Am. Tool Co.	179,980	Chalk	118	Locust	20,500
Iron, cast, Low Moor, No. 2	14,076	" blistered, soft	104,000 123,000	Glass, crown	2,346	Mahogany	21,000
Iron, Cast Am.	18,000 30,000	Steel, cast, maxi'm.	142,000	Gutta-percha	3,500	Maple	10,500
		" " mean	88,657	Ivory	16,000	Oak, Am. white	11,500
Iron, wrought, best Swedish bar	72,000	" plates, crosswise	93,700	Leather belts	330	Pear	9,800
Iron, bolts	52,250	" " lengthwise	96,300	Limestone	670 2,800	Pine, Am. white	11,800
" hammered	53,913	Steel, puddled, extreme	173,817	Marble, Italian	5,200	" pitch	12,000
" mean of Am.	51,929	Steel, razor	150,000	" White	9,000	Poplar	7,000
" " Eng.	53,900	Tin, Banca	2,122	Plaster of Paris	72	Spruce, white	10,200
" plates, boiler American	48,000 62,000	" cast, block	5,000	Rope, hemp, tarred	15,000	Sycamore	13,000
				" manila	9,000	Teak	14,000
				" wire	37,000	Walnut	7,800
						Willow	13,000

Tensile Strength is the resistance of the fibres or particles of a body to separation. It is therefore proportional to their number, or to the area of its transverse section. The fibres of wood are strongest near the centre of the trunk or limb of a tree.

Principal Elements of the Solar System.

Name.	Mean Distance from Sun, Millions of Miles.	Sidereal Period, Days.	Orbit Velocity, Miles per Second.	Mean Diameter, Miles.	Mass, Earth =1.	Volume, Earth =1.	Density, Earth =1.	Gravity at Surface, Earth =1.
Sun	.....	.....	.....	866,400	331100	1310000	0.25	27.65
Mercury	36.0	87.969	23 to 35	3,030	0.125	0.056	2.23	0.85
Venus	67.2	224.701	21.9	7,700	0.78	0.92	0.86	0.83
Earth	92.8	365.256	18.5	7,918	1.00	1.00	1.00	1.00
Mars	141.5	686.95	15.0	4,230	0.107	0.152	0.72	0.38
Jupiter	483.3	4332.58	8.1	86,500	316.0	1309	0.24	2.65
Saturn	886.0	10759.22	6.0	71,000	94.9	721	0.13	1.18
Uranus	1781.9	30686.82	4.2	31,900	14.7	65	0.22	0.91
Neptune	2791.6	60181.11	3.4	34,800	17.1	85	0.20	0.88

The number of asteroids discovered up to present date is about 465. A number of these small planets have not been observed since their discovery, and are practically lost. Consequently it ...ow sometimes a matter of doubt, until the elements have been computed, whether the supposed ...is really new, or only an old one rediscovered.

Seed Planting in the United States.

(Compiled from reports of the Department of Agriculture.)

NEW ENGLAND.

Kind of Crop.	Date of Planting.	Best Soil.	Amount of Manure per Acre.	Amount of Seed per Acre (1).	Weeks to Mature
Corn	May 10 to 30	Sandy or clay loam	8 to 12 tons	8 to 12 qts	14-
Wheat	Fall or Spring	Clay loam	18 tons	2 bu-h	
Oats	Apr. to May	Strong loam	6 to 8 tons	2 to 3 bush	11-
Barley	Apr. to June 20	Strong loam	7 to 8 tons	2 to 3 bush	10-
Rye	Apr. to May, Sept.	Medium loam	7 to 8 tons	5 to 6 pecks	
Buckwheat	June 1 to 20	Light loam	4 to 6 tons	1 to 1¼ bush	10-
White beans	May to June	Sandy loam	7 to 8 tons	8 to 16 qts	8-
Potatoes	Apr. 15 to May 1	Rich loam	15 to 20 tons	8 to 20 bush	12-
Turnips	July 1 to Aug. 3	Sandy loam	10 tons	1 lb	
Mangels	Apr. 15 to May 5	Strong heavy loam	8 to 15 tons	4 to 6 lbs	17-
Tobacco	Seed bed Apr.	Sandy loam	8 to 12 tons		9-
Hay					

MIDDLE STATES.

Corn	Apr. 20 to May 30	Medium loam	8 to 12 tons manure	6 to 8 qts	16-
Wheat	Sept. 20 to Oct. 20	Loam	8 tons; 300 lbs. fer	2 bush	41-
Oats	Mar. to May	Moist clay loam	8 tons; 300 lbs. fer	2 to 2½ bush	16-
Barley	Mar. to May	Clay loam	8 tons; 300 lbs. fer	2 to 2½ bush	13-
Rye	Sept. 1 to Oct. 1	Sand or gravel loam	8 tons; 300 lbs. fer	1½ bush	40-
Buckwheat	June to July	Loam	5 tons	½ to 1½ bush	8-
White beans	May to June	Sandy loam	8 tons	1½ bush	13-
Potatoes	Mar. to May	Loam	10 to 18 tons	8 to 15 bush	14-
Sweet potatoes	May to June	Sandy loam		10 to 12 bush	10-
Cabbage	Mar. to July	Clay or sandy loam	300 to 600 lbs. fer.	4 to 8 oz	8-
Turnips	July	Loam		2 to 5 lbs	10-
Mangels	May	Loam	10 to 20 tons	10 to 15 bush	15-
Flax	May	Limestone loam		20 qts	8-
Tobacco	Seed bed Mar.	Sandy loam	Commercial fer		15-
Hay, timothy	Aug. to Oct	Clay loam		6 to 8 qts	
Hay, clover	Feb. to Apr.	Clay loam		6 qts	

CENTRAL AND WESTERN STATES.

Corn	Apr. 1 to June 1	Black or sandy loam	5 to 10 tons	6 qts	16-
Wheat	Fall or Spring	Strong loam	8 tons	2 bush	40-
Oats	Apr. 1 to May 1	Clay loam	8 tons	2 to 3 bush	12-
Barley	Fall or Spring (1)	Clay loam	8 tons	2 bush	11
Rye	Sept. 1 to 30	Light loam	8 tons	1 to 2 bush	35-
Buckwheat	June	Clay loam	5 tons	1 to 2 bush	10-
White beans	May 10 to June 10	Clay loam	8 tons	1½ bush	1
Potatoes	Mar. 15 to June 1	Sandy loam	5 to 10 tons	5 to 10 bu h	10-
Turnips	July 15 to Aug. 30	Loam or muck	8 to 10 tons	1 to 6 lbs	10-
Mangels	Apr. 1 to May 15	Sandy loam	8 to 12 tons	6 to 8 lbs	22-
Flax	Mar. 15 to May 15	Loam	10 to 15 tons	2 to 3 pecks	15-
Tobacco	Seed bed, Mar.	Sandy loam	8 to 10 tons	Oz. to 6 sq. rd.	15-
Hay	Apr. to May	Clay loam	10 tons	8 to 15 lbs	

SOUTHERN STATES.

Cotton	Feb. to May 15	Sandy loam (2)		1 to 3 bush	20-
Corn	Feb. to June	Rich loam	10 bush. cot. seed	8 qts	18-
Wheat	Sept. to Nov	Clay loam (2)	8 tons	2 bush	4
Oats	Feb., May, Sept.	Clay loam (2)	8 to 10 tons	2½ bush	1
Barley	Apr. to May	Clay loam (2)	8 to 10 tons	2½ bush	1
Rye	Sept. to Oct.	Clay loam (2)	10 tons	1½ bush	4
White beans	Mar. to May	Light loam	8 tons	1 to 2 bush	7-
Cabbage	Oct., Mar. to May	Light loam	6 to 10 tons	¼ to ½ lbs	1
Watermelons	Mar. 1 to May 10	Rich, light loam	5 tons; 300 lbs. fer	2 to 7 lbs	16-
Onions	Feb. 1 to Apr. 10	Loam or muck			16-
Potatoes	Jan., Feb. to Apr.	Light loose loam	8 to 12 tons	8 to 10 bush	11-
Sweet potatoes	May to June	Sandy loam		10 to 12 bush	12-
Pumpkins	Apr. 1 to May 1	Rich, light loam		4 to 7 lbs	17-
Tomatoes	Jan. 1 to Feb. 19	Rich, sandy loam		4 to 9 oz	14-
Turnips	Feb., Aug., Apr.	Rich, light loam		2 to 6 lbs	8-
Tobacco	Seed bed, Mar.	Sandy loam	8 to 15 tons	oz. to 6 sq. rd.	18-
Cow peas	May 1 to July 15	Sandy loam	200 to 300 lbs. phos.	2 to 5 pecks	6

(1) The standard varieties of seed planted in the several sections of the United States are as follows: Corn—New England, leaming, sanford, flint; Middle States, leaming, white dent, yellow dent; Central and Western States, leaming, sanford, flint, white dent; Southern States, hickory king, goard seed, Cox prolific. Wheat—Middle States, fultz; Central and Western States, fultz, poole, fife; Southern States, fulcaster. Oats—New England, white; Middle States, white, black; Central and Western States, gray Norway, silver mine, Russian; Southern States, Texas rustproof. Barley—Middle States, mansbury; Southern States, Tennessee Winter. Rye—New England, white; Middle States, white, Winter; Central and Western States, Winter; Southern States, excelsior Winter. Buckwheat—Middle States, silver hull; Central and Western States, silver hull. Potatoes—New England, green mountain, carmen 3, rose; Middle States, rose, carmen 3, rural 2; Central and Western States, hebron, rural, early rose, early Ohio. Tobacco—Central and Western States, yellow prior, Spanish, white burley. Hay, clover—Middle States, medium red. Sweet Potatoes—Middle States, yellow Jersey; Southern States, yellow Jersey. Cotton—Southern States, Texas stormproof. Spring wheat is to some extent grown in Ohio, Indiana, Illinois and many other States. It matures in eighteen to twenty weeks.

(2) In Texas the black loam is a good soil for cotton, corn, wheat and most other field crops.

Principal Elements of the Solar System.

Name.	Mean Distance from Sun, Millions of Miles.	Sidereal Period, Days.	Orbit Velocity, Miles per Second.	Mean Diameter, Miles.	Mass, Earth =1.	Volume, Earth =1.	Density, Earth =1.	Gravity at Surface, Earth =1.
Sun	.....	.....	.....	866,400	331100	1310000	0.25	27.65
Mercury	36.0	87.969	23 to 35	3,030	0.125	0.056	2.23	0.85
Venus	67.2	224.701	21.9	7,700	0.78	0.92	0.86	0.83
Earth	92.8	365.256	18.5	7,918	1.00	1.00	1.00	1.00
Mars	141.5	686.95	15.0	4,230	0.107	0.152	0.72	0.38
Jupiter	483.3	4332.58	8.1	86,500	316.0	1309	0.24	2.65
Saturn	886.0	10759.22	6.0	71,000	94.9	721	0.13	1.18
Uranus	1781.9	30686.82	4.2	31,900	14.7	65	0.22	0.91
Neptune	2791.6	60181.11	3.4	34,800	17.1	85	0.20	0.88

The number of asteroids discovered up to present date is about 465. A number of these small planets have not been observed since their discovery, and are practically lost. Consequently it is now sometimes a matter of doubt, until the elements have been computed, whether the supposed [illegible] is really new, or only an old one rediscovered.