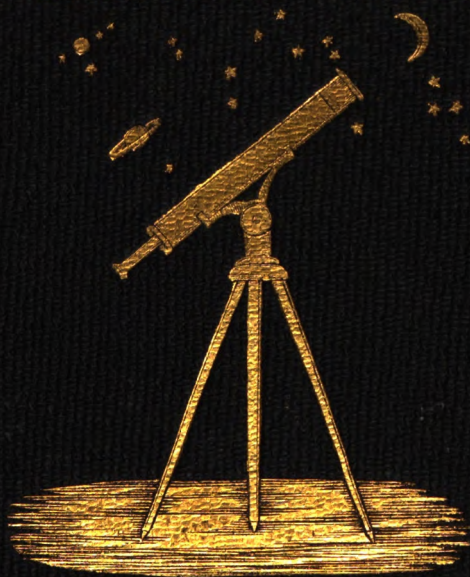

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OBSERVATIONAL ASTRONOMY
AND
COMPANION TO THE TELESCOPE.



OBSERVATIONAL ASTRONOMY,

AND

GUIDE TO THE USE OF THE

TELESCOPE ;

CONTAINING A LIST OF NEARLY 300 DOUBLE STARS AND NEBULÆ,
WITH TWENTY MAPS OF CONSTELLATIONS, &c.,

BY A CLERGYMAN.

EDITED BY J. T. SLUGG,

AUTHOR OF "THE STARS AND THE TELESCOPE," AND "THE CONSTRUCTION AND
USE OF THE TELESCOPE."

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P R E F A C E.

THE Author has learned by experience to sympathise with those students in Observational Astronomy who do not possess the advantage of an equatorially mounted telescope, and whose time and patience are often severely taxed, fishing in vain for the celestial objects described in popular works on astronomy. He resolved to devote an occasional leisure hour towards removing some of the difficulties, and constructing some "finger-posts" and "mile-stones" along the principal highways and bye-ways of the celestial regions, to guide young travellers in their first journeyings in "pursuit of knowledge under difficulties."

It is not the design of this work to furnish information concerning astronomy as a science. That knowledge may be readily obtained from the numerous works in general circulation. Many writers on astronomy, in describing the wonders of the heavens, seem to think that nothing more is necessary than to give the Right Ascension and Declination of the celestial object described, assuming that observers generally are possessed of an equatorial stand. A great mistake, truly; especially when it is considered that the cost of the equatorial mounting has hitherto placed it beyond the reach of all but the wealthy. It must, however, be a consolation to the observer of limited means to learn that many of the principal objects of the starry firmament may be very well observed with a fair three-inch aperture telescope, on a plain stand, and at a very moderate expense, aided by some such diagram-maps as those contained in this work.

These maps represent 34 of the principal constellations, with sections of 12 others ; showing the positions of above 200 double stars and 85 star clusters and nebulae, all of which may be found, by the star pointers traced on the maps, with a non-equatorial telescope. Four lithographed plates of objects have been introduced to give the student an idea of the form of several of the principal celestial objects.

The chief aim of the Author in this work has been to simplify observational astronomy, to divest it of its learned technicalities, and make it intelligible and practicable to all who may have sufficient interest, skill, and means to procure or construct an astronomic telescope, and who then anxiously look around and inquire “ *What* are the wonders to be seen in the heavens ? *Where* are they to be found ? and *How* are we to observe them ? ” An attempt is now made to answer these inquiries—whether successfully or otherwise will soon appear.

In every work on observational astronomy, the list of objects must necessarily be drawn from the same sources. The compilers of the great Catalogues were astronomers who possessed first-class instruments, ample means, and untiring zeal ; they reaped a rich harvest of discovery, and they generously poured out the treasures of their knowledge to the world, to become the common property of all who had means, interest, and ability to follow in exploring the glorious works of Creation.

The following selection of objects is taken chiefly from “The Bedford Catalogue,” as given by Admiral Smyth. For the descriptions generally, except when a quotation is given, the author is responsible. Several notices of objects have been derived from “Celestial Objects,” by the Rev. T. W. Webb. The maps of the constellations appended, which shew the positions of the objects, are copies of the sketches made from time to time in the

Author's note book, as a help in observations, and are given as an illustration of the system of pointers. The principal northern constellations are shown, including Orion, Virgo, and Ophiuchus, which partly descend below the equinoctial; Aquarius, Capricornus, Libra, Scorpio, and sections of some others have been added, as they contain some fine objects easily observed. The observation of celestial objects below the equinoctial, near the horizon, and with so few stars visible to the naked eye, requires an equatorial telescope to find them, and a finer atmosphere to observe them satisfactorily than generally belongs to the precincts of "the brick and mortar wilderness" of a large city.

EDITOR'S ADDRESS.

AFTER the publication of his manuals on Astronomy and The Telescope, encouraged by the success of his efforts to popularise the telescope, it was the Editor's intention to publish a Guide to the various celestial objects suitable for telescopic observation. The requisite leisure needed for such a purpose being denied him, he gladly entered into a mutual arrangement with a clerical friend, who, he found, was collecting suitable materials for the publication of such a work.

The maps and plates of objects are the product of the Author, as well as the descriptive catalogue of double stars and nebulae, with the exception of the magnitudes of

the stars, and the prefatory remarks at the head of each constellation, giving the times for its observation, &c., which have been inserted by the Editor.

Whilst the maps of the stars published by the Society for the Diffusion of Useful Knowledge, will teach the astronomical student the positions of the various constellations *with regard to each other*, the maps in this work are intended to point out the exact position in each constellation of the principal double stars and nebulae. Their whereabouts may be easily ascertained by noticing how they are situated with regard to the principal stars, and drawing lines from one to the other, forming triangles, parallelograms, &c. The double stars are marked *dup* (*duplex*, double), whilst the nebulae are indicated by a round dotted disc.

The Editor trusts the work will prove to be of considerable service to the student of observational astronomy, enabling him to make the best use of his telescope, and revealing to him still more of the wonders of the starry firmament.

J. T. S.

214, STRETFORD ROAD, MANCHESTER,
JUNE, 1862.

PRACTICAL ASTRONOMY.

THE possession of an astronomical telescope is—or ought to be—a source of pleasure of the purest and most elevated character. Its employment, however, should not be limited to a mere occasional or fitful survey of one or two of the planets. There are many persons, whose operations in practical astronomy begin and end with once or twice a year bringing out their telescope, and shewing some friend the ring of Saturn, the satellites of Jupiter, or the mountains and shadows on the surface of the moon. If Sir Isaac Newton, at the close of such a life as his, should say of himself, that he was “like a boy on the sea shore, picking up a few pebbles, whilst the great ocean of truth lay before him;” may not such a sentiment be applied with still greater force to such persons? How vast is the ocean which may be explored by means of such an instrument as the astronomical telescope, and how great the reward of those who will patiently and assiduously devote themselves to the work of practical astronomy! It is very natural that the amateur, on his first becoming possessed of a suitable instrument, should *begin* with such objects as Jupiter, Saturn, and the moon—the A B C of the science—but he should not *end* there. They are the *alpha*, but not the *omega*, of observational astronomy.

After the amateur has become an adept in the use of his telescope, by observations on the planets, &c., he should launch out into greater depths, and commence a diligent and systematic survey of the double stars and nebulae which lie scattered through space, presenting a boundless field for investigation and research. For such a purpose,

a lifetime will not be found too long. The subject of observational astronomy divides itself naturally into two parts—1st, *What* to observe; 2nd, *How* to observe. It is the principal object of the present volume to point out the chief objects of interest visible in the northern hemisphere for astronomical observation.

THE CONSTELLATIONS.

The first step in observational astronomy is to obtain a knowledge of the various constellations. In very ancient times, for the convenience of reference, the stars were thus grouped into artificial combinations, representing men and animals. As a proof of the antiquity of the names of some of the constellations, we have the fact that the Pleiades and Orion are mentioned in the book of Job; whilst Homer and Hesiod describe several others by names still in use.

Forty-eight of the ancient constellations are still retained. At present the stars are divided into 91 constellations; viz., 12 zodiacal, 31 northern, and 48 southern. Of the stars composing these constellations, the magnitudes and respective positions of not less than 8,377 are laid down in the catalogue of the British Association. Of the 12 zodiacal constellations the following six are north of the equinoctial line :—

Aries,	Cancer,
Taurus,	Leo,
Gemini,	Virgo.

The remaining six are south of the equinoctial, viz. :—

Libra,	Capricornus,
Scorpio,	Aquarius,
Sagittarius,	Pisces.

These constellations, of course, all rise and set in England. The following eight do not set in the latitude of Greenwich :—

Ursa Major,	Draco,
Ursa Minor,	Cameleopardis,
Cassiopeia,	Perseus,
Cepheus,	Auriga.

The following eight constellations dip a little below the northern horizon :—

Andromeda,	Hercules,
Leo Minor,	Lyra,
Canes Venatici,	Cygnus,
Bootes,	Lacerta.

The following constellations rise and set *north* of the E. and W. points of the horizon.

Triangulum,	Vulpecula,
Musca Borealis,	Sagitta,
Corona Borealis,	Aquila,
Serpens,	Delphinus,
Ophiuchus,	Pegasus,
Scutum Sobieski,	Equuleus.

The following constellations rise and set *south* of the E. and W. points of the horizon :—

Cetus,	Hydra,
Orion,	Sextans,
Lepus,	Crater,
Monoceros,	Coma Berenicia,
Canis Major,	Corvus,
Canis Minor,	Pisces Australia.
Pexis Nautica,	

The following constellations attain a very low altitude above the southern horizon :—

Apparatus Sculptoris,	Argo Navis,
Eridanus,	Centaurus,
Fornax Chemica,	Lupus.
Columba Noaci,	

In the above lists some very small constellations are omitted.

ASTRONOMICAL MAPS AND GLOBES.

Diagrams and maps however well designed, and verbal descriptions however lucid, fail to give the astronomical student as correct an idea of the appearance of the heavens and the motions of the stars, with their relative positions with regard to each other and to the terrestrial observer, as a properly constructed celestial globe.

The celestial globe, however, in one respect is not a correct representation of the heavens. The principle of its construction assumes the observer's position to be *within* the globe. The principles of the science, as well as convenience in working certain problems require this ; but in looking on the globe as we really see it *from without*, the stars, when compared with the heavens, are all in reversed positions. A large concave sphere, with a terrestrial globe hung within it, would more correctly represent the mechanism of the heavens. Such a structure has been actually produced, but it is still preserved more as an object of curiosity than of utility. If the student will keep in mind his imaginary position, *within the globe*, and suppose its surface to be transparent, it will obviate all the difficulties arising otherwise from the difference of aspect of the stars on the surface of the globe, as compared with the heavens.

There is wanting at the present time a complete uniformity in globes and maps in the grouping of the stars under those figurative representations. One instance will illustrate a want of such uniformity :—On Newton's 18 inch globe, date 1857, the group of double stars, θ , κ , ι Bootis, 5° N. E. of Alkoid, is placed 7° E. of the uplifted hand of the Herdsman, while on the large maps of the Society for the Diffusion of Useful Knowledge, this group is placed on the hand of Bootes. Not 7° from it another group of double stars, 44, 39, 38 Bootis, is represented on

the hand of the figure by Newton, and is placed 7° from it by the authorities of the S. D. U. K.; and so likewise in many other instances.

Much confusion also arises from the want of uniformity in placing the *back* or *front* of the constellation figures towards the spectator, some observing one order, some another. Admiral Smyth complains that in many modern charts the figures of the constellations are drawn to *front* the observer, which alters the position of the object; but this is really only a return to the ancient practice, and an effort ought to be made to render it uniform. The ancients proceeded upon the supposition that the internal spectator saw the fronts of the figures, and the external spectator the backs. Hence, on their globes were seen the back view of the figures, but on their star maps the front view. The sooner a return is made to this ancient custom the better. A map of the stars is always properly an *inside* view of the heavens, and the globe will really appear so too, if the spectator will only imagine himself to be within it, and to look up to its star-surface from within.

The individual stars of a constellation are distinguished by the letters of the Greek alphabet, the first letters being generally assigned to the most conspicuous. There are, however, some exceptions to this rule. Beyond the number of the Greek letters, the stars are distinguished by *numerals*, as 61 Cygni, 70 Ophiuchi. The old Latin names of the constellations are usually retained in the books, and in the star-catalogues of astronomers. Many of the principal stars have ancient proper names as Vega, Regulus, Sirius, &c. The numerals which distinguish the lesser stars refer to the numbers on certain astronomical catalogues, as for instance, "Hamstead's Catalogue," generally known as the "British Catalogue." In speaking of a star, sometimes the Latin name of the constellation to which it belongs is put in the *nominative*, and some-

times in the *genitive* or possessive case. Hence we may read either Alpha *Lyra*, or Alpha *Lyræ*; Beta *Leo*, or Beta *Leonis*; 61 *Cygnus*, or 61 *Cygni*; γ *Virgo*, or γ *Virginis*, &c. If the student be not a Greek scholar, he ought by all means to make himself familiar with the *letters* of the Greek alphabet. The following are their characters and names :—

α ... a ... alpha	ι ... i ... iota	ρ ... r ... ro
β ... b ... bēta	κ ... k ... kappa	σ ... s ... sigma
γ ... g ... gamma	λ ... l ... lambda	τ ... t ... tau
δ ... d ... delta	μ ... m ... mu	υ ... u ... upsilon
ϵ ... ē ... epsilon	ν ... n ... nu	ϕ ... ph... phi
ζ ... z ... zēta	ξ ... x ... xi	χ ... ch ... chi
η ... ē ... ēta	$\omicron$... ō ... omicron	ψ ... ps ... psi
θ ... th ... thēta	π ... p ... pi	ω ... ō ... ōmēga

THE FIXED STARS.

The number of stars visible to the naked eye in the northern hemisphere, from the first up to the sixth magnitude inclusive, is thus given by M. Argelander :—1st magnitude, 9; 2nd, 34; 3rd, 96; 4th, 214; 5th, 550; 6th, 1439; Total, 2,342. The stars of the southern hemisphere have not been observed with sufficient accuracy to conclude any numbers with certainty, but it is believed that the total number in the heavens up to the sixth magnitude, distributed over the firmament from pole to pole, does not exceed 4,100. If to them be added the probable number of 7th magnitude stars, visible to the best eyes under very favourable circumstances, the total number would be about 6,000. No correct estimate can be made of the number of stars visible in the telescope, but it must be enormous. The most splendid stars visible in the northern hemisphere, are :—Vega, in *Lyra*; Capella, in *Auriga*; Arcturus, in *Bootes*; Altair, in *Aquila*; Adelbaran, in *Taurus*; Regulus,

in Leo ; Sirius, in Canis Major ; Procyon, in Canis Minor ; Betelgeux and Rigel, in Orion ; and Spica, in Virgo.

Several star clusters are visible to the naked eye :—The Pleiades and the Hyades, in Taurus ; the Præsepe, in Cancer ; and the great star cluster, in Perseus. Many very beautiful double stars are visible with very little optical power : as Mizar ζ Ursæ Majoris, Albireo β Cygni, ϵ Lyrae, γ Arietis, Mesartim β Scorpii, γ Delphinus, &c.

Some of the nebulae are also occasionally visible to some persons with the naked eye, as the nebula in the sword of Orion, the nebula in the girdle of Andromeda, and the nebula in Hercules, called Halley's, between the stars η and ζ ; the latter appears like a small round comet, through an opera glass.

About 36 stars are known as periodic or variable in their magnitudes. Sir J. Herschel has given a table of them. The stars δ in Cepheus and β in Lyra are remarkable for the regular periodicity of their lustre. A still more remarkable instance is that of the star Algol, in the constellation of Perseus ; but the most wonderful star of this class is Omicron, in the neck of Cetus. It retains its lustre for 14 days, equal to a large star of the 2nd magnitude. It then decreases continually for three months, when it becomes invisible. It remains invisible for five months, when it reappears and increases gradually for three months, until it recovers its greatest splendour ; such is the general succession of its phases. Its entire period is about 322 days.

The stars called *temporary* stars are of a still more mysterious character. Several have been known to blaze out in certain constellations with a lustre far exceeding stars of the first magnitude ; rivalling Jupiter and Venus when nearest the earth, and visible even in daylight ; and after some months they have entirely disappeared from the heavens, even to the optical powers of the largest telescopes.

One of this class appeared in the time of Tycho Brahe, 11th November, 1572, in the constellation of Cassiopeia, and after shining with unexampled splendour for some months, at the end of sixteen months, March, 1574, it was no longer visible. Another star, of the same class, appeared in 1604, in the constellation of Ophiuchus, and all its changes were similar to that of the former star. It continued visible till October 1605, when it vanished. A temporary star was observed by Mr. Hind in 1848, in the constellation of Ophiuchus, unknown in the catalogues, and after a short period of brilliancy disappeared.

DOUBLE STARS.

Double and multiple stars constitute a large and interesting class to the observer; they are divided by astronomers into *two* classes,—those *optically* double or multiple, and those which are *physically* so, and gravitate round each other, as planets do around the sun as the centre of motion. Thus many stars seem to be double because of their apparent juxtaposition, in the same line of direction in the heavens. From the calculations of Professor Struve it has been concluded, that few, if any, of the double stars owe their duplicity to apparent juxtaposition; and that nearly all those stars must be physically double, although their periods of revolution may be so long as not to have been hitherto detected by astronomers. The number of double stars is now raised to 6,000.

The discovery of the actual existence of *binary* stars, or the revolution of one star around another as its centre of gravity, and also of *systems* of stars in revolution around a common centre, is owing to the genius, zeal, and perseverance of Sir Wm. Herschel; although the *doctrine* of the binary system was propounded by Jordano Bruno, in the 16th century. This discovery has opened up one

of the most interesting fields of observation in the whole stellar universe.

The observation of a binary star consists in determining the *magnitudes* or degrees of brightness of the component stars of the system,—their *colours*, their *distance* in seconds, and the *angle of position* which a line joining the component stars makes with the meridian.

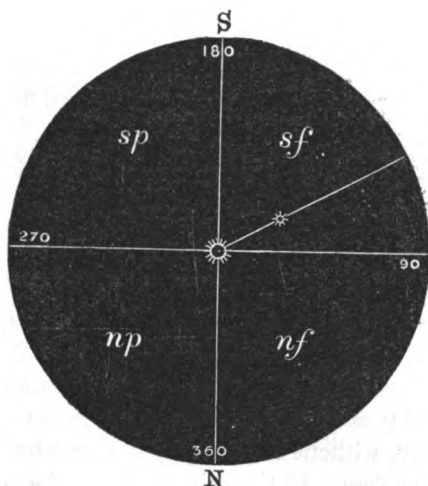


Fig. 1.

The above diagram exhibits the mode by which the *angle of position* of double stars is estimated. The circle represents the field of the telescope. Every star in its apparent passage across the sky moves in a circle parallel with the equinoctial, consequently the passage of a star across the field of the telescope will represent either the equinoctial or a parallel of it; and a line drawn perpendicular to such parallel will indicate a meridian of the heavens. Whether it be the meridian of the observer, or any other, the result is the same. Everything being reversed in an astronomical telescope, the passage of a star

across the field will be from right to left, with *north* at the bottom and *south* at the top. When the star is seen on the observer's meridian, its passage will be horizontal, as indicated by the line extending from 90 to 270, Fig. 1. At other times the star will cross the field variously inclined to the horizon. When east of the meridian, its passage from A to B will be more or less inclined as in Fig. 2; whilst as it descends towards the west, it will appear to move from A to B, as in Fig. 3; the meridian lines

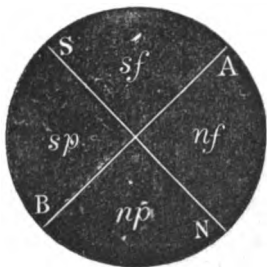


Fig. 2.

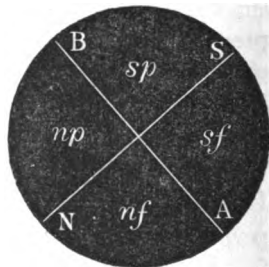


Fig. 3.

being, of course, inclined from the perpendicular. By thus noticing the passage of a star across the field of view, the student may, without much difficulty, mentally divide it into four quarters. If the principal star of a pair be supposed to occupy the centre of the field, its companion will occupy one of the divisions, which remains the same, in whatever part of the heavens the star may be; or however much the relative positions of the pair may alter as regards the *horizon* of the observer. These divisions are indicated in astronomical works as *np*, *nf*, *sp*, *sf*,—abbreviations of *north preceding*, *north following*, *south preceding*, *south following*. When, therefore, an astronomer thus designates the position of one of a pair of stars, its place may be found at once.

Commencing the division of the circle into 360 degrees, at the point N (Fig. 1), and carrying it round in the oppo-

site way to the figures of a watch, the *angle of position* is the angle formed by a line drawn from one star to its companion, and the meridian of the field. Their *distance* is measured on the line uniting them. The student will be greatly assisted by using an eye-piece furnished with cross lines, instead of trusting to a mental effort. They may be made to correspond with the equinoctial and meridian, by turning the eye-piece round so that the star, in its transit across the field, shall traverse the line A B. If, during successive observations, the companion should change position relatively to the central and principal star, the change would be detected by the cross lines, and its course followed till it had completed its revolution. Its whole period, however, might be predicted from the time in which it had accomplished a small portion of its orbit. Inasmuch as the plane of its orbit will seldom, if ever, be perpendicular to our line of vision, it will appear to us foreshortened, and hence will appear to be elliptical—the companion advancing towards or receding from the principal star. Several stars of the binary systems have been followed by observers all through their periodic revolution. Sir W. Herschel detected between fifty and sixty changes of the angle of position of double stars, for instance:—Castor, γ Virginis, ξ Ursa Majoris, 70 Ophiuchi, σ and η Coronæ, ξ Bootis, η Cassiopeia, γ Leonis, ζ Herculis, δ Cygni, μ Bootis, ϵ 4 and ϵ 5 Lyræ, λ Ophiuchi, μ Draconis, and ζ Aquarii. Four of the most remarkable of those physically connected systems are 61 Cygni, Castor, and γ Virginis, in the northern hemisphere, and α Centauri in the southern. Castor is the largest and finest of all the binary systems, and has been the longest observed. In Bradley's time (1760), the line joining Pollux and the largest star of Castor passed through the companion; now it is different, and forms a sensible angle. η Coronæ, since it was discovered as a double star by Sir W. Herschel, has

gone through more than a complete revolution. The period of the revolution of Castor is 253 years, γ Virginis about 200 years, 61 Cygni 540 years, γ Leonis 1,000 years.

It is now generally concluded by astronomers that the double stars which constitute the binary systems are really each *two suns* of different colours physically connected; the centres, perhaps, of planetary bodies revolving around them, as in our solar system, but invisible to the most powerful telescopes yet invented. We have in this system but one sun, whose light is uniformly *white*, but in those binary systems they have two suns of contrasted or complementary colours. What a variety of illuminations two suns must exhibit—crimson and green, orange and blue, or white and purple—as, for instance, in the cases of the binary systems— ϵ Canis, γ Andromeda, and η Cassiopeia. “Imagination,” observes Sir John Herschel, “fails to conceive the charming contrasts and grateful vicissitudes” of a red and green day, and so on of the other contrasts, alternating with darkness, in the planetary systems belonging to those suns. Truly “the heavens declare the glory of God, and the firmament sheweth his handy work.”

Every tint of colour is seen among the stars. Of stars of the first magnitude, Arcturus, Adelbaran, Pollux, Antares, and Betelgeux, are red; Sirius, Vega, Aridell, Regulus, and Spica, are white; Capella, Procyon, Altair, Dubhe, and Polaris, are yellow, or orange tint. Castor has a greenish hue. There has certainly occurred some wonderful change in the constitution of Sirius, for Sirius was known to the ancients as a *red* star, and is described by Ptolemy, Seneca, and others, as red, but it is now unmistakeably and brilliantly white. Within the last half century, γ Leonis and γ Delphini have very perceptibly changed colour. The ancients, singularly enough, recognised no *blue* stars, but only white or red. With the exception of Sirius, their red stars are all red to us.

Solitary red stars—scarlet, crimson, and deep red, as that of blood—occur in many parts of the heavens, but, strange as it appears, no green or blue star has yet been observed, except when associated with a companion brighter than itself. Struve says that Sir W. Herschel assigned to many stars a redder tinge than was verified by other observers, arising either from some instrumental or optical defect. The celebrated John Dalton, of Manchester, could see no difference between red and green. Dugald Stewart and others have had a similar optical peculiarity. Zhan beautifully remarks, concerning the starry firmament, “The stars shine more like torches burning with eternal flame before the altar of the Most High, than the lamps of the ethereal vault, or the funeral lights of the setting sun.”

THE NEBULÆ.

The *nebulae*, star-clouds, or, as they are appropriately called by the German astronomers, “*island universes*,” are those extraordinary and wonderful celestial objects, which lie scattered over certain regions of the heavens, apparently as numerous as stars are to the naked eye.

Sir John Herschel thus classified the *nebulae*:—1st, those actually resolved into clusters of distinct and separate stars; 2nd, those which were not wholly resolved, but which apparently would be by the use of greater optical powers; 3rd, those which in the Herschel telescope showed no trace of resolvability; 4th, those considered as planetary *nebulae*; 5th, those called stellar *nebulae*; 6th, nebulous stars.

The classes 4, 5, and 6, of this subdivision of the *nebulae*, are based upon what is called “*the nebular theory*”—a theory which presumed that certain of those mysterious celestial objects were really the elements of planets, or of stars to be hereafter developed and condensed from the chaos in

which they now exist into suns, as centres of light and influence to their planetary systems. This hypothesis was originated and supported by very eminent men—Tycho Brahe, Kepler, Halley, Derhan, Kant, and Lambert; and was embodied into a regular system of the universe by La Place, which was characterised by many inconsistencies and absurdities. It was adopted by Sir W. Herschel, as the only solution he could find of the difficulties of the irresolvable nebulae; but it has been abandoned by nearly all modern astronomers, chiefly through the extraordinary nebular revelations of the great reflector of the Earl of Rosse. Even the great nebula in Orion, supposed to be composed of vast masses of luminous "*floculi*," "*fire-mist*," "*star-dust*," or "*phosphorescent clouds*," in a process of condensation, has at length yielded up the dread secret of its constitution—kept from the birth of creation—and confessed itself a star-cloud or "island universe," and an elder sister of the family to which belongs our own sidereal universe. Thus the great problem was solved which was once put by the Almighty Creator himself, to the patriarch Job—"Canst thou loose the bands of Orion?" "We could plainly see (writes Lord Rosse to Dr. Nicholl, 19th March, 1846,) that all about the trapezium is a *mass of stars*, the rest of the nebula also abounding with stars and exhibiting the characteristics of resolvability strongly marked."

The nebulae are vastly more distant than the stars. The stars change in their positions perceptibly, they have a motion in space occasioned by "*the precession of equinoxes*;" but the right ascensions and declinations of the nebulae have hitherto been concluded to be always the same. No planetary or opaque substances could ever be visible at their enormous distances, for even comets disappear from faint light, which are nine millions of miles nearer to us than the nearest fixed star. but the nebulae are always

visible, therefore their light must be the light of self-luminous suns, congregated into vast systems resembling faint clouds from their immense distance.

Huygens, in the middle of the 16th century, propounded the true theory of the universe, which was also the doctrine of Galileo, of Casoini, and of John Mitchel: "That whatsoever objects have been called *nebulae*, and even the Milky Way, when looked at through telescopes show nothing nebulous, and are merely multitudes of stars crowded together in clusters."

In the French "*Nautical Almanack*" for 1784, the celebrated French astronomer, Messier, gave a catalogue of 103 *nebulae*; and though the number has since been enlarged to 4,000, yet in modern catalogues, any one of those 103 *nebulae* remains still distinguished by the number assigned to it on Messier's list; as for instance, 51 Messier designates the great spiral nebula of Lord Rosse, in Canes Venatici. The real *magnitudes* of the *nebulae* must be beyond all comprehension. If the highest optical power ever yet employed fails to bring up the true disc of even the very nearest star, and if, as has been hitherto concluded, the *nebulae* be so immensely farther distant than the stars, and yet present discs of such great magnitudes, that the nebula, for instance, in Orion, spreads over an apparent area of the heavens nearly equal in surface to the full moon, how inconceivably vast must be their dimensions. Our own nebula, or "island universe," is probably but a mere speck in space, compared with the nebula in Orion, or that in Andromeda.

Many of the *nebulae* as seen by Lord Rosse have a truly wonderful *spiral conformation*. From centres of great condensation stars unfold themselves, radiating in spiral convolutions, exhibiting marvellous regularity in the organisation of the structure. Nos. 51 and 99 of Messier's catalogue, as sketched by Lord Rosse are beautiful speci-

mens of this extraordinary class. The number of ascertained spiral nebulæ is said to be eight—51 Messier, 57 Herschel, 66 M, 99 M, 97 M, 94 M, 33 M, 55 H. A few others have given indications of a spiral conformation, 59 M, 60 M, 4 H, 45 H, and 61 M.

Long before the discovery of the spiral character of certain of the nebulæ, the similarity of the nebula 51 Messier to our own system was maintained by the elder Herschel. 51 Messier is admitted to be the most beautiful and perfect specimen of all the spirals that the six-feet reflector has yet revealed. It looks like a vast bed of stars rolled in strange convolutions around two great central balls or condensed star clusters. This class of nebulæ, therefore, has a peculiar interest for us, as claiming, in the opinion of eminent astronomers, a similarity to our own stellar system.

A very large number of the nebulæ seem to be placed in *pairs* close together, physically connected like stars in the binary system, two distinct universes connected by some unknown laws, each having its own centre of condensation. Nearly all the spiral nebulæ yet discovered are found to be twin systems; this fact leads to the supposition that all the double nebulæ, if examined by a sufficiently high optical power, might be resolved into the class called spirals, and like some stars have a *binary character*. Many of the nebulæ are of enormous length and very narrow. Two of the class of spirals are of this configuration. Several of these have a long narrow aperture, like a straight line for some distance down the centre. These are supposed to be flat-ring nebulæ seen obliquely. Others are of a comet shape, having a nucleus at one end; others look like "the ghost of Saturn," others like "a mock Jupiter;" while others again baffle all speculation as to their true form by the most incongruous combinations—in some instances (as that near the star β in Ursa Major)

resembling the face of some monster with flaming eyes, fiery mouth, and radiating hair.

The nebula known as 30 Doradus, sketched at Paramatta by Mr. Dunlop, and examined by Sir John Herschel at the Cape of Good Hope, resembles a number of loops or a true lover's knot, formed by a bunch of ribbons. A triangular shaped nebula is found in Gemini. The great nebula in Andromeda resembles two enormous luminous cones, joined together at their base. The Crab nebula resembles more closely an enormous cactus plant, glistening with diamonds. The great nebula in Orion, as figured by Sir John Herschel, is like some vast creature of the elephant species, with a fish's mouth.

The annular or ring-shaped nebulae are fewer in number. Only *nine* of this class have hitherto been discovered. The elliptical-shaped nebulae are very numerous: a beautiful specimen is that discovered by Miss Herschel, which lies nearly midway between the star Algol, in the head of Medusa, and Almach in Andromeda.

The great nebular regions in the southern hemisphere, marked on the globe as *Nubecula major* and *Nubecula minor*, known familiarly to navigators as the *Megellanic clouds*, and visible to the naked eye, are thus described by Sir John Herschel:—"When examined by powerful telescopes the constitution of the Nubeculae is found to be of astonishing complexity. The general ground of both consists of large tracts and patches of nebulosity, in every stage of resolution,—but besides these there are also nebulae in abundance, both regular and irregular; globular clusters in every state of condensation; and objects of a nebulous character quite peculiar, that have no analogy in any other part of the heavens. One of these nebular beds is so rich that in passing through a section of it, only in the time of 36 minutes, I detected no less than 31 nebulae, all distinctly visible upon a fine blue sky. Their

situation and shape, as well as condition, seems to denote the greatest variety imaginable. In another stratum, or perhaps a different branch of the former, I have seen double and treble nebulae variously arranged ;—large ones, with small seeming attendants, narrow but much extended, lucid nebulae, or bright dashes ; some of the shape of a fan, resembling an electric brush, others of the comet shape, with a seeming nucleus in the centre, or like cloudy stars surrounded with an atmosphere ; a different sort again containing a nebulosity of the milky kind, like that wonderful inexplicable phenomenon about θ Orionis ; while others shine with a fainter mottled kind of light, which denotes their being resolvable into stars.” Imagination fails to grasp the ideas thus suggested of the vastness and variety of creation, and of the wisdom and power and dominion and glory of the Creator. “O Lord, how manifold are thy works, in wisdom hast thou made them all.”

VARIABLE NEBULÆ

Astronomers have long been acquainted with the fact that there are many stars whose brilliancy is subject to change—now appearing brighter and now fainter ; whilst others which formerly occupied a prominent position in the heavens, have since altogether disappeared, and *vice versa*. A belief in the immensity of the distance of nebulae has hitherto prevented the most enthusiastic astronomer from imputing the same changeable character to them. At all events, we have supposed that only the lapse of ages could reveal any change in their constitution or position.

The attention of astronomers, however, has lately been arrested by the discovery of the fact, that some of the nebulae do show unmistakable evidence of similar changes. A nebula which was discovered in the constellation of

Taurus, in 1852, by Professor D'Arrest, of Copenhagen, R. A. $4^h 13^m 54^s$, N. D. $19^\circ 11' 37''$, was announced by him, towards the close of 1861, to have totally disappeared. This fact was confirmed by M. Leverrier and M. Chacornac, who searched for it on the night of the 26th January, 1862, with the great Paris equatorial, whose object-glass is more than 12 inches in diameter. The position of the nebula is about a degree and a half from ϵ Tauri. From 1852 to 1856 a star of the 10th or 11th magnitude almost touched the nebula at its *nf* edge.

Since then the nebula has reappeared; for M. Winnecke and M. Otto Struve observed it in the great telescope of Paulcova, on the 22nd of March last (1862). Its position was determined by the star of the 11th magnitude which accompanies it.

M. D'Arrest, in 1850, gave the positions in the "Tresses of Berenice" of two nebulae, which he regarded as new, but which had been previously noted by Sir W. Herschel. The latter astronomer, however, recorded three nebulae in the place where the former observed but two; the third, therefore, must have disappeared since 1784.

M. Schmidt, of the observatory of Athens, mentions also another instance. A nebula which, in 1855, was seen in a finder of $\frac{3}{4}$ -inch aperture, is now barely visible in the large refractor at Athens, on a very clear evening.

Certain changes in the appearance of the great nebula of Orion, it is said, have been suspected by M. Otto Struve, since 1857. This important subject is now claiming the attention of astronomers, and doubtless will open out a new field of inquiry.

THE USE OF THE TELESCOPE.

It may be well to give a few general directions as to the use of the telescope, and to point out some mistakes into which the inexperienced observer is liable to fall. It is not uncommon for a person without experience in astronomical observations, to feel some disappointment in his first views of some of the heavenly bodies, both as to their aspect and size. He has heard, for instance, that when Jupiter is magnified 40 times only, he appears as large as the moon, and that on his surface are seen one, two, or more dusky-looking belts. But he can neither see the one, nor can he believe the other. He is told that on the surface of Mars may be seen dark spots, and that at one of his poles which may at the time be presented to us, ice or snow may be observed. Expecting all this to appear as plain to him as if delineated in a picture, he is perfectly bewildered in looking at a small, uninteresting, red-looking disc,—ignorant that in ordinary-sized telescopes these appearances are only made out by—to some extent—a trained eye, as the result of patient painstaking. The unpractised observer, on finding that everything is not so visible and well-defined as he expected, is apt to attribute his disappointment to some imperfection in his instrument. Hence it is that the maker of a good ordinary amateur's telescope, would rather have its performance criticised by one who has had a good deal of experience in the use of the instrument, and who is fully aware of all the difficulties in the way of successful observations, arising from the state of the atmosphere and other causes, natural and artificial, than by one devoid of such experience. A good eye is necessary as well as a good telescope. In proof of what may be done with a trained eye, the Rev. Mr. Webb, one of the most experienced amateur astronomers in this country, states* that he has seen "even Castor of

* "Intellectual Observer." May, 1862.

course with feeble light, but very well defined, with an object-glass of only $1\frac{1}{2}$ -inch diameter." He remarks: "It is possible, indeed, that with inferior optical means our first view may not answer our expectations; but a great master, to whom we amateurs are so much indebted (Admiral Smyth), will teach us that many things deemed invisible to secondary instruments, are plain enough to *one who knows how to see them*;—the eye itself improves, and the vision becomes sharper under practice, *insomuch that the telescope seems to improve.*"

Mr. Webb, in his "Celestial Objects for Common Telescopes" (meaning by this expression, he tells us, "such instruments as are generally met with in private hands, achromatics of various lengths up to 5 or $5\frac{1}{2}$ feet, with diameters up to $3\frac{3}{4}$ inches"), in speaking of the quality of the object-glass, says:—"Never mind bubbles, sand-holes, scratches, in object-glass or speculum; they merely obstruct a very little light. * * A proper test-object must be chosen: the moon is too easy; Venus too severe; *large* stars have too much glare; Jupiter and Saturn are far better; a close double star is best for an *experienced* eye, but for general purposes a moderate-sized star will suffice; its image should be a small disc without wings, &c., or appendages, except one or two narrow rings of light, regularly circular and concentric with the image. * *

An achromatic, notwithstanding the derivation of its name, will shew colour under high powers, where there is a great contrast of light and darkness. This 'outstanding' or uncorrected colour results from the want of a perfect balance between the optical properties of the two kinds of glass of which the object-glass is constructed: it cannot be remedied, but it ought not to be obtrusive. In the best instruments it forms a fringe of violet, purple, or blue, round luminous objects, in focus under high powers, especially Venus in a dark sky."

In using a telescope,* if it be placed in a warm room, when the window is opened, cold air will necessarily rush in, and a current of it will be constantly kept up, which will greatly interfere with distinct vision. When used in a room, either the end of the telescope should be projected beyond the window, or the temperature of the air within and without should be equalised as far as possible. Neither can we expect as much steadiness with a stand placed in a room as when placed on solid ground. When used out of doors, experienced astronomers generally place a "dew-cap" on to the end of the instrument, to protect the object-glass from the vapour often found in the atmosphere, which would otherwise settle upon it. This is merely a tube made of tin, pasteboard, or anything else, slipped on the end of the telescope, and projecting beyond the object-glass from six to twelve inches, according to the diameter of the glass; being longer, of course, for a larger glass.

In order to successful observation, it is of the greatest importance that the telescope be accurately focussed. Great pains and patience should be used for this. Different objects, being at different distances, will require a different focus.

One of the greatest mistakes made by inexperienced observers is the notion that, no matter what may be the size of the telescope, the highest magnifying powers inevitably give the best views. Nothing but long experience will correct this error. On this point, the Rev. Mr. Webb has given the following judicious advice:—

"Do not over-press magnifying power. Schröter long ago warned observers against this natural practice, which is likely to lead beginners into mistakes. A certain pro-

* For other useful hints on this subject, the reader is referred to the Editor's manual on "The Construction and Use of the Telescope."

portion of *light* to *size* in the image is essential to distinctness ; and though by using a deeper eye-piece we can readily enlarge the size, we cannot increase the light so long as the aperture is unchanged ; while by higher magnifying we make the inevitable imperfection of the telescope more visible. Hence the picture becomes dim and indistinct, beyond a certain limit, varying with the brightness of the object, and the goodness of the telescope. Comets and nebulae, generally speaking, will bear but little magnifying. For the moon and planets, the power should be high enough (if the weather will bear it) to take off the glare, low enough to preserve sufficient brightness and sharpness. * * A very high power has so many disadvantages, in the difficulty of finding and keeping the object, the smallness of the field, the rapid motion of the image (in reality, the magnified motion of the earth), and the exaggeration of every defect in the telescope, the stand, and the atmosphere, that the student will soon learn to reserve it for special objects and for the finest weather."

In order to detect exceedingly minute and faint objects, which may be very difficult to see, astronomers have recourse to *oblique vision*. Every one knows that if you look straight at a particular object, it is yet possible to take notice of any other object near to it, on the right or left. If two persons are before you, you may, as it were, pretend not to notice one of them, by looking direct at the other, and yet take particular notice of him all the while. It is a most singular fact that by thus looking *sideways* at a faint star or nebula, it may often be detected when it cannot be seen by direct vision.

Another help to the observation of faint objects is the dilation of the pupil of the eye. The eye is the most complete optical instrument ever constructed, its pupil being to it what the object-glass is to a telescope. The larger the object-glass, the more is the light which is

admitted. "He that made the eye" has so wisely constructed it, that the pupil of it is self-adjusting. It expands and contracts in proportion to the quantity of light surrounding us. When it is dusk or dark, the pupil expands to admit as much as possible. When there is much light the pupil contracts, thus excluding more than the eye can bear. Hence, if before using a telescope, we withdraw the eye for a while from the light, the pupil will expand, and we shall be able to discern very faint objects all the more easily.

The state of the weather is of considerable importance in practical astronomy, and a subject to which Dr. Dick and other writers have directed attention. The author already quoted observes:—"Astronomers well know that a high degree of transparency may be combined with a most annoying amount of unsteadiness, and that what is called a brilliant night may hence prove perfectly useless for all delicate investigations: and thus we find Herschel II. speaking of such a night as 'the worst possible for vision, though superbly clear.' Higher powers becoming necessary as the components are nearer together, every atmospheric defect is magnified in the same proportion. At one time no care in focal adjustment will sharpen up the diffused blot to the semblance of a star; at another, the comparatively defined discs will be *rippled over*, as it were, as though they lay at the bottom of a rapid stream; at another, 'flares' and distortions of various kinds and degrees will task the observer's patience, if they do not wholly frustrate his expectations. Strange as it may seem, the unvarying experience of observers speaks strongly in behalf of a slight fog or haze, not, of course, for the detection of evanescent points of light, but for that steady definition which, with large apertures especially, is so seldom to be met with, and so very beautiful when it is attained. The new dusky ring of Saturn was discovered

by Bond, in America, in a sky so hazy that to the naked eye only the brighter stars were perceptible. Herschel I. states that vision is generally very perfect in windy weather; but a very steady stand will be necessary to avail ourselves of it. In the winter, his son tells us that distinct vision often comes on an hour or two before midnight. It is a singular fact, but attested by the concurrence of many observers, that a twilight sky is often favourable to the definition of difficult objects; the spurious discs seeming to be diminished upon a brighter background."

The last remark, as to a twilight sky, is applicable to observations of Venus. Dr. Mann observes of this planet that "its surface is always enveloped in a glare of light, that prevents it from being satisfactorily seen even by the best telescopes." Mr. Webb also remarks that "it is often a source of disappointment in the telescope." Observers will subscribe to the experience of Herschel II. who says: "*It is the most difficult of all the planets to define with the telescope.*" The best time to observe Venus, is before, or after the darkness comes on—so that the light of the sun shall soften down her extraordinary brilliancy: or else to use a piece of tinted glass between the eye and the eyepiece.

The field of the telescope may be estimated as to its extent by directing the instrument to a star on or near to the equinoctial; as, for instance, 5 Libra, which is in the same field with the nebula 5 M, or the upper of the three bright stars forming the belt of Orion. Let the star pass over the centre of the field, count the number of seconds occupied by its passage across, and reckon that four seconds of time are equal to one minute of space, and four minutes of time to one degree. So that if a star thus occupy two minutes, the field of view embraces a portion of the heavens whose diameter is half a degree. This being about the space occupied by the moon, if the full moon

just fill the field, the extent of the latter is half a degree in every direction.

In concluding these remarks on the use of the telescope, it is perhaps hardly needful to remind the reader that in studying any kind of star maps, allowance must be made for the altered position of the constellations when seen in different parts of the sky. Let the letter R represent a constellation as seen in the south; when rising in the east it will be seen thus $\mathfrak{R}$, and when setting it will be reversed—thus $\mathfrak{R}$. When Castor and Pollux are east, Castor is the uppermost star; when south they are more horizontal, and when setting, Castor goes first. Hence, in looking at a map which gives a constellation as it appears on the meridian, a mental calculation must be made, by which the relative position of the stars will be altered according to the position of the constellation, east or west. If, for instance, the quadruple star, ϵ Lyrae, be wanted, when in the east it will be seen to the left of Vega; when in the south it will be over that star, and when descending towards the west it will be seen differently situated again.

PLATE, I.

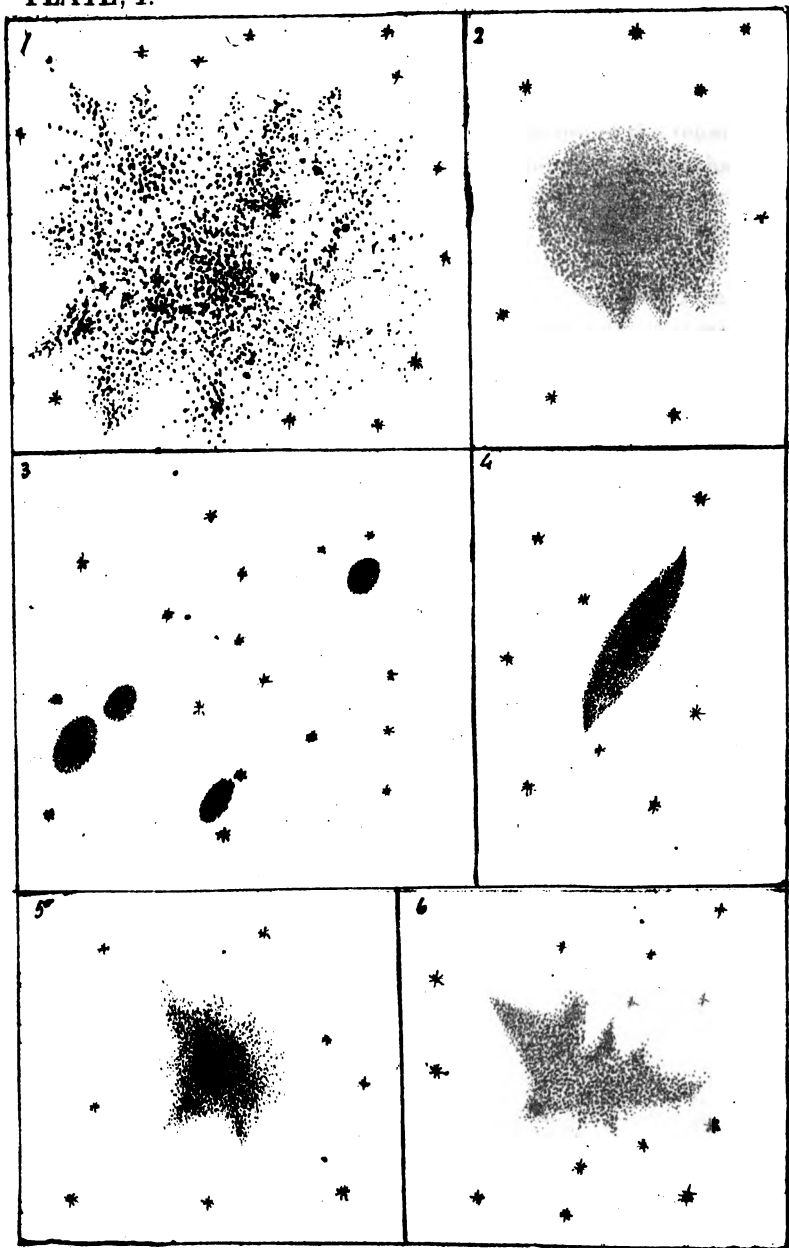


PLATE II.

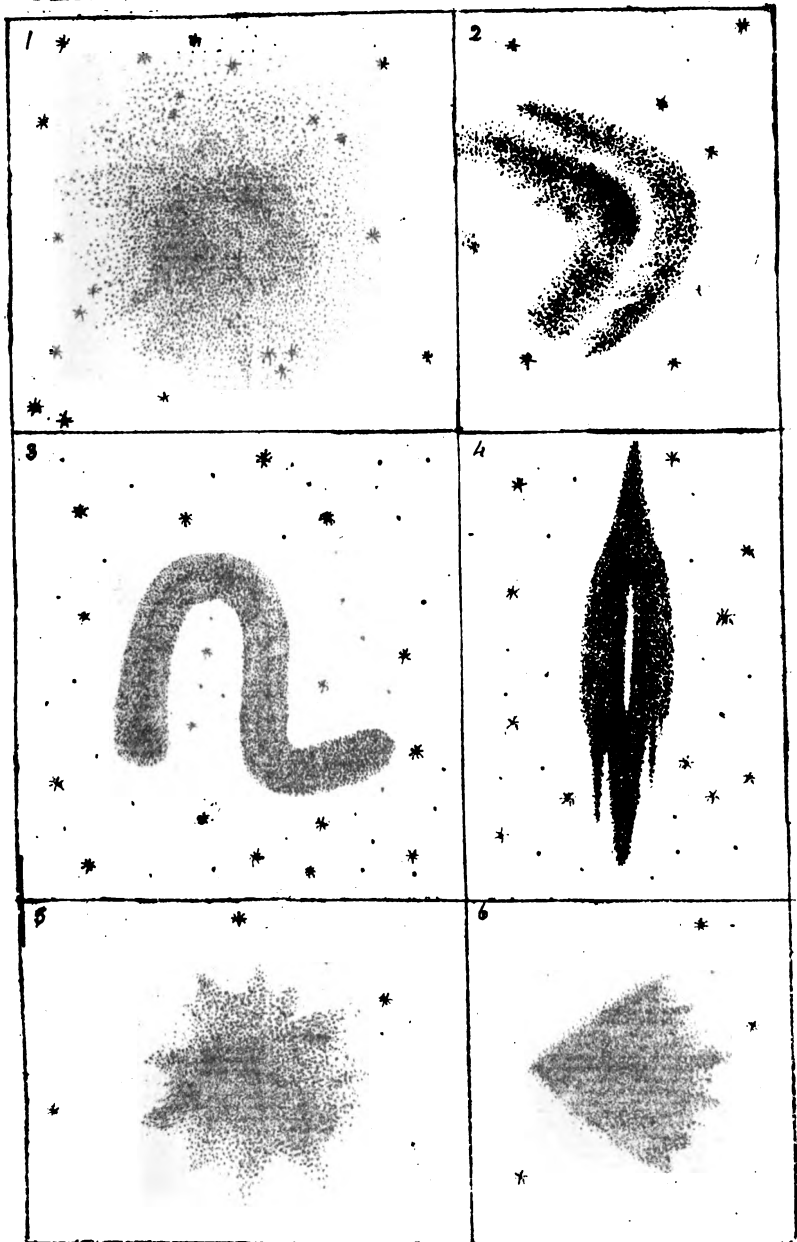
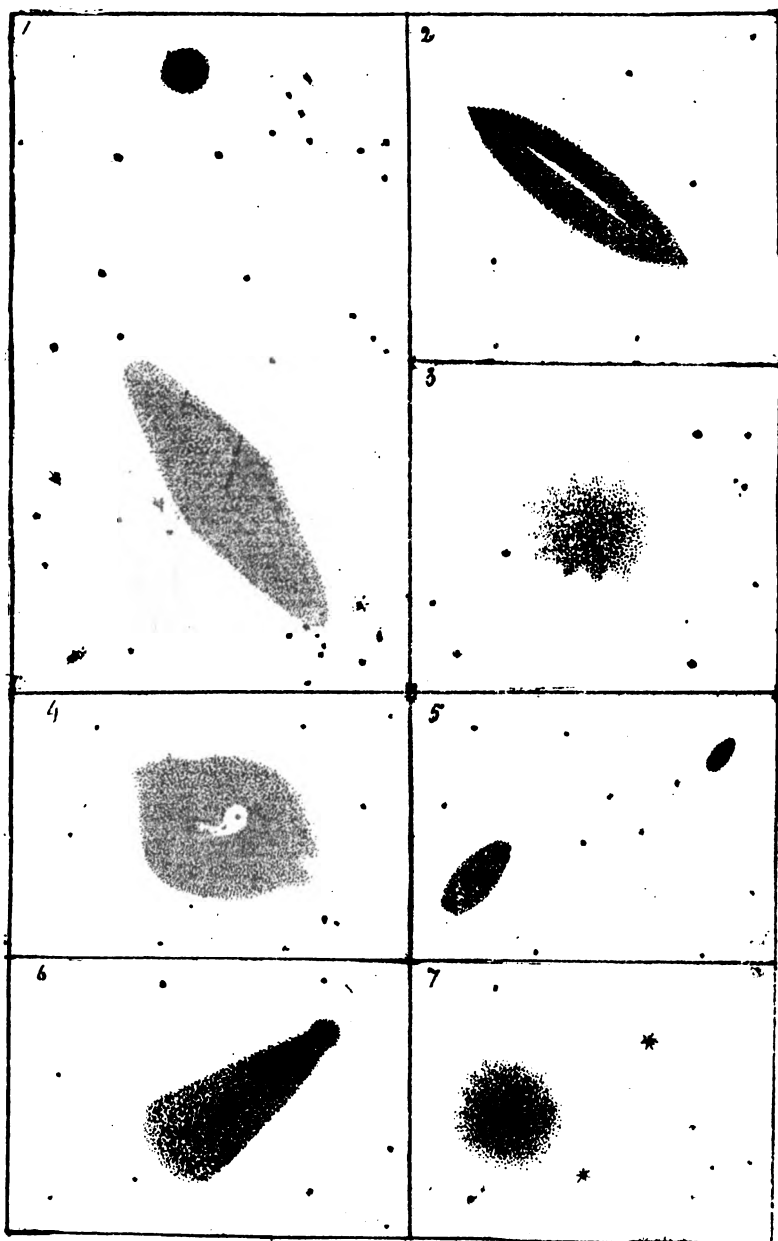
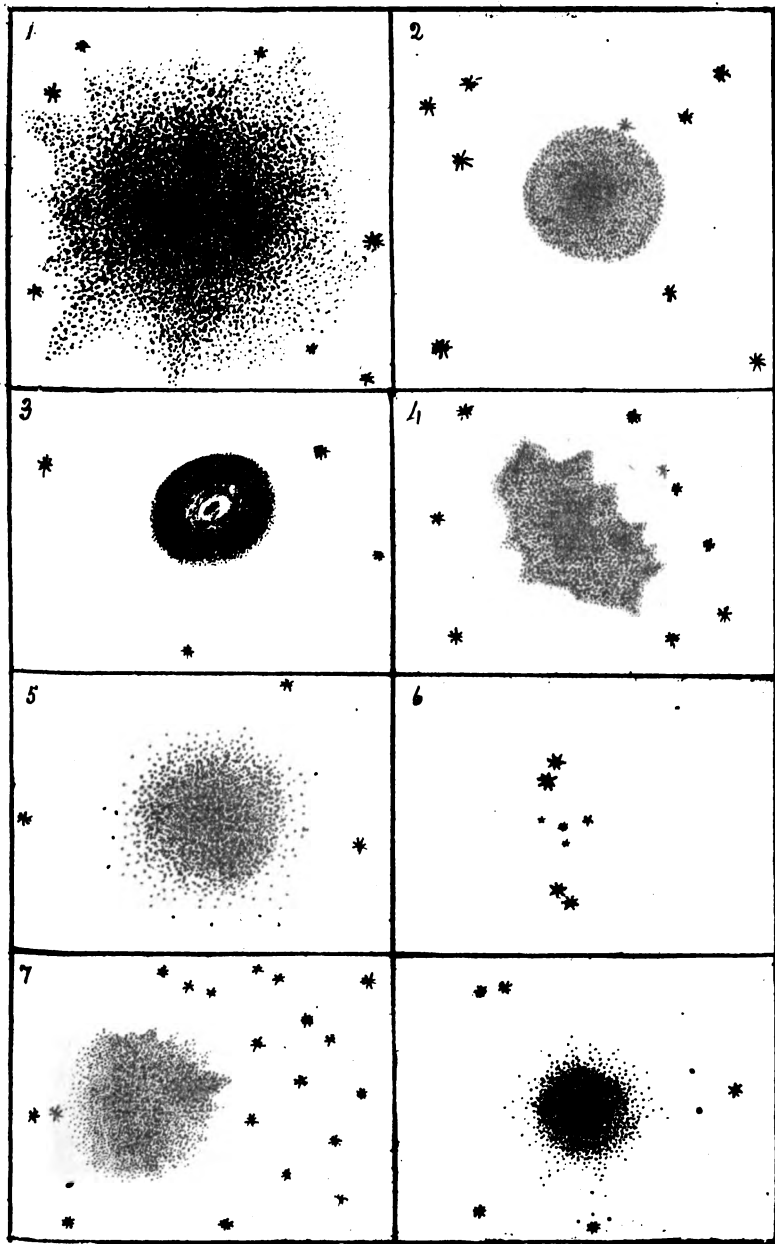
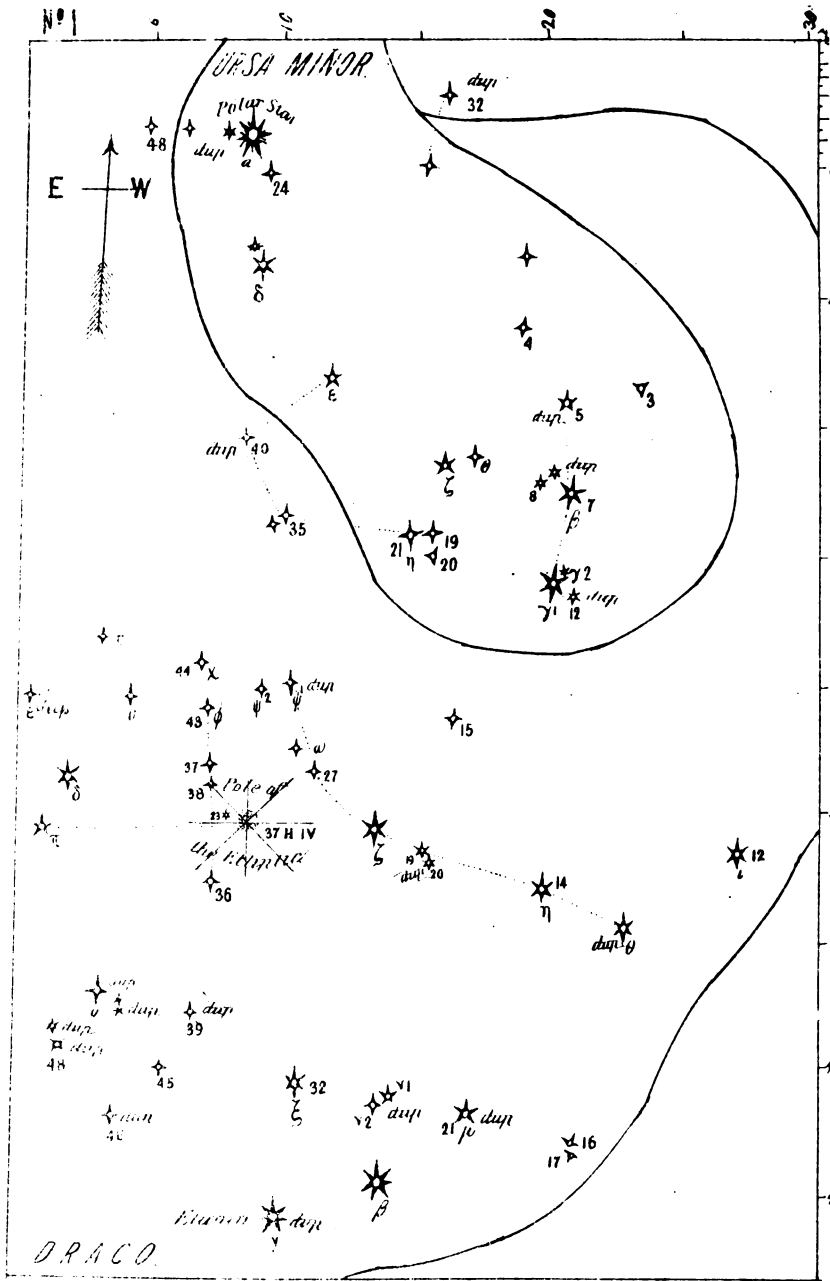


PLATE. III.



PLATE, IV





CATALOGUE

NEBULÆ, DOUBLE STARS, &c.

IN the following list of objects, the magnitude of each star is placed between parentheses after its letter or number, and is followed by its Right Ascension in hours and minutes, and its North or South Declination in degrees and minutes. For example:—Ursa Minor: β (3)— $14^h 51^m$ N $74^\circ 48'$: means Beta—third magnitude—Right Ascension, 14 hours 51 minutes; North Declination, 74 degrees 48 minutes.

The capital letters, H and M, following the number of a nebula refer to the catalogues of *Herschel* and *Messier*.

MAP I.—EMBRACING URSA MINOR AND PART OF DRACO.

The stars represented in this map seem to swing round the Pole Star once in every 24 hours. If the leaf were loose, and fixed to the table by means of a pin stuck through the Pole Star, by turning the map round, a correct idea would be obtained of the motion of these stars around the Pole Star. At one time this star would appear to be at the top; then the constellations would be stretched out to the right; then the Pole Star would be at the

C

bottom ; and afterwards the other stars would stretch out to the left. So with the heavens. Sometimes these stars will be seen at the right hand of the Pole Star, and at others to the left. At one period of the night they will be seen between the Pole Star and the northern horizon, and at another season the Pole Star will be between them and the northern horizon. These stars, of course, never set. At nine o'clock at night, in midsummer, they are situated between the Pole Star and the *southern* horizon, so that the lowest stars in the map are nearly over head. At the same hour in midwinter they will be found between the *northern* horizon and the Pole Star. About the end of September, at 9 p.m., they will be found to the west of the Pole Star, and at the end of March to the east. This map will correspond with the true position of the two constellations, at 9 p.m. in June, by looking to the north, and holding the map overhead, face downwards, the upper part pointing to the north, and the lower to the south. On the contrary, by holding the map before you in its natural position, you will have a representation of this portion of the heavens, as it appears at 9 p.m. about Christmas ; but in such case the east and west of the map must be reversed, east being at the right and west at the left. This explanation is given, as its principle applies to all the other constellations which do not set.

1.—URSA MINOR (THE LESSER BEAR).

This small constellation derives its chief interest from its embracing the position of the *equinoctial pole*, near to which is the Pole Star, around which the stars seem to revolve once in every 24 hours. By observing the positions of its leading stars, the ancients were enabled to tell the hour of the night.

DOUBLE STARS.

α (3)—Known as *Polaris*, or the Pole Star; Right Ascension, $1^h 9^m$; North Declination, $88^\circ 34'$; $1^\circ 56'$ from the true pole, to which point *Polaris* will approach until A.D. 2095, when it will be only $26' 30''$ distant, after which period it will retire again. This motion in space of the stars is occasioned by the precession of the equinoxes. If a circle be traced on the globe or star map, having the pole of the ecliptic as its centre, and the equinoctial pole as a point in its circumference, the circle described will pass through all those positions where the equinoctial pole ever has been or ever will be. The period of the revolution is nearly 26,000 years. In about 12,000 years hence, *Vega* will be the Pole Star. 3,970 years ago, γ *Draconis* occupied that position.

The companion of *Polaris* is a mere point, $18''$ distant, nearly in a line with a distant wide pair of stars in the same field, with a low power. It is also nearly in a line with the two pointers of Ursa Major. The colours are yellow and pale white. The companion star forms a very general test for all telescopes under three-inch aperture. The Rev. Mr. Dawes proposed it as a standard test for two-inch aperture and power of 80. The Dorpat telescope shows it by day, and in Lord Rosse's great reflector it blazes like *Vega* or *Sirius*. Admiral Smyth mentions a faint star, *Blucher*, within $2'$ of the pole.

β (3)— $14^h 51^m$ N $74^\circ 48'$. A fine star with a distant companion—reddish tint and pale grey. β and δ were anciently called "the guards" or guardians of the pole.

δ (3)— $18^h 24^m$ N $86^\circ 35'$. A star with a distant telescopic companion—greenish tinge and grey.

5 (4)— $14^h 28^m$ N $76^\circ 24'$. A beautiful double star—yellow and crimson.

2.—DRACO (THE DRAGON).

A difficult constellation to recognise, on account of its enormous length. It embraces the pole of the ecliptic.

NEBULÆ.

37—iv. *Herschel's Catalogue*. $17^{\text{h}} 59^{\text{m}}$ N $66^{\circ} 38'$. A nebula at the pole of the ecliptic; in appearance, Mr. Webb states, like a star out of focus, of a pale blue colour. A difficult object.

219 H (Map II)— $15^{\text{h}} 2^{\text{m}}$ N $56^{\circ} 25'$. One of the Rosse Nebulæ (Plate II, Fig. 4); long, narrow, and very bright; wider at its centre and terminating in a mere point at each end. The major axis is vertical, and is to its minor axis as 8 to 1. A straight longitudinal division, like a dark line, appears for about one-third of its length, in the direction of its major axis.

DOUBLE STARS.

γ (2)— $17^{\text{h}} 53^{\text{m}}$ N $51^{\circ} 31'$. A bright star, with a distant companion on the crown of the Dragon's head, called Etanin in astronomical catalogues, and is one of the most important stars, passing near the zenith in the south of England. It is the star by which Bradley and Molyneux discovered the aberration of light.

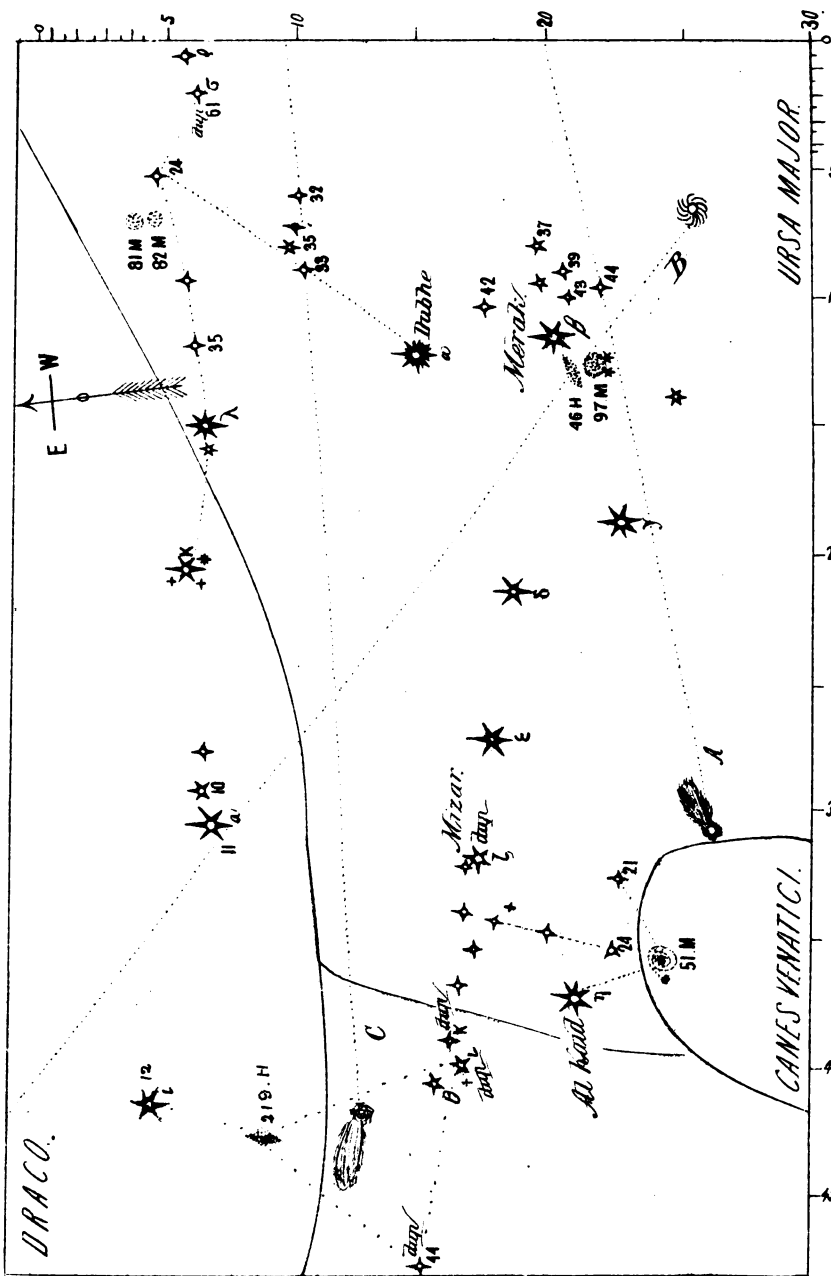
ϵ (4)— $19^{\text{h}} 49^{\text{m}}$ N $69^{\circ} 55'$. A fine double star—yellow and blue.

μ (4)— $17^{\text{h}} 2^{\text{m}}$ N $54^{\circ} 40'$. A beautiful double star—a miniature of Castor—both white. $3\frac{1}{2}^{\circ}$ N W of β ; supposed period, 690 years.

ν^1 and ν^2 (5)— $17^{\text{h}} 29^{\text{m}}$ N $55^{\circ} 17'$. Both stars pale white.

$\omicron$ (5)— $18^{\text{h}} 49^{\text{m}}$ N $59^{\circ} 13'$. Orange and lilac.

ψ^1 and ψ^2 (4)— $17^{\text{h}} 44^{\text{m}}$ N $72^{\circ} 13'$. Both stars clear white.



MAP II.—EMBRACING URSA MAJOR AND PARTS OF DRACO AND CANES VENATICI

3.—URSA MAJOR (THE GREAT BEAR).

This is one of the most striking constellations in the heavens, second only to Orion. It is always visible in England, and universally known by its seven principal stars, called Charles's Wain; four of which form an irregular square, and three form an arch, representing the tail of the Great Bear. The two westerly stars, called Dubhe and Merak, always point to the Pole Star, in whatever position the constellation may be. So that a person travelling in any part of the kingdom at night, if he can only see Charles's Wain, may know at once which is north and which is south, &c.

This constellation is also remarkable as the highway of many comets. The map shows the course of Hally's comet (A) in 1835, and of the two comets of 1861 (B & C).

Ursa Major is seen nearly overhead at 9 o'clock in the evening in May, and a little above the northern horizon at the same hour in November.

NEBULÆ.

97, *Messier's Catalogue*. $11^{\text{h}} 3^{\text{m}} \text{ N } 55^{\circ} 46'$. Described by the Herschels as "a large round planetary nebula;" one of the most wonderful of the nebulæ observed by Lord Rosse, resembling the face of some dreadful monster. It is found within 2° to the S. E. of β (*Merak*), the lower of the pointers to the Polar Star.

51 M— $13^{\text{h}} 24^{\text{m}} \text{ N } 47^{\circ} 55'$. The "whirlpool" nebula of Lord Rosse. It belongs to the constellation of *Canes*.

Venatici, but is marked on Map No. II on account of the star pointers to it in Ursa Major.

46 H— $11^h 3^m N 56^\circ 25'$. An elongated nebula, with a central star-like nucleus, within 1° S. E. of β ; often mistaken for a comet.

81 M and 82 M— $9^h 44^m N 69^\circ 46'$. Two nebulae; one oval, the other comet shaped, with a nucleus at one end; both in the same field with a low power, closely following the star 24.

DOUBLE STARS.

ζ (3)— $13^h 18^m N 55^\circ 39'$. *Mizar*, a splendid double star—brilliant white and pale emerald. Distance, $14''$. The faint star so close to it is *Alcor*, and is supposed to be the centre of revolution to *Mizar* and its companion.

A diagram of these stars is given in the editor's work on the telescope, page 67.

σ (5)— $8^h 58^m N 67^\circ 42'$. Double star in the Bear's left ear—white and blue.

ν (4)— $11^h 10^m N 33^\circ 58'$. A delicate double star on the Bear's left hind foot (not shown on the diagram), just above ξ —orange tint and clear blue. A beautiful object.

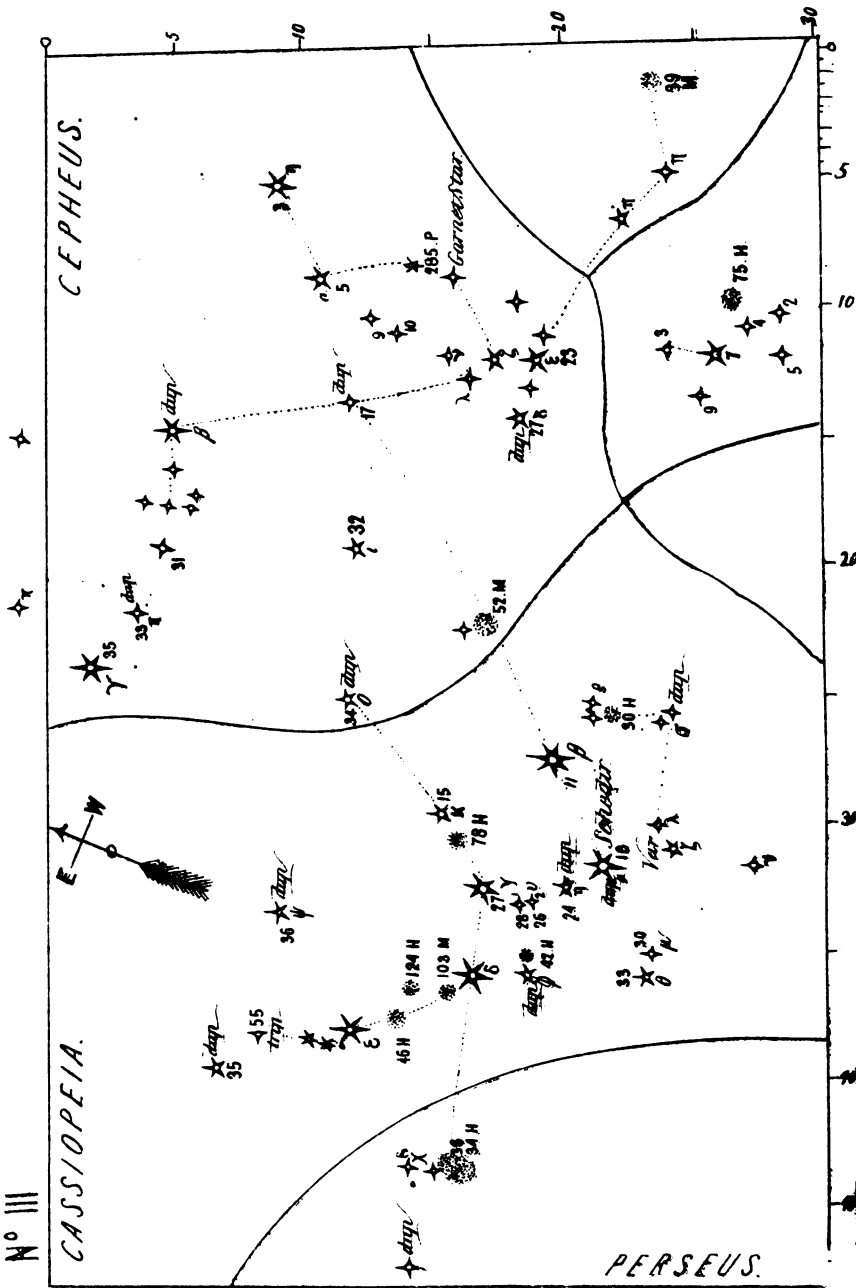
ξ (4)— $11^h 11^m N 32^\circ 19'$. One of the most interesting of the binary stars. It has been observed throughout a whole revolution (65 years), and is computed to be seven millions of solar distances from us. It is found within $1\frac{1}{2}^\circ$ of ν .

The constellations of the *Camel Leopard*, the *Lynx*, and *Leo Minor*, do not present a sufficient number of stars visible to the naked eye, to form pointers to some very beautiful double stars scattered through them, and which, therefore, can only be found with an equatorial telescope. But if the observer will sweep over those regions on a clear night with a low power, he will find himself amply rewarded for his toil.

CASSIOPEIA.

CEPHEUS.

PERSEUS.



MAP III.—CASSIOPEIA, CEPHEUS, AND PART OF PERSEUS.

4.—CASSIOPEIA (THE LADY IN HER CHAIR).

A small but very rich constellation in the Milky Way. Seen in one position it somewhat resembles a chair, but in another it may be more easily recognised as shaped like the letter W. It may always be found by drawing a line from Charles's Wain through the Pole Star to the opposite side, revolving around it like Ursa Major, and never setting. Consequently it is always visible here; and will be seen just above the northern horizon when Ursa Major is overhead, and vice versa.

NEBULÆ

30 H— $23^{\text{h}} 50^{\text{m}}$ N $55^{\circ} 56'$. (Plate 1, Fig. 1.) A splendid star cluster, called "The Crab Cluster," discovered by Messrs. Herschel. "A glorious assemblage, both in extent and richness, having spangled rays of stars, which give it a remote resemblance to a *crab*, the claws reaching the confines of space. The crab itself is a mere patch, in a vast region of inexpressible splendour, spreading over many fields."—*Smythe*.

46 H— $1^{\text{h}} 19^{\text{m}}$ N $61^{\circ} 26'$. A cluster, nearly midway between δ and ϵ of a triangular shape. Diameter, $2'$ or $3'$. There are two bright stars in the field—orange and red.

78 H— $0^{\text{h}} 35^{\text{m}}$ N $61^{\circ} 1'$. Another cluster, discovered by Messrs. Herschel, just midway between γ and κ .

124 H— $1^{\text{h}} 19^{\text{m}}$ N $61^{\circ} 28'$ A cluster half-way from ϵ to γ .

103 M— $1^h 23^m$ N $51^\circ 51'$. A cluster, 2° S. W. of δ . A fine *red* star in the cluster, which is also a double star—pale yellow and blue.

42 H— $1^h 9^m$ N $57^\circ 57'$. A cluster, with a fine double star close to ϕ , both white.

33 H and 34 H. The celebrated great star cluster in *Perseus*, γ and δ are the pointers to it. (See page 11.)

DOUBLE STARS.

η (4)— $0^h 41^m$ N $57^\circ 4'$.—A fine binary star—pale white and purple. Distance, 9". Period about 700 years. The companion is a more difficult object, from its purple colour, than the companion of *Polaris*. In the field of the telescope the white star is underneath the purple; an excellent test for telescopes.

κ (4)— $23^h 52^m$ N $54^\circ 58'$.—A gorgeous field in the Milky Way.

ϕ (4)— $1^h 10^m$ N $57^\circ 30'$.—A magnificent neighbourhood.

σ (5)— $0^h 24^m$ N $62^\circ 4'$.—A beautiful double star, south of β ($2\frac{1}{2}$)—white and blue. A miniature of ϵ *Bootes*, in a very splendid field.

ψ (4)— $1^h 16^m$ N $67^\circ 24'$. A fine double star—orange and blue. The companion seen double in very large telescopes.

5.—CEPHEUS.

A poor constellation to the naked eye, but possessing some fine double stars. Like *Ursa Major* and *Cassiopeia*, it never sets and is always visible. In September and October it is nearly overhead at 9 in the evening, so that it will be more favourably situated for observation in March or April, when its altitude will not be so great.

NEBULÆ.

52 M— $23^{\text{h}} 18^{\text{m}}$ N $60^{\circ} 44'$ (Plate 1, Fig. 6).—A fine cluster, resembling a bird with outstretched wings, with an *orange star* in the head; known as “The Bird Cluster,” near the triple star 4, N. W. by W. of β Cassiopeia, one third of the way towards α Cepheus.

DOUBLE STARS.

β (3)— $21^{\text{h}} 27^{\text{m}}$ N $69^{\circ} 57'$. A very beautiful double star—white and blue.

δ (4)— $22^{\text{h}} 24^{\text{m}}$ N $57^{\circ} 42'$. A splendid double star—orange and blue colours in fine contrast.

ϵ (5)— $23^{\text{h}} 13^{\text{m}}$ N $67^{\circ} 21'$. Orange, yellow, and deep blue.

π (5)— $23^{\text{h}} 2^{\text{m}}$ N $74^{\circ} 31'$. A close double star, with a distant companion—yellow, purple, and blue.

285 P— $21^{\text{h}} 39^{\text{m}}$ N $58^{\circ} 8'$. The celebrated “*garnet Sidus*” of Piazzi’s Catalogue. “It is of a very fine deep garnet colour.”—*Herschel*.

LACERTA (THE LIZARD).

This is a small constellation due south of *Cepheus*; the name is omitted on Map No. III.

75 H— $22^{\text{h}} 10^{\text{m}}$ N $49^{\circ} 11'$. A rich cluster, near a splendid field containing several fine double stars.

7— $22^{\text{h}} 24^{\text{m}}$ N $49^{\circ} 26'$. Marks an immensely rich locality.

MAP IV.—AURIGA AND PERSEUS.

6.—AURIGA (THE CHARIOTEER).

This constellation, like the former, does not set ; always remaining above the horizon. In consequence of its greater distance from the Pole Star, at one period of its daily revolution around that star, it just skirts the north point of the horizon ; whilst at the opposite side, its principal stars get beyond the zenith in a southerly direction. It contains one of the brightest stars in the heavens—Capella—by which it may be easily recognised. Its altitude is greatest at 9 in the evening, at the end of January, and least at the end of July. Consequently, the most favourable months for observing it will be those of spring and autumn.

NEBULÆ.

36 H—5^h 26^m N 34° 2'. A fine cluster, shaped like the device of a heraldic star, composed of very minute stars. It follows ϕ by 2°.

37 M—5^h 43^m N 32° 35'. "A magnificent object, the whole field being strewed as it were with sparkling gold dust, and the group being resolved into about 500 stars, besides numerous outlines."—*Smyth*.

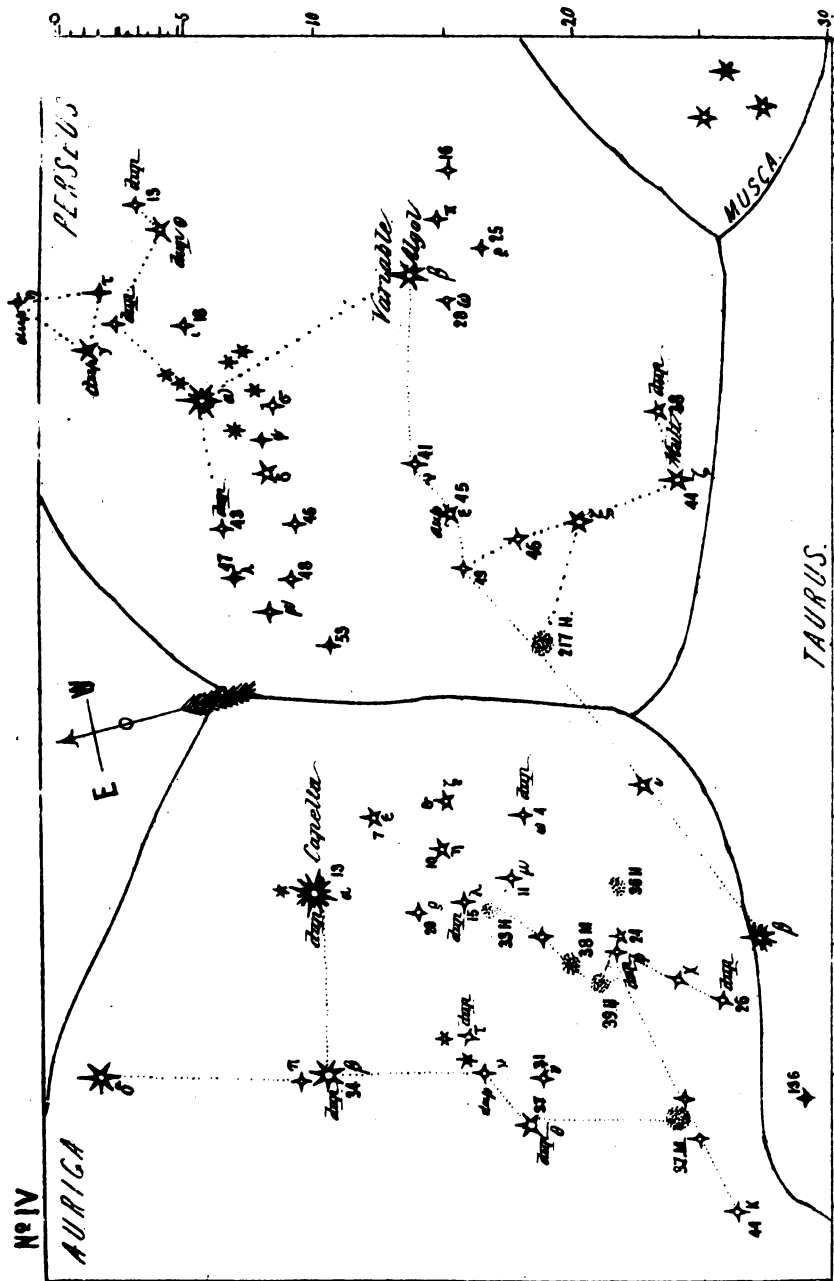
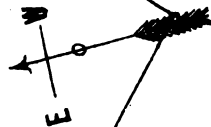
38 M—5^h 20^m N 35° 46'. A splendid cluster, shaped like an oblique cross ; the whole neighbourhood is gorgeously rich.

39 H—5^h 19^m N 35° 12'. A magnificent region, with a low power.

33 H—5^h 9^m N 39° 10'. White and dusky, between λ and σ . A bright orange-coloured star, in a splendid neighbourhood.

Nº IV

AURIGA



DOUBLE STARS.

α (1)— $5^h 5^m$ N $45^\circ 49'$. *Capella*, a splendid first magnitude star, with two distant companions—yellow, with a reddish tinge, pale blue, and grey. *Capella* is supposed to have increased in brightness during the present century.

θ (4)— $5^h 49^m$ N $37^\circ 12'$. A fine double star—brilliant lilac and pale yellow.

ν (5)— $5^h 40^m$ N $39^\circ 6'$. Rich yellow and dusky red, near θ , on a line towards α .

ω (6)— $4^h 48^m$ N $37^\circ 39'$. A fine object—pale red and light blue.

7.—PERSEUS.

This is a very striking constellation, containing the well-known star cluster in the "sword handle." It revolves around the Pole Star without setting, coming to the zenith at 9 p.m. about the month of December; and skirting the northern horizon in June, at that hour. The best months for observation will, consequently, be March, April, and May, or September to November. As you look to the north, it will appear in spring to the left-hand of the Pole Star, and in autumn to the right.

NEBULÆ.

33 H and 34 H— $2^h 9^m$ N $56^\circ 30'$ (on Map III). The great double star cluster in the sword handle of Perseus. (Plate II, Fig. 1.)

"A brilliant mass of stars, from the 7th to the 15th magnitude, emitting a peculiarly splendid light. In the centre is a coronet or ellipse of small stars. 34 H is another group in the same field, with a low power. One of the stars is of a fine ruby colour, and another of a pale garnet tint; there are two sparkling but minute triplets,—alto-

gether one of the most brilliant telescopic objects in the heavens."—*Smyth*.

Sir W. Herschell employed several telescopes to gauge the depths of these clusters, and found with every increase of optical power new congeries of stars developed, until the eye was absolutely overpowered with splendour. The object is visible to the naked eye, and is pointed out by γ and δ Cassiopeia at double their distance towards Perseus.

217 H— $4^h 20^m$ N $34^\circ 15'$. A globular nebula between *Auriga* and the legs of *Perseus*, surrounded by six stars. A line from β *Tauri*, in the tip of the bull's northern horn, to the star ι , and produced nearly as far again beyond, will pass over it.

DOUBLE STARS.

η (5)— $2^h 40^m$ N $55^\circ 29'$. Orange and blue, the colours finely contrasted.

ϵ (4)— $3^h 48^m$ N $39^\circ 36'$. A very fine object—pale white and lilac.

γ (4)— $2^h 54^m$ N $52^\circ 53'$. An unequal double star—white and blue.

θ (4)— $2^h 34^m$ N $48^\circ 34'$. A triple star—yellow, violet, and grey.

ζ (5)— $3^h 45^m$ N $31^\circ 28'$. A quadruple star—white, blue, and pale blue.

β (2)— $2^h 59^m$ N $40^\circ 25'$. *Algol*, one of the most remarkable of the *variable stars*. It changes in brightness from a 2nd to a 4th magnitude star in a few seconds less than 2 days 20 hours and 49 minutes. The increasing and decreasing periods taken together occupy only seven hours, the minimum brightness only 18 minutes, so that *Algol* ranks as a star of the 2nd magnitude. Astronomers have not yet arrived at any satisfactory solution of the cause of the changes of variable stars.

MAP V.—ANDROMEDA AND TRIANGULUM

8.—ANDROMEDA.

A very grand and interesting constellation, easily discovered by the stars Alpherat, Mirach, and Almach. Alpherat, the brightest star, is due east at 10 p.m. in the month of August, and due west at the same hour in the month of February; about which seasons the constellation is most favourably situated for observation.

NEBULÆ.

31 M— $0^h 36^m$ N $40^\circ 30'$. "The transcendantly beautiful Queen of the Nebulæ," as it was called by the early astronomers after the discovery of the telescope, visible to the naked eye, the oldest known of all the nebulæ, and the most splendid in the whole northern hemisphere, exceeds even the great nebula in Orion in splendour of appearance, though not in extent. It was partially resolved by Lord Rosse, but is said to have been completely resolved by the great Cambridge refractor, U. S. It resembles two cones, with their bases placed to each other. Bond and Secchi have seen two dark lines, nearly parallel, extending nearly half the length of its major axis. Like the Orion nebula it has a companion in the field, with a low power—36 H, a faint globular object; 18 H v. being close at hand (see Plate III, Fig. 1). 36 H and 18 H v. have been resolved into stars by Lord Rosse. 31 M is easily found by the pointers, β , μ , and ν .

19 H— $2^h 13^m$ N $41^\circ 36'$. A lenticular nebula, discovered by Miss Herschel, with a dark narrow line along the centre, for about half its length, in the direction of its

major axis. It is found a little to the north of the double star 61 (yellow and lilac), on a line from *Almach* to *Algol*. A difficult object in a small telescope (Plate III, Fig 2).

18 H iv.— $23^{\text{h}} 18^{\text{m}} \text{ N } 41^{\circ} 36'$. One of the extraordinary Rosse nebulae, resembling two large concentric flat rings, hung obliquely like the ring of Saturn, with an intensely dark ring intervening, and a dark aperture in the centre. Rather a difficult object to find.

DOUBLE STARS.

α (1)— $0^{\text{h}} 0^{\text{m}} \text{ N } 28^{\circ} 12'$. *Alpherat*, a fine star, with a minute companion—white and purple.

γ (3)— $1^{\text{h}} 55^{\text{m}} \text{ N } 41^{\circ} 39'$. *Almach*, one of the loveliest of all the double stars—bright orange and emerald green. Distance, 10". The companion has been discovered to be double by Struve.

β (2)— $1^{\text{h}} 1^{\text{m}} \text{ N } 34^{\circ} 46'$. *Mirach*, a beautiful star, with a distant companion—rich yellow and pale blue. One of the pointers to the great nebula.

μ (4)— $0^{\text{h}} 48^{\text{m}} \text{ N } 37^{\circ} 38'$. A most delicate double star, 5° N. E. of β —bright white and gray.

π (4)— $0^{\text{h}} 29^{\text{m}} \text{ N } 32^{\circ} 57'$. White and blue, north of δ .

36 (6)— $0^{\text{h}} 47^{\text{m}} \text{ N } 22^{\circ} 52'$. Bright orange and yellow, near ζ . Period, 250 years.

55 (6)— $1^{\text{h}} 44^{\text{m}} \text{ N } 39^{\circ} 56'$. A most delicate double star—yellow and blue. 3° S. W. from *Almach*, with the star 203 near—both yellow.

175 and 176 (7)— $0^{\text{h}} 39^{\text{m}} \text{ N } 30^{\circ} 11'$. Both sets yellow, and nearly alike.

9.—TRIANGULUM (THE TRIANGLE).

Though called "The Triangle," there are in reality two triangles in this constellation, which would be an insignificant one, but that it contains a very remarkable nebula.

NEBULA.

33 M— $1^h 26^m$ N $29^\circ 58'$. One of Lord Rosse's great spiral nebulae, having a diameter equal to half that of the moon. Its spiral arrangement is different from that of any other of the class, having one centre, from which the filaments diverge in curved streams, with dark lines intervening. Although a faint object in a small telescope, it is easily found from the pointers, and fills nearly the whole field.

There are many very beautiful double stars in both the Triangles and in the northern part of Aries.

MAP VI.—CYGNUS, LYRA, AND PART OF VULPECULA.

The two former constellations graze the northern horizon about 10 p.m. in the month of February ; and are nearly overhead at that hour in August, being then at a little to the south of the zenith. The most convenient seasons for their observation are about the months of April, May, and June, October, November, and December.

10.—CYGNUS (THE SWAN).

An exceedingly rich constellation, in one of the most crowded and splendid portions of the "Milky Way." Many of its low power fields are gorgeous. The constellation is easily recognised by its *cruciform* shape. *Aried* and *Albireo* forming the line of the stem of the cross ; and ϵ , γ , and δ the beam.

CLUSTERS.

29 M— $20^{\text{h}} 18^{\text{m}} \text{ N } 38^{\circ} 0'$. Cluster nearly 2° due S. of γ , on a line between ϵ and δ .

39 M— $21^{\text{h}} 27^{\text{m}} \text{ N } 47^{\circ} 49'$. A fine cluster, $9\frac{1}{2}^{\circ}$ N. E. of α , just half way in a direct line between α and the star 3, the northernmost star in the asterism of the Lizard (*Lacerta*).

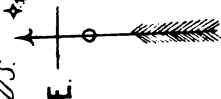
DOUBLE STARS.

α (2)— $20^{\text{h}} 36^{\text{m}} \text{ N } 44^{\circ} 43'$. *Aried*, a fine star, with a minute companion—brilliant white and pale blue.

β (3)— $19^{\text{h}} 25^{\text{m}} \text{ N } 27^{\circ} 40'$. *Albireo*, one of the most brilliant and beautiful of the double stars—topaz yellow and sapphire blue, the colours in striking contrast.

61 (6)— $21^{\text{h}} 0^{\text{m}} \text{ N } 38^{\circ} 3'$. The celebrated star "61 Cygni." One of the nearest stars in the heavens, ascer-

CYGNUS.



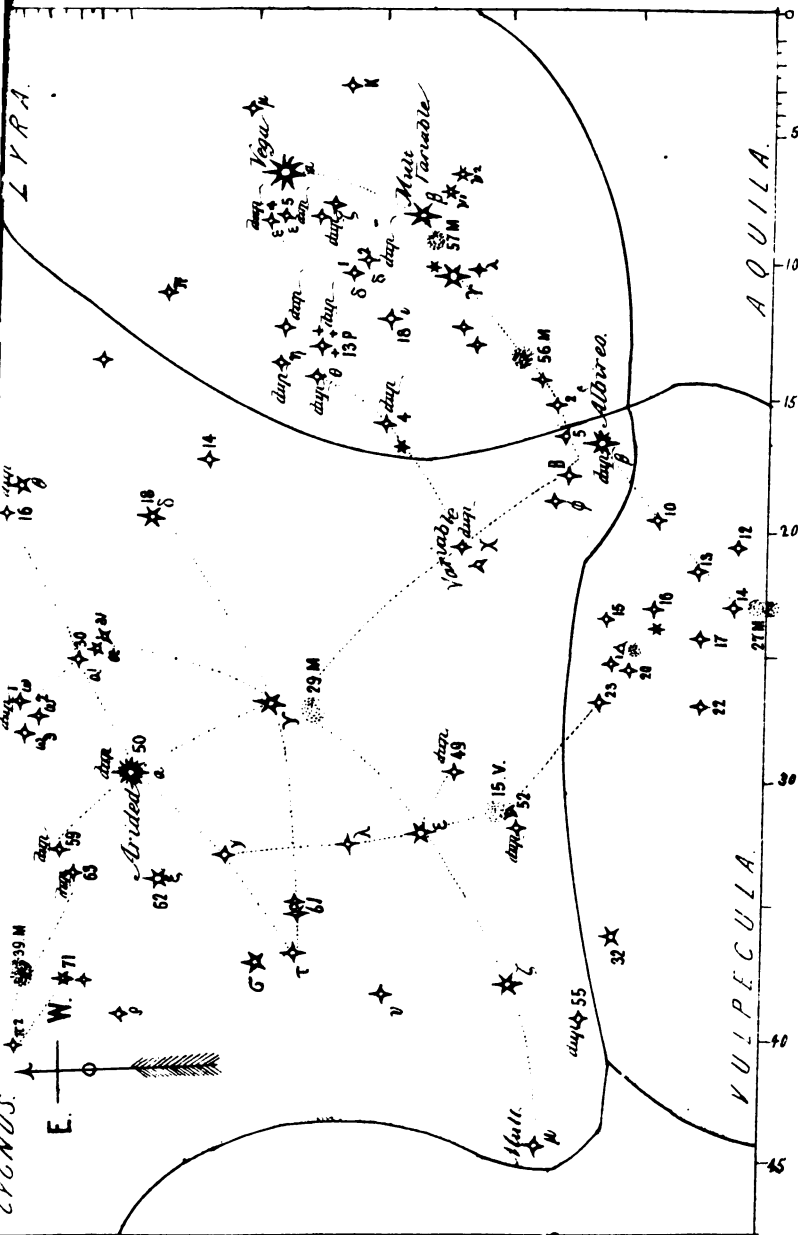
39 M

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LYRA.



tained from the calculations of astronomers founded on its parallax; yet the light from it only reaches our orb in ten years! Both stars yellow; the companion a deeper yellow. Period, 514 years.

μ (5)— $21^{\text{h}} 38^{\text{m}}$ N $28^{\circ} 7'$. Triple star—white, blue, and blue.

σ^3 (5)— $20^{\text{h}} 9^{\text{m}}$ N $46^{\circ} 19'$. Triple—orange, blue, and blue. Fine field, with a low power.

16 (6)— $19^{\text{h}} 38^{\text{m}}$ N $50^{\circ} 12'$. A fine star—fawn colour. 1° from θ .

* 59 (6)— $20^{\text{h}} 54^{\text{m}}$ N $46^{\circ} 54'$. A very delicate triple star—orange; the companions both blue; in the tail of the Swan.

χ (4)— $19^{\text{h}} 40^{\text{m}}$ N $33^{\circ} 22'$. A fine double star—golden yellow and pale blue, on the Swan's neck, variable.

11.—LYRA (THE LYRE).

A small but very rich constellation, easily known from the splendour of *Vega* and the two stars, β and γ , that seem to hang upon it in its annual sweep around the pole. *Vega* is visible from May to November, and is on the S. meridian at 9 30 p.m. in August.

NEBULÆ.

57 M— $18^{\text{h}} 48^{\text{m}}$ N $32^{\circ} 51'$ (Plate IV, Fig. 3). One of the most beautiful and perfect of the class of *ring-nebulæ*. It shews a mottled surface even in a four-inch aperture telescope, and sparkles under the eye. The opening in the centre is very distinctly seen. Lord Rosse sees "wisps of stars" within, and numerous fringes streaming outward, all round the exterior of the ring. It lies nearly midway between β and γ , but closer to β .

56 M— $19^{\text{h}} 11^{\text{m}}$ N $29^{\circ} 56'$ (Plate IV, Fig. 7). A resolvable nebula, in a splendid field; its condensed part, of a triangular shape, nearly midway between γ and Albireo. Rather a faint object.

D

DOUBLE STARS.

α (1)— $18^h 31^m$ N $38^\circ 38'$. *Vega*, one of the most splendid of the first magnitude stars. Some astronomers rank *Vega* next after *Sirius*; the *Herschels* place it after *Arcturus* and *Capella*. It has a minute companion, $43''$ distant. A difficult test object. *Vega* is pale sapphire; the companion pale blue.

β (3)— $18^h 45^m$ N $33^\circ 12'$.—A quadruple star, variable. Period, 6 days and $10\frac{1}{2}$ hours, having two maxima and two unequal minima during that time.

γ (3)— $18^h 53$ N $32^\circ 28'$. A lustrous star, with a minute distant companion—bright yellow and blue. γ was formerly less bright, but is now considerably brighter than β , and is supposed to be variable.

ϵ^4 and ϵ^5 (5)— $18^h 40^m$ N $39^\circ 31'$ (Plate IV, Fig. 6). A double double or quadruple star; seen as one star to the naked eye, resolved into two with an opera glass. A three-inch aperture, with a power of 100, will resolve each of these into a double star, the first pair yellow and ruddy, the second both white. There are between the two sets, a little out of the line, and forming a slight curve, three faint stars. Lord Rosse has added a fourth. The whole group is supposed to constitute one system. Period, probably, 2,000 years.

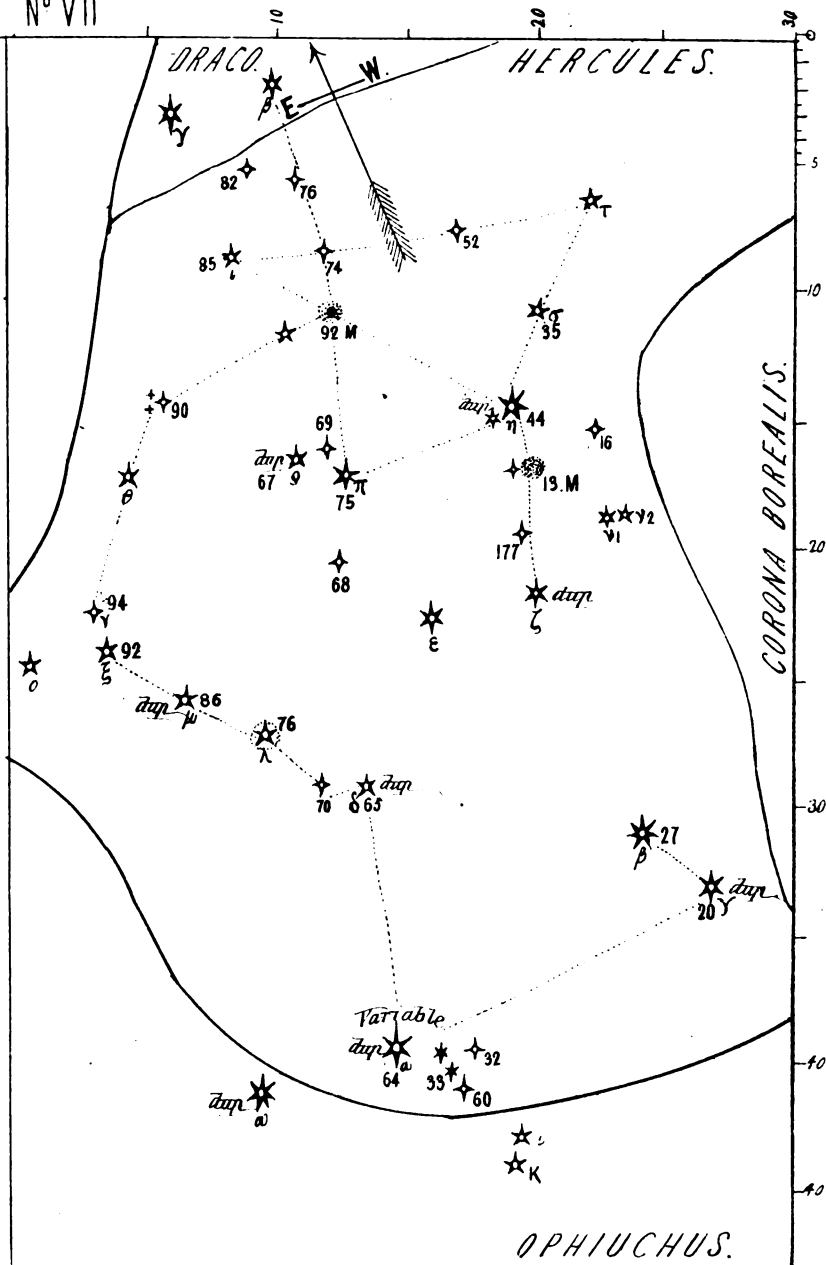
13, P. (6)— $19^h 3^m$ N $37^\circ 39'$. A double double star; the stars of one pair bright yellow and pale gray; of the other, greenish and dusky—a difficult object.

η (5)— $19^h 8^m$ N $38^\circ 52'$. Sky blue and violet tint, E. of *Vega*.

ζ (5)— $18^h 39^m$ N $37^\circ 26'$. A fine double star—topaz and greenish.

ν^1 (6)— $18^h 44^m$ N $32^\circ 38'$. A quadruple star—pale yellow, bluish, pale blue, and blue. To the S. of β , and followed, at $15''$ distance, by ν^2 , a white star of the 6th magnitude.

Nº VII



MAP VII.—HERCULES.

12.—HERCULES.

An extensive constellation, stretching over 40° N. to S. of the heavens. The northern part is well marked to the naked eye. It contains no large stars, but has some first-class telescopic objects. Hercules shows itself above the N. E. point of the horizon about 9 p.m. in the month of March; is found on the meridian, nearly overhead, about 10 p.m. at the beginning of July; and is lost from sight near the N. W. about 9 p.m. in November, although a few of its upper stars never set in England. Consequently, the best seasons for observing this constellation will be when at some elevation above the eastern horizon, before it attains its greatest altitude, in the months of April and May; or in the west when found midway between the zenith and the horizon, in August and September.

NEBULÆ.

13 M— $16^{\text{h}} 37^{\text{m}}$ N $36^{\circ} 43'$ (Plate IV, Fig. 1). Halley's Nebula, one of the finest in the heavens, and one of the three visible to the naked eye.

"Perhaps no one ever yet saw it for the first time through a good telescope, without uttering a shout of wonder."—*Dr. Nichol*. "An extensive and magnificent mass of stars, with the most compressary parts densely compacted and wedged together under unknown laws of aggregation."—*Smyth*.

A three-inch telescope will show numerous stars on its surface, and a number of stellar outstreamers, but there still remains the great central globular mass, impenetrable

to all but to first-class telescopes. Between η and ζ one-third of the way nearer to η .

92 M— $17^h 13^m N 43^\circ 17'$. A very splendid globular-shaped nebula, inferior only to 13 M, very bright in the central mass with streaming edges, difficult to find. It forms the apex of a nearly equilateral triangle with a line from η to π , for its base; a right line from ϵ to β Draconis will pass near it at within 9° of the latter star (Plate IV, Fig. 5).

DOUBLE STARS.

α ($3\frac{1}{2}$)— $17^h 8^m N 14^\circ 33'$. A delicate double star, with companions, to the extreme south of the constellation, near α Ophiuchi—orange, pale red, and greenish. Between the first and third there are three minute stars of a lilac tinge, forming a good test-object for a telescope. α is a variable star, changing from maximum 3rd mag. to minimum 4th, in $60\frac{1}{4}$ days.

γ ($3\frac{1}{2}$)— $16^h 15^m N 19^\circ 32'$. A fine double star—silvery white and lilac.

ρ (4)— $17^h 19^m N 37^\circ 17'$. White and pale emerald— 3° E. of π .

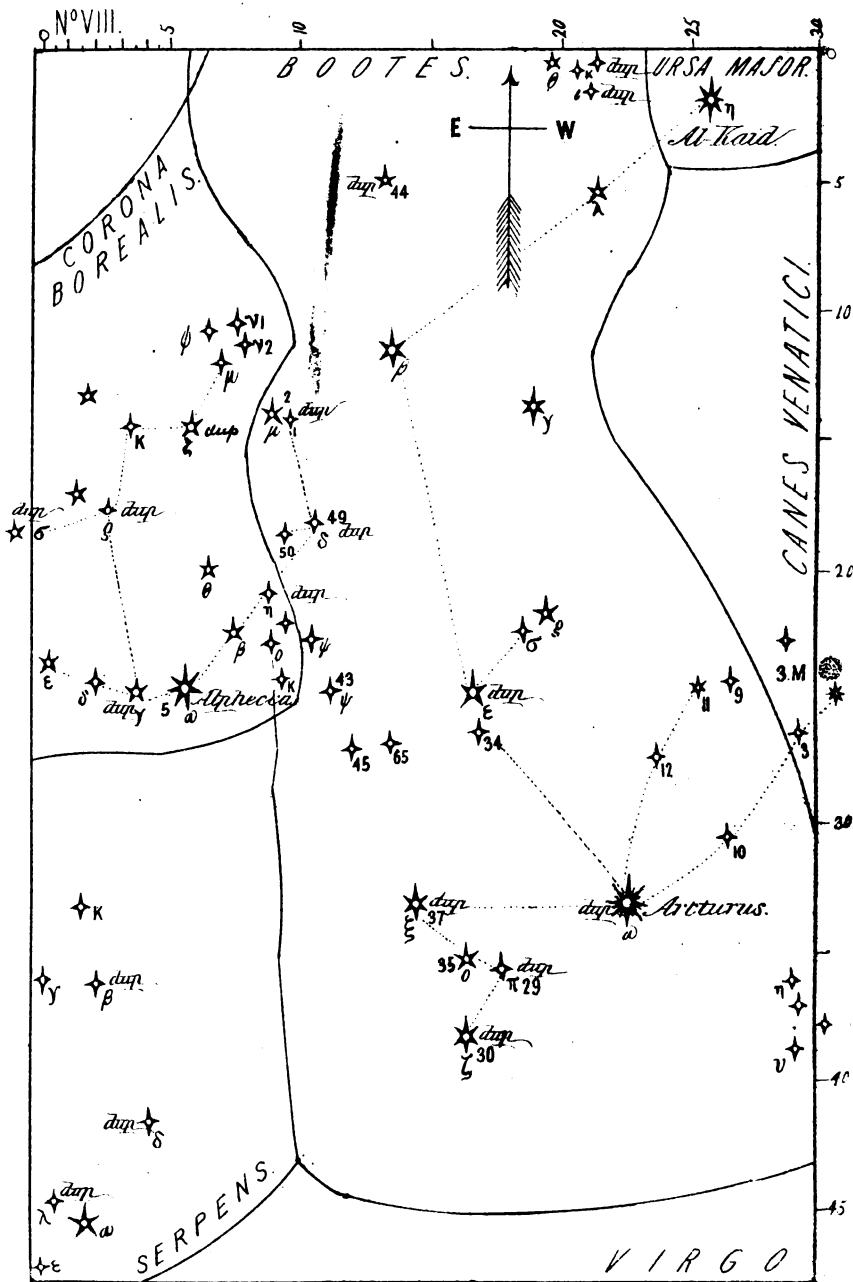
ζ (3)— $16^h 35^m N 31^\circ 54'$. One of the very closest of the double stars. It has the astonishing velocity, according to Struve, of revolving in an apparently very elliptical orbit of about 14 years period.

μ (4)— $17^h 41^m N 27^\circ 48'$. A delicate double star—straw colour and blue.

λ (5)— $17^h 25^m N 26^\circ 13'$. A deep orange colour star, which marks *the point* (according to Sir W. Herschel and M. Argelander) *towards which our whole solar system is moving*.

δ (4)— $17^h 9^m N 25^\circ 0'$. Greenish white and grape red—a beautiful object.

3.



MAP VIII.—BOOTES, CORONA BOREALIS.

13.—BOOTES (THE HERDSMAN).

This is a constellation of great extent, easily recognised by its principal star, Arcturus,—the star which appeared in the tail of the Comet on the night of the 5th of Oct., 1858. It is remarkable chiefly for its fine double stars.

Arcturus rises about 9 p.m. at the beginning of February, 7 p.m. at the beginning of March, gets on to the southern meridian about 11 p.m. in May, and sets at 9 p.m. towards the end of October. Hence it will be favourably situated for observation in the months of March, April, August, and September.

NEBULA.

3 M— $13^{\text{h}} 36^{\text{m}}$ N $29^{\circ} 4'$. This fine nebula belongs to the constellation of *Canes Venatici* (which see), but is introduced here on account of the star pointers to it on the Map No. VIII.

DOUBLE STARS.

α (1)— $14^{\text{h}} 8^{\text{m}}$ N $20^{\circ} 0'$. *Arcturus*, one of the finest of first magnitude stars; with a distant companion—reddish yellow and pale lilac.

ϵ (3)— $14^{\text{h}} 39^{\text{m}}$ N $27^{\circ} 40'$. A most beautiful double star, called “Pulcherissima,” or “fairest of the fair,” by astronomers—pale orange and sea green. Distance, $3''$. Period, 980 years. It constitutes a well known test for large telescopes.

ι (4)— $14^{\text{h}} 11^{\text{m}}$ N $52^{\circ} 1'$. Yellow and white. In large telescopes the principal star is again double. One of the three stars in a group to the E. of Alkaid.

κ (6)— $14^{\text{h}} 7^{\text{m}} \text{ N } 52^{\circ} 1'$. Pale white and blue—close to ι . A fine object.

ζ ($3\frac{1}{2}$)— $14^{\text{h}} 34^{\text{m}} \text{ N } 14^{\circ} 20'$. White and blue—a difficult object.

π (3) $14^{\text{h}} 34^{\text{m}} \text{ N } 17^{\circ} 1'$. Both stars white.

ξ (4) $14^{\text{h}} 45^{\text{m}} \text{ N } 19^{\circ} 41'$. Orange and purple. Period, 117 years.

δ ($3\frac{1}{2}$)— $15^{\text{h}} 10^{\text{m}} \text{ N } 33^{\circ} 50'$. Pale yellow and blue.

μ^1 and μ^2 (4)— $13^{\text{h}} 19^{\text{m}} \text{ N } 37^{\circ} 52'$. White and green. The companion is seen double in large telescopes, and the whole group probably form one system.

14.—CORONA BOREALIS (THE NORTHERN CROWN).

A small constellation, one of the very few whose form—for it has a real resemblance to an inverted crown—justifies the appropriateness of the name; easily recognised from its neighbourhood to Arcturus, and visible at the same times.

DOUBLE STARS.

η (5)— $15^{\text{h}} 17^{\text{m}} \text{ N } 30^{\circ} 48'$. A very close double star, less than one second of distance, and one of the severest tests of a large telescope—white and golden yellow. Sir W. Herschel says that with a power of 227 he could not detect its duplicity, and with 460 the component stars are as fine a miniature of ι Bootis as that is of α Geminorum. η Corona is a binary star of a most interesting character, and has completed a whole revolution since it was discovered. The period is 432 years.

ζ (4)— $15^{\text{h}} 34^{\text{m}} \text{ N } 37^{\circ} 6'$. A fine star—components, bluish white and blue.

σ (5)— $16^{\text{h}} 9^{\text{m}} \text{ N } 34^{\circ} 13'$. White and blue. A binary star; period, about 560 years.

γ (4)— $15^h 36^m$ N $26^\circ 48'$. A most difficult binary star, with a distant companion. Principal star, flushed white ; companion, uncertain ; distant companion, pale lilac. The most difficult double star in the heavens to resolve ; closer than ζ Herculis. The companion will show itself only on the finest night, to the best eye, and with a power of 500. Period, 40 years.

ν^1 and ν^2 (6)— $16^h 17^m$ N $34^\circ 2'$. A fine group, the former pair deep yellow and grey, the latter pale yellow and garnet. Near the top of the staff of *Bootes*.

MAP IX.—CANES VENATICI AND COMA BERENICES.

15.—CANES VENATICI (THE HOUNDS).

A poor constellation to the naked eye, only distinguished by one bright star, *Cor Caroli*, but easily found from its position, due south of the Bear's tail. It contains some remarkably fine telescopic objects, and comes on the south meridian in May; together with Coma Berenices, it is situated for observation about the same time as Bootes.

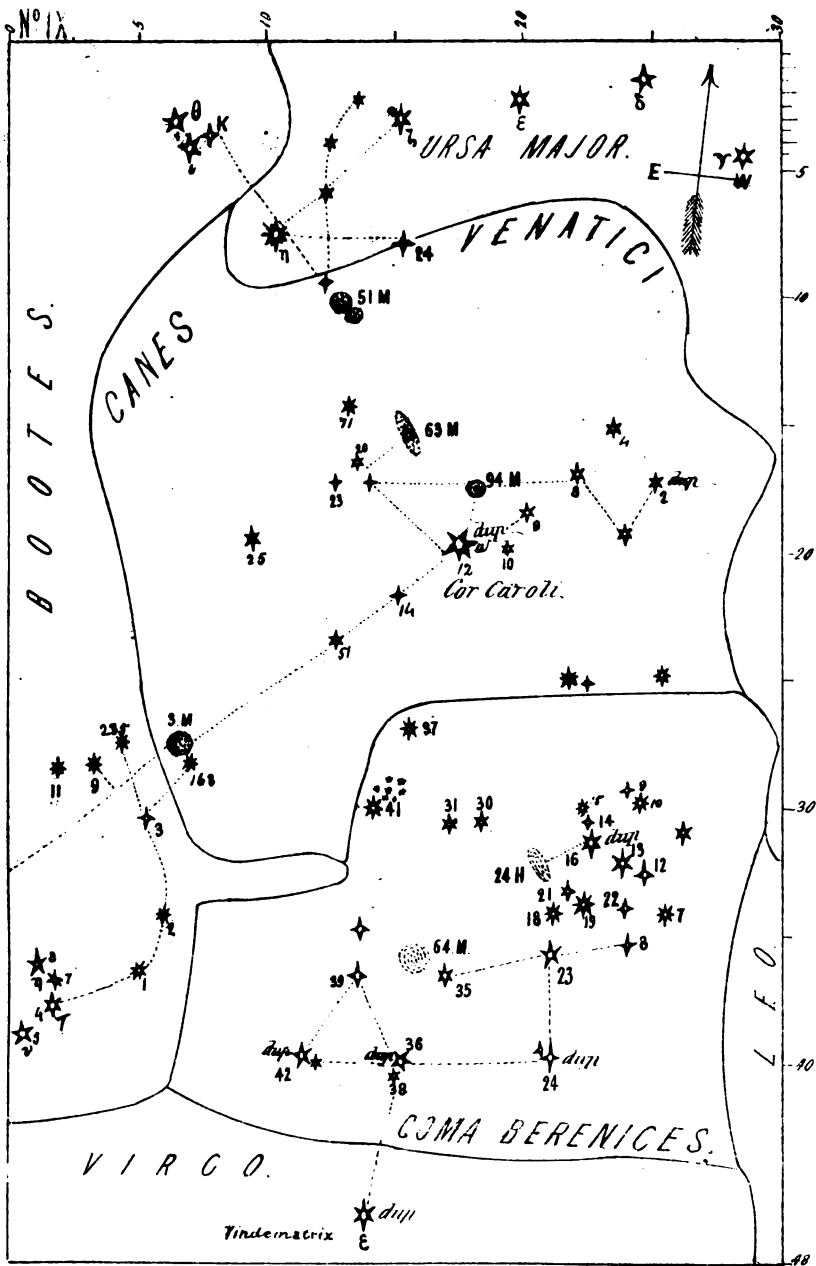
NEBULÆ.

51 M— $13^{\text{h}} 24^{\text{m}} \text{ N } 47^{\circ} 55'$. The astonishing "whirlpool nebula" of Lord Rosse. It has two centres or nuclei, one larger than the other; the smaller is the brighter and, it may be assumed, the nearer. A good three-inch telescope will show a luminous haze around the larger nucleus, and stars on the surface of both. It will be easily found from the pointers on the Map.

3 M— $13^{\text{h}} 36^{\text{m}} \text{ N } 29^{\circ} 4'$ (Plate I, Fig. 2). One of the first-class nebulæ, resolvable into stars. About 1000 stars have been seen on its surface. It blazes splendidly at its centre. Found nearly midway between *Cor Caroli* and *Arcturus*, rather nearer the latter, within 11° N. W., near a star of the 6th magnitude, 163 of the Catalogues, and forms the apex of an equilateral triangle with the stars 3 and 9, *Bootis*. A very splendid object even in a small telescope.

94 M— $12^{\text{h}} 44^{\text{m}} \text{ N } 41^{\circ} 53'$. A large white globular nebula, with symptoms of resolvability. 3° N. by W. of *Cor Caroli*.

63 M— $13^{\text{h}} 10^{\text{m}} \text{ N } 42^{\circ} 46'$. A nebula very white in its



colour, and bright in the centre, with a star-like nucleus, 10' long by 4' broad. Placed between two telescopic stars, $5\frac{1}{2}^{\circ}$ N. E. of Cor Caroli.

DOUBLE STARS.

12 (3)— $12^{\text{h}} 49^{\text{m}}$ N $39^{\circ} 4'$. *Cor Caroli*, a fine double star—flushed white and pale lilac. Period, about 57 years. Mid-way between *Coma Berenices* and the Bear's tail.

2 (6)— $12^{\text{h}} 9^{\text{m}}$ N $41^{\circ} 26'$. A very fine double star—golden yellow and blue. 8° W. by N. from Cor Caroli. In Smyth's "Cycle of Celestial Objects," this star is described as being 9° to the *south-west* of Cor Caroli, and one-third of the distance between that star and δ Leonis, and this description is followed in Webb's "Celestial Objects"—"one-third from Cor Caroli towards δ Leonis." The star marked 2 *dup.* on Map No. IX, is that which answers to the Right Ascension and Declination of the star described, and is certainly not *south-west* but *north-west* of Cor Caroli; and is on a line towards Ursa Major and *not* on the line towards Leo. There is another star in *Canes Venatici* marked 2, but it is 8° due south of the above star, and answers to the description of position—"one-third from δ Leonis towards Cor Caroli," but it is not marked double on any of the globes or maps, and is included within the boundary of *Coma Berenices* by Malby, though not by Newton nor by the Maps of the Society for the Diffusion of Useful Knowledge; and, moreover, it is not $12^{\text{h}} 9^{\text{m}}$ N $41^{\circ} 26'$, but $12^{\text{h}} 9^{\text{m}}$ N $44^{\circ} 15'$.

16.—COMA BERENICES (THE HAIR OF BERENICE).

A small constellation, composed of stars of the 5th and 6th magnitudes, situated between the Hounds and Virgo, easily found from its proximity to Arcturus. It comes to the south meridian in May, and is visible near the same times as Bootes.

NEBULÆ.

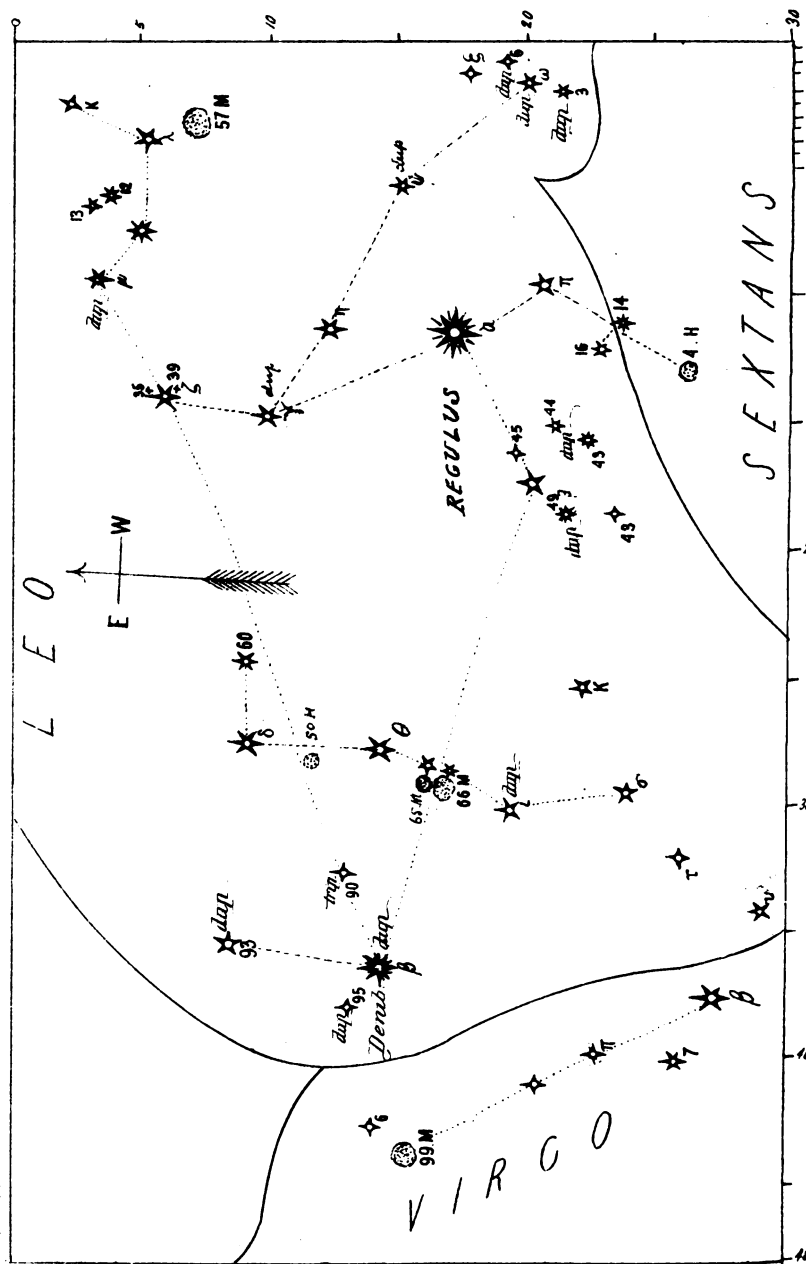
24 H— $12^{\text{h}} 28^{\text{m}}$ N $26^{\circ} 52'$. A large, white, long nebula in the centre of the tresses; 2° S. E. of the star 16. "A curious, long, streaky object."—*Smyth*. There is a companion nebula very close, and both are supposed to belong to the class of spiral-nebulæ.

64 M— $12^{\text{h}} 48^{\text{m}}$ N $22^{\circ} 33'$. An elongated nebula, with a very brilliant centre. A magnificent object (Plate I, Fig. 4), 1° N. E. of the star 35.

DOUBLE STARS.

12 (6)— $12^{\text{h}} 15^{\text{m}}$ N $26^{\circ} 37'$. A beautiful object—pale yellow and rose red.

24 (6)— $12^{\text{h}} 28^{\text{m}}$ N $19^{\circ} 9'$. A fine double star—orange and emerald green.



MAP X. — LEO, PARTS OF SEXTANS, AND VIRGO.

17.—LEO (THE LION).

A very fine and well-marked constellation to the naked eye, and contains many superb objects. Leo first appears above the eastern horizon about 9 p.m. at the end of December; comes to the southern meridian about 9 p.m. in the middle of April; and disappears behind the western horizon at 9 p.m. about the end of July. As Leo never attains a very great altitude—its greatest being from 40° to 50° —it can conveniently be observed at any time from February to June.

NEBULÆ.

57 H— $9^{\text{h}} 20^{\text{m}}$ N $8^{\circ} 53'$. One of the extraordinary spiral-nebulæ of Lord Rosse; resembling a vast luminous coil unfolding itself from one centre, and of astonishing lustre. Seen as a bright globular nebula in ordinary telescopes. It is situated in the lower jaw of Leo, under the star λ . Easily found from the pointers on the Map.

50 H— $11^{\text{h}} 8^{\text{m}}$ N $18^{\circ} 55'$. Midway between δ and θ , a little to the east. A round white nebula, with a bright centre; and beside it, to the west, is another nebula, 51 H ii.

66 M and 65 M— $11^{\text{h}} 13^{\text{m}}$ N $13^{\circ} 46'$ (Plate III, Fig. 5). Two elongated, large, and faint nebulae; the former having a bright nucleus in the centre. Both in the field under a low power. 1° to the S. E. is another elliptical nebula, 875 H, of "even a more stupendous character as to apparent dimensions."

DOUBLE STARS.

α (1)— $10^h 1^m$ N $12^\circ 39'$. *Regulus*, a splendid first-magnitude star, with a distant companion—both white.

β ($1\frac{1}{2}$)— $11^h 42^m$ N $15^\circ 21'$. *Denib* or *Denebola*, a wide double star—blue and dull red.

γ (2)— $10^h 12^m$ N $20^\circ 33'$. A splendid double star—bright orange and greenish yellow. Distance, $2' 8''$. A most beautiful object; about 8° N. E. of *Regulus*; period, 1000 years.

ϵ (4)— $11^h 17^m$ N $11^\circ 18'$. A binary star, very beautiful—pale yellow and light blue. $5\frac{1}{2}^\circ$ S. by E. of θ .

μ (3)— $9^h 44^m$ N $26^\circ 45'$. A star with a companion—orange and pale lilac.

ψ (5) $9^h 35^m$ N $14^\circ 45'$. A variable star, with a distant companion—bright orange and bluish white.

ω (5)— $9^h 20^m$ N $9^\circ 45'$. An exquisitely close double star—pale yellow and greenish yellow. Period, 82 years; 10° W. of *Regulus*.

3 (6)— $9^h 20^m$ N $8^\circ 53'$. A delicate double star—pale yellow and blue; within a degree of ω .

6 (6)— $9^h 23^m$ N $10^\circ 25'$. Pale rose tint and purple.

90 (6)— $11^h 27^m$ N $17^\circ 34'$. A fine triple star—bright white, purple, and pale red. 4° N. W. of β .

18.—SEXTANS (THE SEXTANT).

Sextans being so close to Leo, and its principal telescopic object so near to *Regulus*, the times given for Leo apply equally to this constellation.

NEBULA.

4 H i— $10^h 7^m$ N $4^\circ 15'$. A large faint globular and *bicentral* nebula, with indications of a *spiral arrangement*; and another larger and fainter 255 H iii, on the following

parallel, 9° S. E. of Regulus. A line from η Leonis to Regulus, and carried nearly twice as far beyond, will reach it. This object is on or near the spot where the capuchin De Rheita, in 1643, fancied he saw "the handkerchief of St. Veronica," with an improved binocular telescope which he had constructed.

VIRGO.

99 M—The position of this nebula is shewn on this Map, as well as on Map XX.

MAP XI.—GEMINI, CANCER, CANIS MINOR, WITH PARTS OF HYDRA & MONOCEROS.

The principal objects in the first three constellations form the shape of the letter V,—Castor and Pollux, in Gemini, being at the head of the right-hand stroke; Præsepe, or the *Beehive*, in Cancer, on the left; and the principal stars in Canis Minor at the point. Gemini, being the more westerly, will, of course, rise first. About 9 p.m. at the end of October, Castor and Pollux may be seen just about the N. E. point of the horizon, pointing towards Cassiopeia. In about two hours time they will be followed by Procyon in the east, and by the *Beehive* a little more N. E. These constellations will remain favourably situated for observation until the summer months return. Castor, Pollux, and Procyon, will be on the southern meridian at 9 p.m. at the end of February, and Præsepe about an hour after.

19.—GEMINI (THE TWINS).

A constellation distinguished chiefly by the remarkable stars, Castor and Pollux.

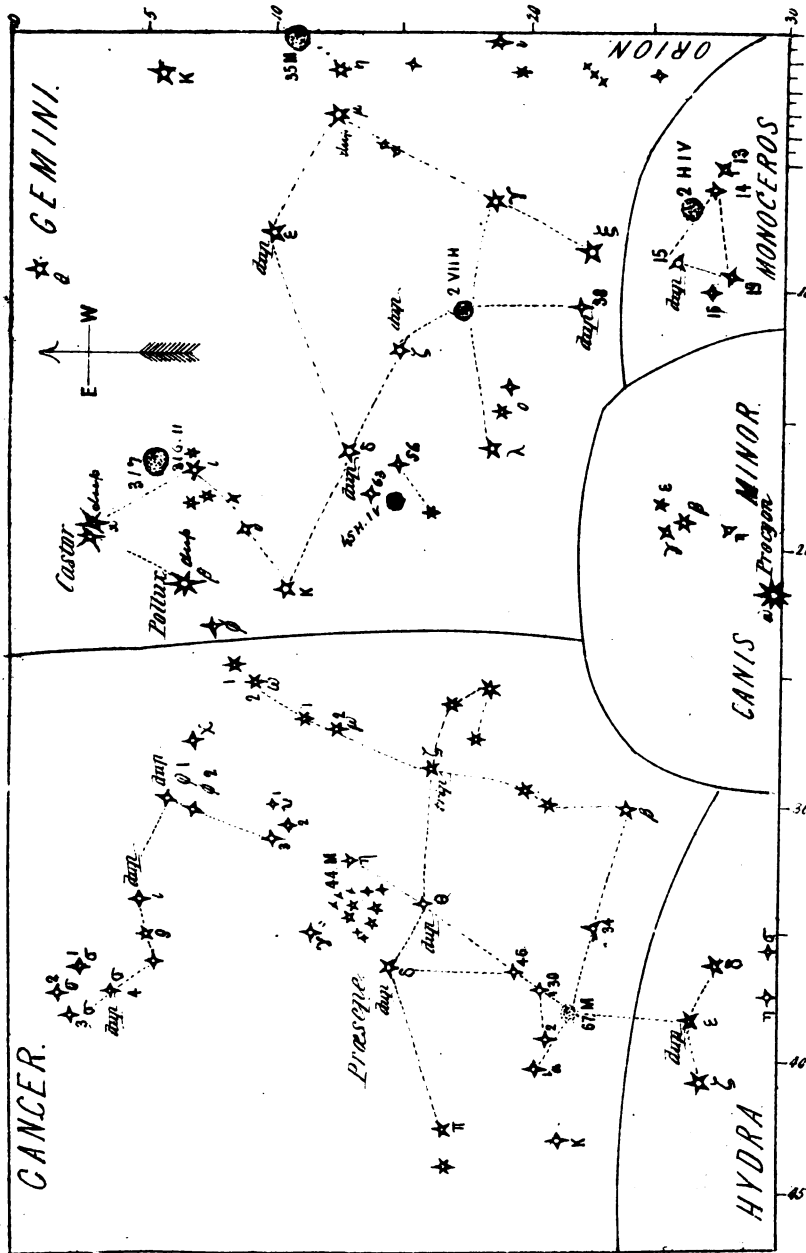
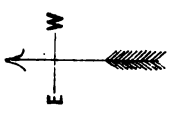
NEBULÆ.

35 M—6^h 0^m N 24° 21'. A rich cluster of very small stars, in a fine neighbourhood, "resembling the bursting of a sky-rocket."

45 H—7^h 21^m N 21° 12'. A nebula "like a star of the 9th magnitude, with a very bright nebulosity equally dispersed all round."—*Herschel*. "Like a star enveloped by an atmosphere."—*Smyth*. Lord Rosse observes an object like a bright star, surrounded with a circular nebula having

CANCER.

GEMINI.



a dark aperture at its centre, near the star, while beyond and around the nebula there is an intensely dark ring, which is again surrounded by an outer luminous ring, very bright and constantly flickering.

317 H ii and 316 H ii— $7^h 15^m N 29^\circ 49'$. Another of the Rosse nebulae, considered the most wonderful and mysterious in appearance and structure of all the extraordinary nebulae hitherto observed by Lord Rosse. It was drawn by Sir J. Herschel as an elongated bicentral nebula, but as observed by Lord Rosse, Dec. 22, 1848, it presented the appearance of a bright crab-like nebula in the centre, from which claws and filaments sprang out; and was surrounded by two bright oval concentric rings, incomplete in their outline, and not corresponding in the line of their curves at either end, as if they were not really ellipses, but sections of a great spiral coil, whose centre and outline only were visible, but whose details could be revealed by higher optical power.

2 H vii— $6^h 46^m N 18^\circ 10'$. A strange angular-shaped cluster of stars (Plate II, Fig. 6).

DOUBLE STARS.

α (1)— $7^h 26^m N 32^\circ 12'$.—*Castor*, "The largest and finest of all the double stars in our hemisphere."—*Sir J. Herschel*. Bright white and pale white. Distance, $4''$; period, about 240 years. A good test for a small telescope. The component stars are closing rapidly, and will soon be resolvable only by the first-class telescopes.

β (3)— $7^h 36^m N 28^\circ 24'$. *Pollux*, a splendid coarse triple star in the eye of Pollux—orange, ash-coloured, and pale violet; there is also a minute attendant.

ϵ (3)— $6^h 35^m N 25^\circ 16'$. Brilliant white and blue.

μ (5)— $6^h 14^m N 22^\circ 35'$. A fine star, with a distant companion—crocus yellow and bluish.

δ (4)—7^h 11^m N 22° 16'. A fine double star; very close; a difficult object—pale white and purple.

38 (6)—6^h 46^m N 13° 23'. A remarkably fine double star—light yellow and purple. The colours in brilliant contrast; 2½° E. of ξ.

20.—CANCER (THE CRAB.)

NEBULA AND CLUSTER.

67 M—8^h 42^m N 12° 24' (Plate IV, Fig. 4). A resolvable nebula; angular shaped, with above 200 stars of various magnitudes on its surface. It is found at the root of the southern claw of the Crab; 5° nearly due N. of ε *Hydræ*.

44 M—8^h 30^m N 20° 15'. The well-known *Præsepe*, or "Beehive." It is visible to the naked eye as a dull patch of light. A fine cluster; larger stars, but fewer than in the *Pleiades*.

DOUBLE STARS.

δ (4)—8^h 35^m N 18° 44'. A delicate double star—pale yellow and blue.

ζ (5)—8^h 3^m N 18° 7'. A fine triple star—yellow, orange tinge, and pale yellow.

ι (5)—8^h 37^m N 29° 30'. Pale orange and blue—the colours in beautiful contrast. Distance, 30"; in the northern claw of the Crab.

φ¹ (6)—8^h 17^m N 28° 25'. A star, with a distant companion—pale white and lilac.

φ² (6)—8^h 17^m N 27° 27'. A close double star, near φ¹; both stars silvery white.

σ² (6)—8^h 46^m N 31° 6'. A close double star—white and yellow; over the Crab's northern claw.

σ⁴ (6)—8^h 52^m N 32° 52'. White and sky blue—a beautiful object.

21.—CANIS MINOR (THE LESSER DOG).

α (1)— $7^h 31^m$ N $5^\circ 38'$. *Procyon*, a splendid first-magnitude star, with a distant companion — yellowish white and orange tinge.

22.—HYDRA.

ϵ (4)— $8^h 39^m$ N $6^\circ 56'$. A fine double star—pale yellow and purple. Binary ; period of revolution, 450 years.

MAP XII.—ORION AND MONOCEROS.

23.—ORION.

The grandest and most conspicuous constellation in the heavens. "Orion is a rich mine for the astronomer, containing a wondrous universe of bright stars, double stars, star clusters, and nebulæ, within itself."—*Smyth*.

"Orion's beams! Orion's beams!
His star-gemmed belt and shining blade;
His isles of light, his silvery streams,
And gloomy griefs of mystic shade."—*Manilius*.

The equinoctial circle cuts the constellation in two, just above the northernmost star of the belt. Orion comes on the S. meridian in January, and is visible from the middle of October to the middle of April.

NEBULÆ.

θ^1 — $5^h 28^m$ S $5^\circ 29'$. The great nebula in the sword of Orion, which seems to be without a number or a name in the Bedford Catalogues, and in the Star Maps. It is generally called "the Huyghens' Nebula," because discovered by Huyghens; but θ^1 , its designation in Smyth's "Cycle of Celestial Objects," and in Webb's "Celestial Objects," points out the principal star of the trapezium of stars in the nebula, and cannot be a proper designation for the nebula itself.

The nebula in Orion is one of the three visible to the naked eye, and far exceeds in dimensions and variety of surface all other nebulæ in our hemisphere, or perhaps in the whole heavens. Sir John Herschel, who examined it at the Cape of Good Hope, describes its surface as very

TAURUS.

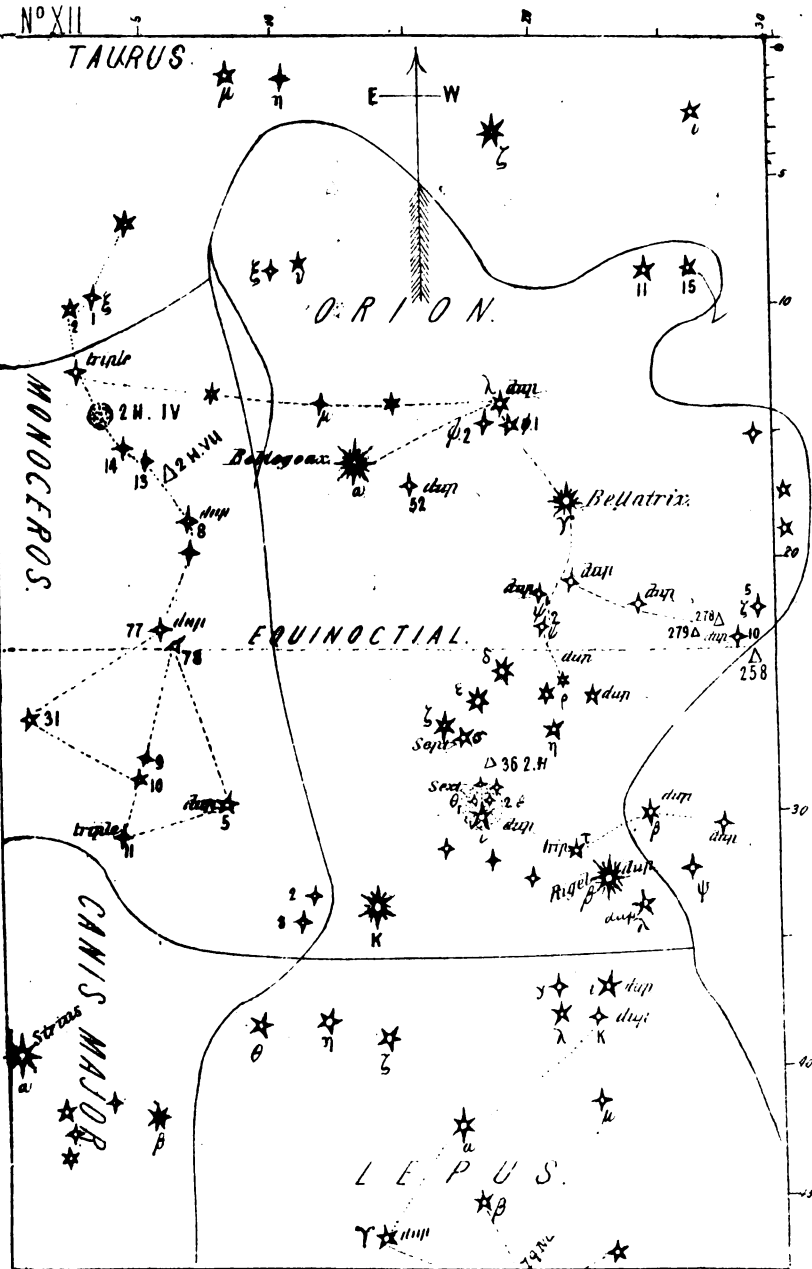
ORION.

MONOCEROS.

EQUINOCTIAL.

CANIS MAJOR.

LEPUS.



much resembling "flocks of wool, or the breaking up of a mackerel-sky." Lord Rosse first resolved it into stars: "we could plainly see that all about the trapezium is a mass of stars; the rest of the nebula also abounding with stars, and exhibiting the characteristics of resolvability strongly marked."—*Letter of Lord Rosse to Dr. Nicholl, March 19th, 1846.* The intensely dark openings in some parts of the surface of the nebula produce an overwhelming sensation on the mind of the observer, as if he looked through the portals of this island universe into the vast unexplored regions of infinite space. Several drawings of the nebula in Orion have been furnished by astronomers, all differing according to the degree of optical power employed. It is perhaps the most difficult object in the heavens to sketch; neither Sir John Herschel's drawing, nor Mr. Lassell's more elaborate one, will be recognised by the observer with a small telescope. Lord Rosse has furnished sketches of detached portions of the nebula.

362 H— $5^{\text{h}} 29^{\text{m}}$ S $4^{\circ} 27'$. The star cluster to the north of the great nebula; and there is a similar cluster just to the south. The whole neighbourhood is rich in clusters and double stars.

12 H iii— $5^{\text{h}} 29^{\text{m}}$ S $6^{\circ} 0'$ (Plate III, Fig. 4). The nebulous star nearly opposite the great dark opening in the nebula. It appears like a star enveloped in a haze in a small telescope. Lord Rosse sees it as in the Figure 4, Plate III. This object is generally described as ϵ , a triple star—white, pale blue, and grape red.

DOUBLE STARS.

α (1)— $5^{\text{h}} 47^{\text{m}}$ N $7^{\circ} 22'$. *Betelgeux*, a variable star; by some astronomers considered the brightest star in the northern hemisphere. "A most beautiful and brilliant gem, singularly beautiful in colour—a rich topaz, in hue

and brilliancy different from any that I have seen.”—*Lassel*.

β (1)— $5^h 8^m$ S $8^\circ 22'$. *Rigel*, a fine star, with a distant companion—orange tinge and sapphire blue. A severe test for a fine eye and a good telescope.

δ (2)— $5^h 25^m$ S $0^\circ 24'$. *Mintaka*, a wide double star; the uppermost of the three brilliants in Orion's belt, and nearly on the line of the equinoctial—both white.

ρ (6)— $5^h 6^m$ N $2^\circ 41'$. Orange and blue; 2° W. of δ .

λ (4)— $5^h 27^m$ N $9^\circ 50'$. Pale white and violet; in the head of Orion.

278 and 279 P iv. (6)— $4^h 55^m$ N $1^\circ 24'$. White and blue—“a little to the S. is an eighth magnitude star, of a singularly deep and striking red hue.”—*Webb*.

258 P iv. (6)— $4^h 51^m$ N $1^\circ 27'$. White and grey—a beautiful object.

ϵ (2)— $5^h 28^m$ S $1^\circ 18'$. The central “brilliant” in the belt. A distant companion—white and blue; a nebulous star.

τ (4)— $5^h 10^m$ S $7^\circ 1'$. An extremely delicate triple star; $1\frac{1}{2}^\circ$ to the N. E. of *Rigel*—pale orange, blue, and lilac, all three in a line between two bright stars; a fine object.

θ (4)— $5^h 28^m$ S $5^\circ 29'$. A multiple star in the nebula; the principal star in the trapezium. These stars twinkle like brilliants on a dark ground; they seem set in one of the dark apertures of the nebula; the colours are white, lilac, garnet, red, and blue. A small telescope (three-inch) will show four stars; a good four-inch, five; a larger aperture, six; Mr. *Lassel* sees eight; and Lord *Rosse* “a mass of stars,” in which, however, the trapezium seems isolated.

σ (4)— $5^h 32^m$ S $2^\circ 41'$. A multiple star, just under the lowest “brilliant” of the belt—bright white, ash-coloured, bluish, grape-red, dusky white, and pale grey. A capital test object.

24.—LEPUS (THE HARE).

A small constellation just under Orion, very near the horizon; and may be easily observed in the months of December and January, when it is on the S. meridian.

DOUBLE STARS.

ι (4)— $5^{\text{h}} 6^{\text{m}} \text{ S } 12^{\circ} 2'$. A fine and delicate double star—white and pale violet, with a distant red star to the north.

κ (5)— $5^{\text{h}} 7^{\text{m}} \text{ S } 13^{\circ} 6'$. A close double star—pale white and clear grey—an “exquisite object.”—*Smyth*.

γ (3)— $5^{\text{h}} 39^{\text{m}} \text{ S } 22^{\circ} 30'$. A fine double star—yellow and garnet.

ξ (4)— $5^{\text{h}} 19^{\text{m}} \text{ S } 24^{\circ} 39'$. A fine white star, with a scarlet companion. It is near the nebula 79 Messier, and about 4° S. W. of α Lepus.

25.—MONOCEROS (THE UNICORN).

A constellation not distinguishable to the naked eye, but containing some fine objects. It lies in the great triangle of stars formed by *Betelgeux*, *Procyon*, and *Sirius*, and is here introduced on account of the following objects, which may be found with a little patience by the aid of the pointers on the Map, and observed from January to March.

NEBULÆ.

2 H iv.— $6^{\text{h}} 30^{\text{m}} \text{ N } 8^{\circ} 30'$ (Plate III, Fig. 6). A nebula described by Sir J. Herschel as “comet-shaped,” but as seen by Lord Rosse it is “bell-shaped,” with two globes, the upper smaller than the under, placed on its vertex. A most extraordinary object.

2 H vii.— $6^{\text{h}} 23^{\text{m}} \text{ N } 5^{\circ} 2'$. A fine cluster, visible to the naked eye.

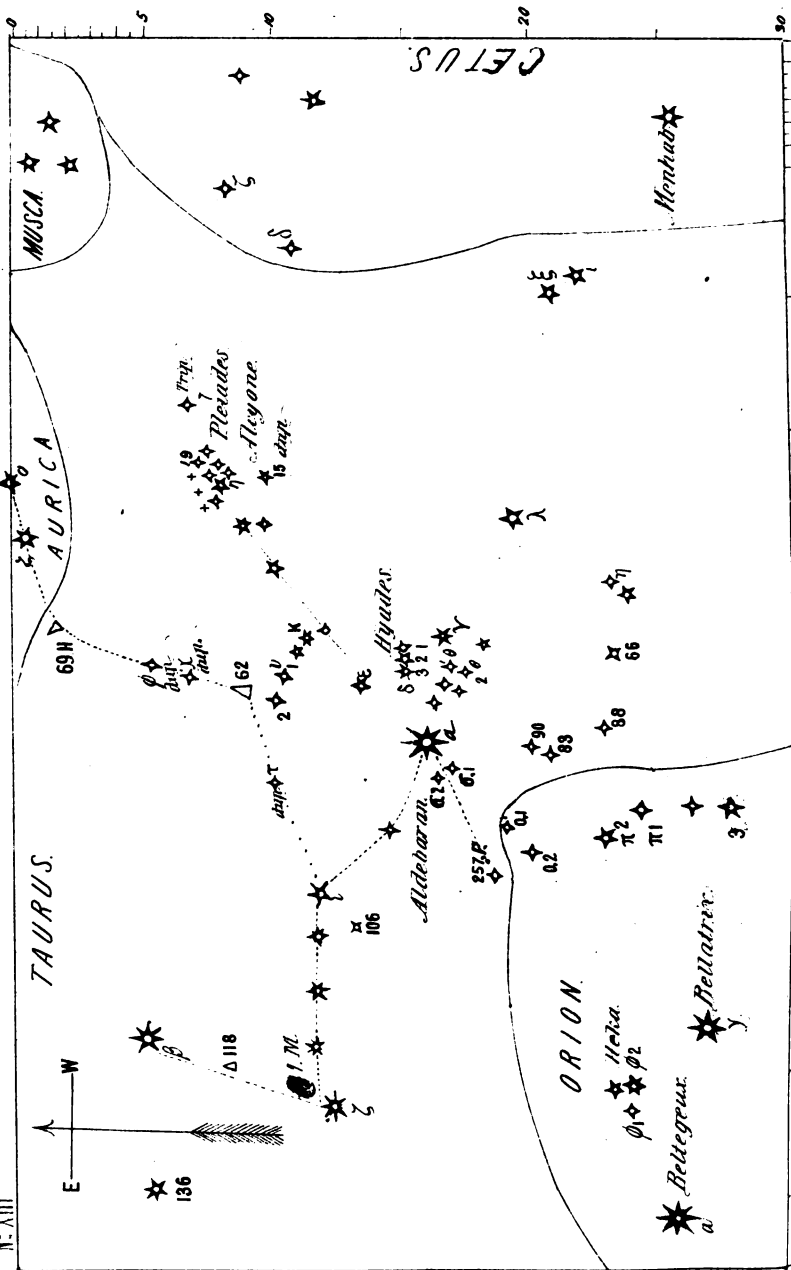
50 M— $6^h 56^m$ S $8^\circ 8'$. A splendid cluster, in a magnificent field in the galaxy, not shown on the Map. A line from the bright star, Procyon, through θ , and produced as far again will reach it.

DOUBLE STARS.

15 (4)— $6^h 32^m$ N $10^\circ 2'$. A delicate triple star, in a magnificent field. (On Map XI.)

11 (5)— $6^h 22^m$ S $6^\circ 57'$. A splendid triple star—white, companion pale white. “One of the most beautiful sights in the heavens.”—*Sir W. Herschel*.

8 (4)— $6^h 16^m$ N $4^\circ 40'$. A fine double star—golden yellow and lilac. About 7° E. of Betelgeux.



MAP XIII.—TAURUS.

26.—TAURUS (THE BULL).

A splendid constellation, inferior only to Orion and Ursa Major. Aldebaran, or the Bull's Eye, comes to the S. meridian at 9 p.m. in January. The constellation is visible from September to April. It contains the well-known star clusters, "The Pleiades," or *seven stars*; and the Hyades, near to Aldebaran.

NEBULÆ.

1 M—5^h 25^m N 21° 55'. A first-class nebula; discovered accidentally by Messier, when searching for a comet in 1758, near the star ζ, in the tip of the Bull's southern horn. "ζ Tauri was also the pointer to Halley's comet in 1835."—*Smyth*. The discovery of this nebula led to the formation of Messier's celebrated Catalogue of the Nebulæ, numbering 103 of the principal celestial objects. This is the famous "crab nebula" of Lord Rosse. It is a large oval nebula to a small telescope, but the great reflector shows numerous branches and filaments streaming outwards and upwards.

69 H—4^h 2^m N 31° 15'. A nebulous star, like a star in burr, whose singular appearance led Sir W. Herschel to adopt the nebular theory. He concluded that "we, therefore, have here a central body which is not a star, or a star which is involved in a thin fluid of a nature wholly unknown to us." The reader will find a satisfactory solution of the mystery of these nebulous stars in Dr. Nichol's *System of the World*, page 97.

STAR CLUSTERS—THE PLEIADES.

η (3)— $3^h 38^m$ N $23^\circ 36'$. Alcyone, the principal star in the Pleiades, with three distant companions—greenish yellow; the companions, pale white. Some astronomers think that Alcyone is the central sun of our universe. The Pleiades is a very ancient name of this cluster—"Canst thou bind the sweet influences of the Pleiades, or loose the bands of Orion?"—*Job xxxviii. v. 31*. The names of the seven Pleiads are:—Merope, Alcyone, Celæno, Electra, Taygeta, Asterope, and Maia. Merope is called "the lost Pleiad," which is a poetic fiction, for a good eye will easily discover her. Two other bright stars in the group are Pleione and Atlas. In the telescope, from 40 to 60 stars are visible in this group.

DOUBLE STARS.

19 (5)— $3^h 36^m$ N $23^\circ 58'$. A delicate double star—white and violet; one of the seven Pleiads.

15 (5)— $3^h 36^m$ N $22^\circ 38'$. A most delicate double star, in the Pleiades—bright white and fine blue.

θ^1 and θ^2 (5)— $4^h 21^m$ N $15^\circ 39'$. A pair of wide double stars in the Hyades—pearly white and yellowish.

γ (3)— $4^h 11^m$ N $15^\circ 14'$. A bright star, with a distant companion—fine yellow and pale blue; the *lucida* of the Hyades.

τ (4)— $4^h 34^m$ N $22^\circ 41'$. Bluish white and lilac, N. of Adelberan.

ϕ (5)— $4^h 12^m$ N $27^\circ 1'$. A wide double star—light red and clear blue.

χ (5)— $4^h 14^m$ N $25^\circ 18'$. A beautiful double star—white and pale sky blue. 2° S. of ϕ .

257 P iv. (6)— $4^h 51^m$ N $14^\circ 20'$. A triple star—white, blue, and purple. S. E. of α , towards α Orionis.

62 (6)— $4^h 16^m$ N $23^\circ 58'$. Silver white and purple.
 "A fair object for a moderate telescope." — *Smyth*.
 Between χ and the Star 2.

118 (6)— $5^h 21^m$ N $25^\circ 2'$. White and pale blue—
 between the tips of the horns.

β (2)— $5^h 16^m$ N $28^\circ 28'$. A fine star, with a distant
 companion—brilliant white and pale grey. On the tip of
 the northern horn of the Bull.

MAP XIV.—ARIES, PISCES, AND CETUS

27.—ARIES (THE RAM).

A constellation marked to the naked eye by three bright stars, α , β , and γ . Aries opened the astronomic year as the "princeps signorum," 2,000 years ago. Owing to the precession of equinoxes, Pisces now occupies that position, and Aries has passed 30° to the E. of that point of the equinoctial which is intersected by the ecliptic. "This apparent motion of the zodiac arises from a slow vibration of the axis of the earth occasioned by planetary attraction." *Smyth*. Aries is on the southern meridian at 9 p.m. in December, and may be seen from September to March.

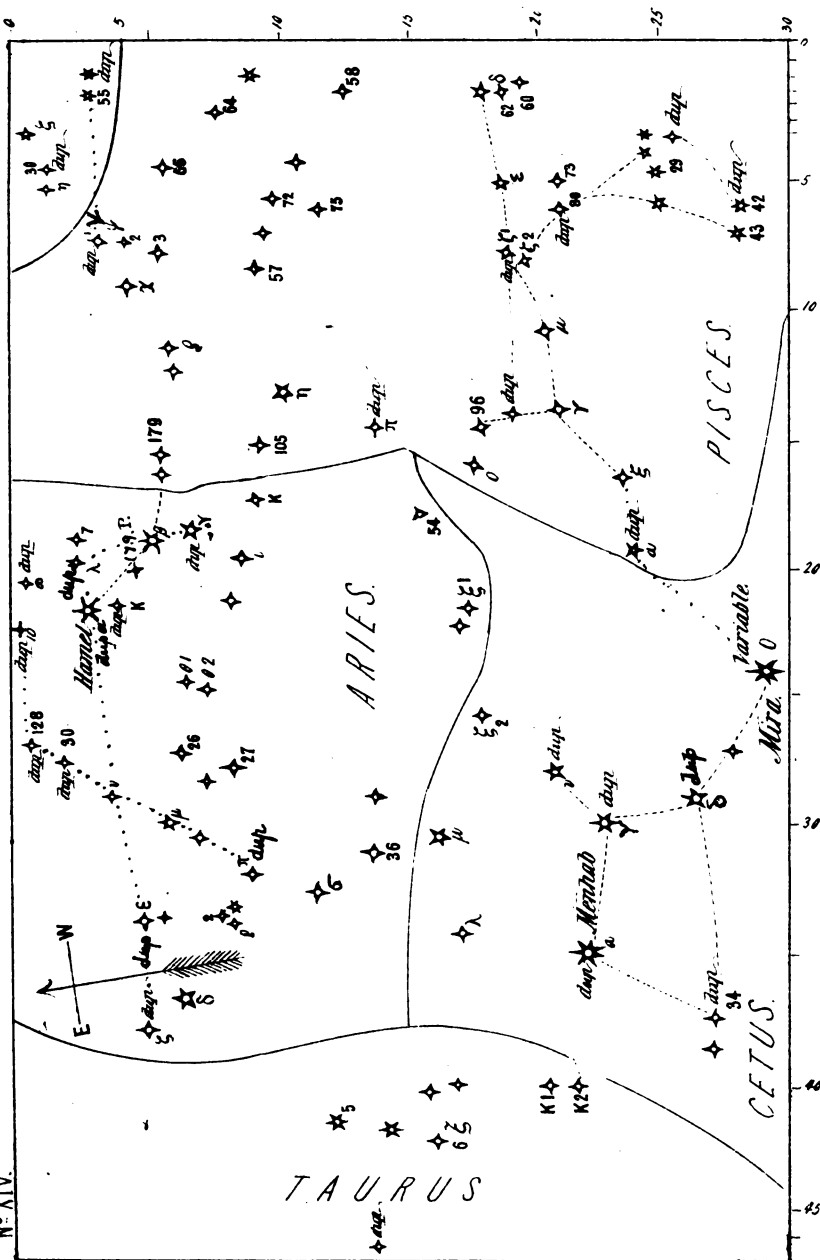
DOUBLE STARS.

α (2)— $1^h 58^m$ N $22^\circ 42'$. A most delicate double star—yellow and purple. "It required the full aperture, and powers varying from 240 to 300, to scrutinise satisfactorily *α Arietis*."—*Smyth*. A good eye may, however, detect the purple companion with a power of 100, on a clear night, with a $3\frac{1}{2}$ -inch aperture.

γ (4)— $1^h 46^m$ N $18^\circ 36'$. *Mesartim*, called the first star in Aries, because the nearest to the equinoctial point, and the first double star ever discovered by the telescope (by Dr. Hook, 1664)—white and grey; a beautiful object.

λ (5)— $1^h 50^m$ N $22^\circ 55'$. Yellowish white and blue, near α .

ϵ (4)— $2^h 50^m$ N $20^\circ 42'$. A very close double star, less than $1''$ of distance, requiring a good $3\frac{1}{2}$ -inch and a fine eye to resolve it.



π (5) $2^h 40^m$ N $16^\circ 48'$. A splendid triple star—pale yellow, white, and dusky.

179 P i. (6)— $1^h 42^m$ N $21^\circ 35'$. Yellow and blue, near β .

30 and 128 P ii. (6)— $2^h 29^m$ N $24^\circ 2'$. Topaz, yellow, and grey. "The most southern of a fine group of about a dozen double stars, spread over Aries, Musca, and Triangulum, with extensive patches of dark blank space, intervening."—*Smyth*.

28.—PISCES (THE FISHES).

A straggling constellation, very difficult to distinguish, with five leading stars of the fourth magnitude; but very rich in double stars. One of the fishes is situated under Mirac, in Andromeda, and the other just under the great square of Pegasus. Visible September to January.

DOUBLE STARS.

α (3)— $1^h 55^m$ N $2^\circ 5'$. A splendid double star, 7' N. W. of Mira, in Cetus—pale green and blue.

ζ^1 and ζ^2 (6)— $1^h 7^m$ N $6^\circ 50'$. A fine double star—silver white and pale grey. N. W. of α , easily observed.

ψ^1 and ψ^2 (6)— $0^h 58^m$ N $20^\circ 43'$. An exceedingly fine double star—both clear white. In the north-west of the constellation.

55 (6)— $0^h 33^m$ N $20^\circ 40'$. On the right arm of Andromeda; a fine object—orange and deep blue; the colours in striking contrast.

29.—CETUS (THE WHALE).

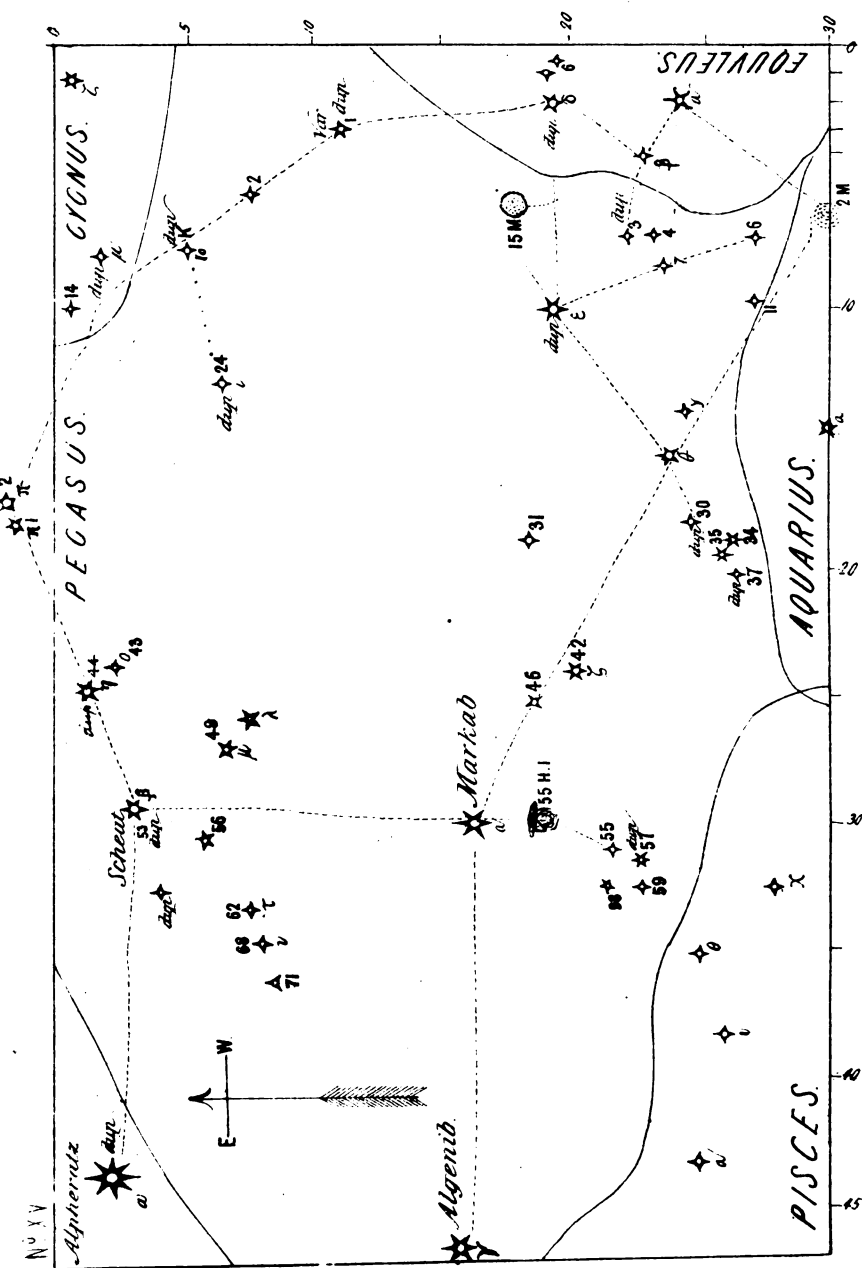
A large and, for the most part, a blank constellation; situated under Aries. It is on the S. meridian at 9 p.m. in December, at a low altitude.

DOUBLE STARS.

α (2)— $2^h 53^m$ N $3^\circ 30'$. *Menkar*, supposed to be variable—bright orange and pale grey. "This is a curious object under a moderate power, on account of a decided blue star in the field north of it."—*Smyth*.

$\circ$ (2)— $2^h 11^m$ S $3^\circ 30'$. *Mira*, the famous variable star, varying from the 2nd to the 7th mag., and sometimes to invisibility, in 331 days $15^h 7^m$ —flushed yellow and pale lilac.

γ (3)— $11^h 36^m$ N $2^\circ 39'$. A fine double star—pale yellow and bright blue; the colours in rich contrast. 5° W. of α .



MAP XV.—PEGASUS.

30.—PEGASUS (THE FLYING HORSE).

A large blank constellation, with very few telescopic objects; readily distinguished to the naked eye by the great square of stars, Alpherat in Andromeda, Scheat, Markab, and Algenib, in Pegasus. Visible in the S. from September to November

NEBULÆ.

15 M— $21^{\text{h}} 23^{\text{m}}$ N $11^{\circ} 33'$. A nebula, with a very bright centre; globular in shape; with "stragglers branching from a central blaze." A fine object, but difficult to find from the absence of star pointers in the neighbourhood. (Plate III, Fig. 3.)

55 H i.— $22^{\text{h}} 57^{\text{m}}$ N $11^{\circ} 28'$. An object seen in a small telescope as a long narrow bright nebula, with a bright star at each end. In Lord Rosse's telescope it is a most extraordinary object; the elongated nebula seems like a ring-shaped nebula, seen at its edge, and lying upon the coil of a vast spiral nebula not revealed by smaller telescopes. The elongated nebula is very much brighter than the other, consequently is very much nearer than the spiral one, and doubtless has only an optical and not a physical connection with it.

DOUBLE STARS.

ι (4)— $21^{\text{h}} 16^{\text{m}}$ N $19^{\circ} 12'$. A variable star, $10\frac{1}{2}$ S. by E. of ζ Cygni—pale orange and purple.

ε ($2\frac{1}{2}$)— $21^{\text{h}} 37^{\text{m}}$ N $9^{\circ} 14'$. A star, with two distant companions—yellow, blue, and violet; all three in a line.

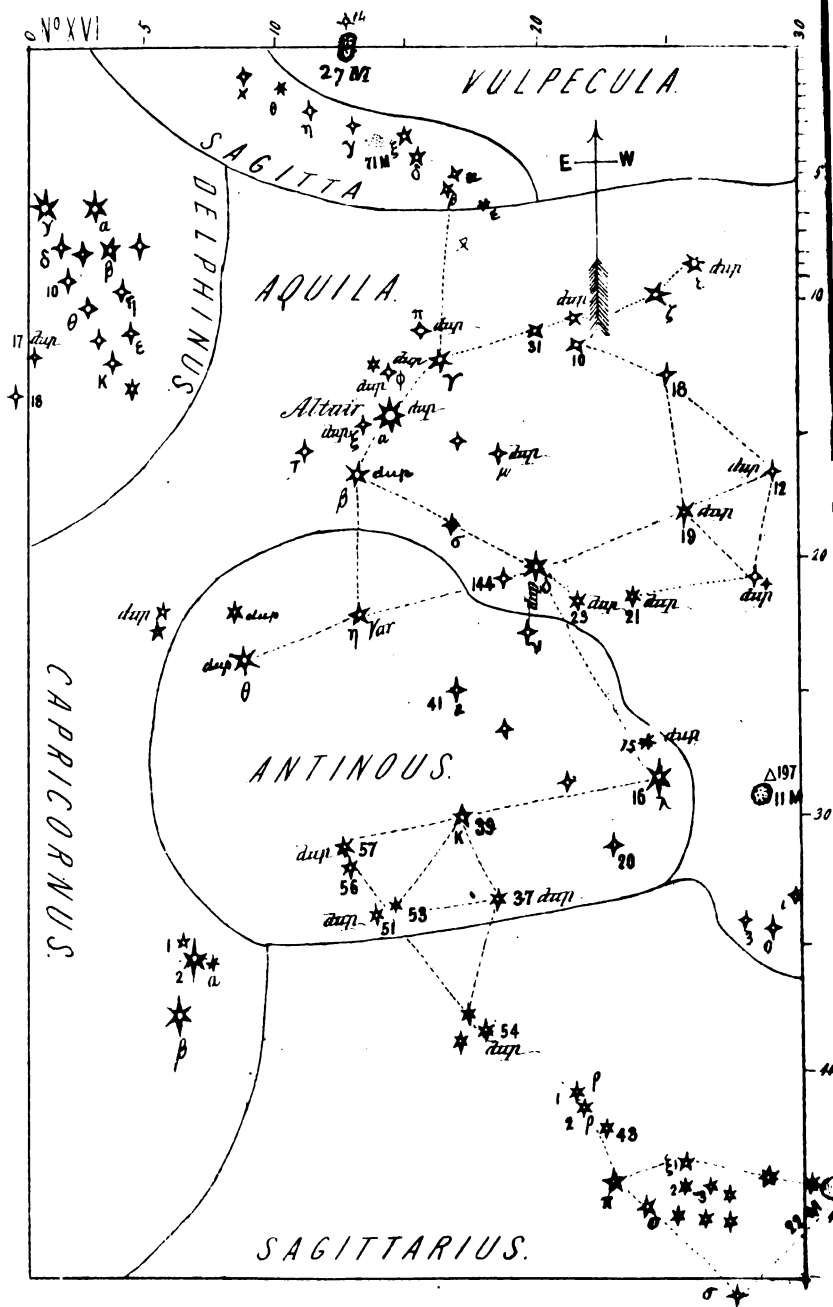
η (3)— $22^{\text{h}} 35^{\text{m}}$ N $29^{\circ} 25'$. A large star, with a distant companion—pale yellow and blue ; N. W. of Scheat.

κ (4)— $21^{\text{h}} 38^{\text{m}}$ N $19^{\circ} 12'$. A delicate double star— $15''$ to the N. of ϵ .

π^1 and π^2 — $22^{\text{h}} 3^{\text{m}}$ N $32^{\circ} 30'$. A splendid pair—both yellow.

β (2)— $22^{\text{h}} 56^{\text{m}}$ N $27^{\circ} 13'$. A bright star, with a minute companion—deep yellow and blue.

α (2)— $22^{\text{h}} 56^{\text{m}}$ N $14^{\circ} 21'$. A splendid star, with a distant companion, S. of Scheat—white and pale grey.



MAP XVI.—AQUILA, ANTINOUS, DELPHINUS,
SAGITTA, VULPECULA, AND SAGITTARIUS.

31.—AQUILA (THE EAGLE).

A constellation easily recognised by the three principal stars in a line with the bright star, Altair, in the centre. Aquila is on the southern meridian in August, about 10 p.m.; and may be conveniently observed in the S. W. at an altitude of 30° to 40° during September and October.

NEBULA.

11 M— $18^{\text{h}} 42^{\text{m}}$ S $6^{\circ} 26'$ (Plate II, Fig. 2). A splendid cluster, or rather a double-cluster, of a singular shape. "This object somewhat resembles a flight of wild ducks in shape."—*Smyth*. $3\frac{1}{2}^{\circ}$ to the S. W. of λ , towards the shield of Sobieski, beyond the boundary of Antinous.

DOUBLE STARS.

α ($1\frac{1}{2}$)— $19^{\text{h}} 43^{\text{m}}$ N $8^{\circ} 27'$. *Altair*, the brightest star of the constellation, has a distant companion—pale yellow and violet tint.

γ (3)— $19^{\text{h}} 40^{\text{m}}$ N $10^{\circ} 16'$. A fine orange star, with a very faint companion; a fine field. δ is also in a rich field.

β ($3\frac{1}{2}$)— $19^{\text{h}} 47^{\text{m}}$ N $6^{\circ} 0'$. A bright star on the Eagle's neck—pale orange and grey.

π (5)— $19^{\text{h}} 42^{\text{m}}$ N $11^{\circ} 28'$. White and green—a miniature of Castor. A beautiful object; $1\frac{1}{2}^{\circ}$ N. E. of γ .

144 (6)— $19^{\text{h}} 23^{\text{m}}$ N $2^{\circ} 37'$. Deep yellow and pale green. 1° from δ .

23 (5)— $19^h 11^m N 0^\circ 50'$. A delicate double star—light orange and grey. 2° from δ , S. W.

197 P xviii.— $18^h 42^m S 6^\circ 4'$. A fine double star ; the cluster above 11 M is in the field, with a low power.

32.—ANTINOUS.

A small constellation, mixed up with Aquila, and occasioning much confusion of outline on the maps ; visible at the same time.

DOUBLE STAR.

57 (5)— $19^h 45^m N 8^\circ 38'$. In the bow of Antinous ; close to the star 56⁵—both stars blue.

33.—DELPHINUS (THE DOLPHIN).

A small but very interesting constellation, easily found from its dolphin shape, and its contiguity to Aquila.

NEBULA.

103 H i.— $20^h 27^m N 6^\circ 57'$. A small bright globular cluster, between the stars γ and δ .

DOUBLE STARS.

178 P (6)— $20^h 23^m N 10^\circ 44'$. A delicate quadruple star ; close to the bright star, ϵ —the 1st and 2nd stars, white ; 3rd and 4th, yellow.

γ (4)— $20^h 40^m N 15^\circ 37'$. One of the most beautiful double stars in the heavens, nearly equal in magnitude—yellow and light emerald ; with a third star, $2\frac{1}{4}'$ distant.

β (4)— $20^h 30^m N 14^\circ 2'$. A most delicate triple star ; $1\frac{1}{2}^\circ$ S. W. of α —the first star, greenish ; the others, dusky ; the third star a severe test for a small telescope.

34.—SAGITTA (THE ARROW).

A small constellation consisting of a line of stars, bearing some resemblance to an arrow, N. of Aquila; visible at the same times.

NEBULA.

71 M— $19^{\text{h}} 46^{\text{m}}$ N $18^{\circ} 22'$. A globular cluster, on the shaft of the arrow, nearly midway between γ and δ .

DOUBLE STARS.

θ (5)— $20^{\text{h}} 4^{\text{m}}$ N $20^{\circ} 26'$. A fine triple star, near the head of the arrow—pale topaz, grey, and pearly yellow.

ϵ (5)— $19^{\text{h}} 31^{\text{m}}$ N $16^{\circ} 9'$. A star, with a distant companion—pale white and light blue.

35.—VULPECULA (THE LITTLE FOX).

This is remarkable for the great “Dumb-bell Nebula.” The constellation may be recognised about 10 p.m. in August, as lying nearly in a line between Vega and the south point of the horizon; and may be conveniently found during the months of September and October, in a line from that star to the S. W. of the horizon.

NEBULA.

27 M— $19^{\text{h}} 54^{\text{m}}$ N $22^{\circ} 20'$. The great “Dumb-bell Nebula.” It will be easily found from the pointers on Maps No. VI. or XVI. A line from γ Lyra, through Albireo, and produced as far again towards the Dolphin, will strike it; the outline is well shown with a three-inch. Admiral Smyth's description (accompanied by a sketch), in which he likens it to “a double-headed shot,” cannot be affirmed by any telescope above $2\frac{1}{2}$ -inch aperture. A

F

power of 30 will show it very much fuller in the middle than the common drawings, which have too much of the hour-glass shape. It was first resolved into stars by Lord Rosse, with his 3ft. reflector ; the 6ft. shows it a most astonishing object—myriads on myriads of suns bewildering the mind and dazzling the eye with insufferable splendour.

36.—SAGITTARIUS (THE ARCHER).

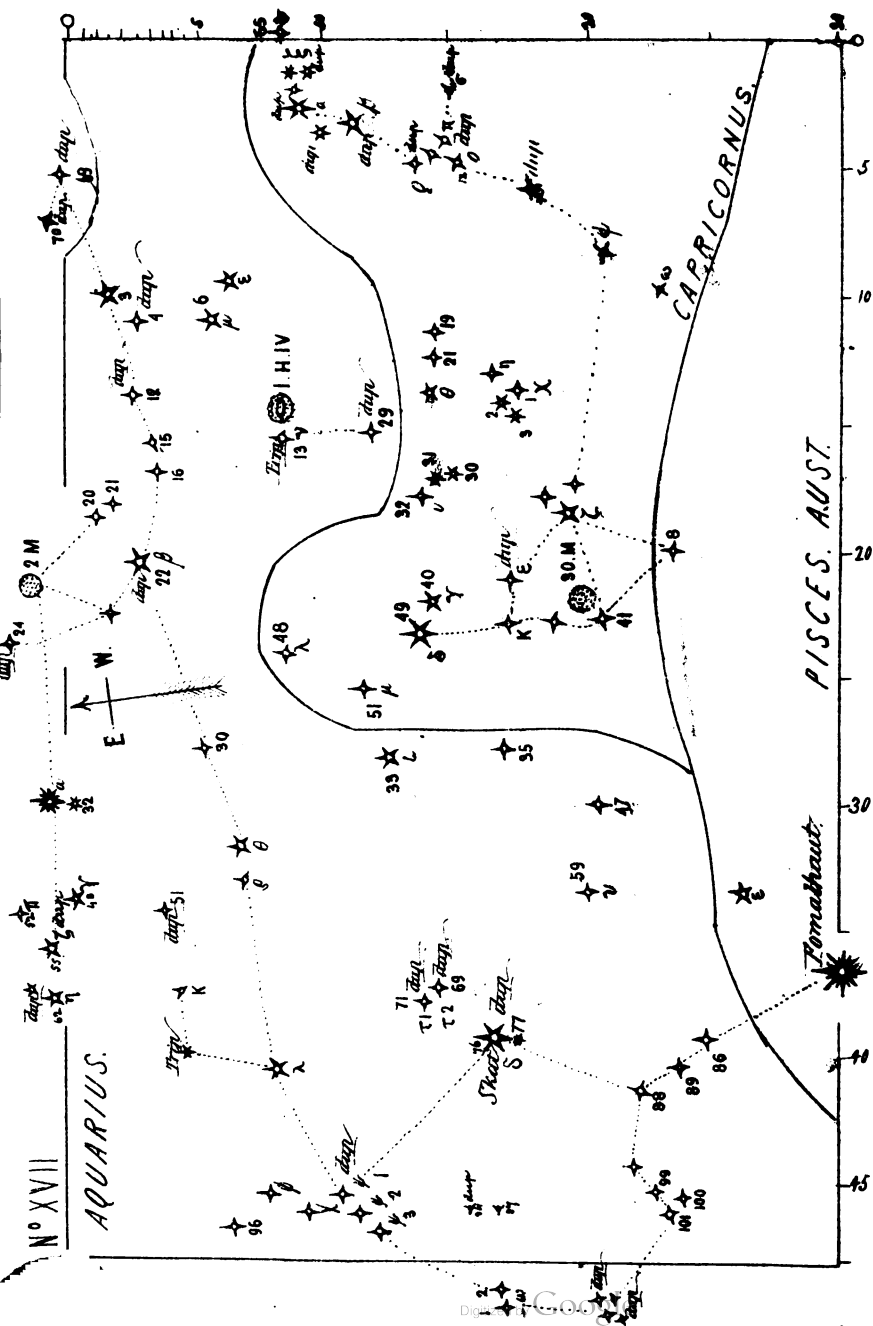
Visible in August, very low over the southern horizon.

NEBULA.

22 M— $18^h 28^m$ S $24^\circ 1'$. A very rich star cluster, in a line between the stars μ and σ , nearer to σ ; μ not shown on the Map.

N° XVII

AQUARIUS.



MAP XVII.—AQUARIUS, CAPRICORNUS, AND PISCES AUSTRALIS.

37.—AQUARIUS (THE WATER-CARRIER).

This constellation has only a few bright stars, and is very difficult to recognise. It lies below the equinoctial, nearly due S. of the Dolphin, and is introduced on account of the following telescopic objects. It comes on the meridian in September and October, about 9 to 11 o'clock.

NEBULÆ.

2 M—21^h 26^m S 1° 27' (Plate IV, Fig. 2). A large globular bright nebula, with indications of revolution near the neck of the Water-bearer. 5° nearly due N. of the bright star β , and in the angle of a right angled triangle formed by α , β , and the nebula. "This magnificent ball of stars condenses to the centre, and presents so fine a spherical form that imagination cannot picture the inconceivable brilliancy of the invisible heavens to its animated myriads."—*Smyth*.

1 H iv.—20^h 57^m S 11° 55'. One of the extraordinary nebulae of Lord Rosse; like a vast globe, surrounded by a ring of inconceivably vast dimensions, like Saturn on a large scale, with his ring over his head, except that the ring has luminous irradiations all round; beyond which another ring appears as if seen edgewise, projecting on each side from the equator of the central body; this object has been called "the mock Saturn." Small telescopes show it as a globular nebula of equable light, and of a bluish white colour. It is found near the star ν ; 73 M will be found 1° to the S. W. and 72 M 2° to the W., not shown on the Map, and not given in the Bedford Catalogue.

DOUBLE STARS.

ψ^1 (5)— $23^h 9^m$ S $9^\circ 51'$. A fine double star—topaz yellow, and sky blue; to the N. E. of Skat.

ζ (4)— $22^h 22^m$ S $0^\circ 44'$. White and dull white—a very fine object; on a line from α to ϵ .

τ^2 (5)— $22^h 41^m$ S $14^\circ 30'$. An orange star, with a distant companion.

12 (6)— $20^h 57^m$ S $6^\circ 22'$. A close double star—creamy white and light blue. Discovered by Struve; a fine object; 7° W. of β .

29 (6)— $21^h 51^m$ S $17^\circ 38'$. Both stars brilliant white; S. of ν .

38.—CAPRICORNUS (THE GOAT).

One of the zodiacal constellations, intersected by the ecliptic, and interwoven with the constellation of Aquarius. A line from the three prominent stars of Aquila, through θ in the bow of Antinous, and produced as far again, will reach it. It comes to the S. meridian in September evenings.

NEBULA.

30 M— $21^h 32^m$ S $23^\circ 47'$ (Plate I, Fig. 5). "A fine pale bright cluster; and from the straggling streams of stars on its northern verge, has an elliptical aspect with a central blaze." It is situated in one of the blank voids or dark chasms of the universe, unilluminated by the light of a single star.

DOUBLE STARS.

α^1 (4) and α^2 (3)— $20^h 10^m$ S $12^\circ 59'$. A fine double star to the naked eye, but to a good telescope a quintuple star—pale yellow, yellow, blue, ash-coloured, lilac; at the tip of the Goat's right horn.

β^1 and β^2 (3)— $20^h 13^m$ S $15^\circ 13'$. A wide double star—orange, yellow, and sky blue; $2\frac{1}{2}^\circ$ S. E. from α . There are several telescopic companions.

ϵ (6)— $20^h 21^m$ S $18^\circ 16'$. A close double star; 4° S. S. E. of β —white and pale blue.

σ^2 (6)— $20^h 11^m$ S $19^\circ 33'$. A fine double star, to the S. of ρ .

σ (6)— $20^h 10^m$ S $19^\circ 37'$. A wide double star, 4° S. of β .

39.—PISCES AUSTRALIS (THE SOUTHERN FISHES).

DOUBLE STAR.

α (1)— $22^h 49^m$ S $30^\circ 28'$. The well-known nautical star, *Fomalhaut*, a splendid star of the first magnitude; with a distant companion—red and dusky blue. Fomalhaut is about 5° high, S. by E., on the 15th September, at 10 p.m.

MAP XVIII.—OPHIUCHUS & SCUTUM SOBIESKI.

40.—OPHIUCHUS (THE SERPENT BEARER).

A very extensive constellation, with few stars visible to the naked eye; easily found from its position S. of Hercules. It comes on the S. meridian about 10 p.m. in July, and may be seen in the S. W. in August and September.

NEBULÆ.

40 H— $16^{\text{h}} 23^{\text{m}}$ S $12^{\circ} 41'$. A large resolvable nebula, with five telescopic stars around it, in the form of a cross; 3° to the S. S. W. of ζ .

9 M— $17^{\text{h}} 11^{\text{m}}$ S $18^{\circ} 22'$. A nebula or, rather, a condensed cluster in the galaxy. 3° to the S. E. of η . "A miniature of 53 M, and one of those objects which form a capital test-object for proving the space-penetrating power of the telescope."—*Herschel*. "A myriad of minute stars clustering to a blaze in the centre, and wonderfully aggregated."—*Smyth*.

14 M— $17^{\text{h}} 30^{\text{m}}$ S $3^{\circ} 10'$ (Plate IV, Fig. 7). A large globular cluster, of a lucid white colour. 8° S. of β , and forming the vertex of an isosceles triangle, with a line from β to σ as the base.

DOUBLE STARS.

ρ (5)— $16^{\text{h}} 17^{\text{m}}$ S $23^{\circ} 7'$. A fine object—pale topaz and blue, 3° N. of Antares.

λ (4)— $16^{\text{h}} 24^{\text{m}}$ N $2^{\circ} 18'$. A binary star; period, about 90 years—a difficult object.

70 (6)— $17^{\text{h}} 58^{\text{m}}$ N $2^{\circ} 33'$. Pale topaz and violet. A celebrated binary star; period, 80 years; with movements



shewing great perturbation, as if from a third invisible companion, and rings surrounding the telescopic image which puzzle the astronomers. 4° E. of γ .

41.—SCUTUM SOBIESKI (THE SHIELD OF SOBIESKI).

A small constellation between Ophiuchus, Antinous, Sagittarius, and Scorpio; lying in a very rich position of the Milky Way. It is visible on the S. meridian in August.

NEBULA.

17 M— $18^{\text{h}} 13^{\text{m}} \text{ S } 16^{\circ} 15'$. The singular nebula, resembling the greek capital, *Omega*. "A magnificent-arched and irresolvable nebulosity in a splendid group of stars; the wonderful quantity of suns scattered about here would be confounding, but for their increasing our reverence of the omnipotent Creator, by revealing to us the immensity of the creation."—*Smyth*. The whole region here is one of surpassing splendour; several of Messier's grand clusters (16, 18, 24 and 26) lie scattered over it (Plate II, Fig. 3).

MAP XIX.—SERPENS, LIBRA, AND PART OF SCORPIO.

42.—SERPENS (THE SERPENT).

A constellation interwoven with Ophiuchus, and very difficult to distinguish beyond the portion contained in the Map. It appears on the meridian from 11 to 12 p.m. in June.

DOUBLE STARS.

α (2)— $15^{\text{h}} 36^{\text{m}} \text{ N } 6^{\circ} 56'$. A splendid star, with a minute companion—pale yellow and fine blue; the companion an extremely delicate object.

β (3)— $15^{\text{h}} 38^{\text{m}} \text{ N } 15^{\circ} 56'$. A very delicate double star—both pale blue.

δ (3)— $15^{\text{h}} 28^{\text{m}} \text{ N } 4^{\circ} 1'$. A fine double star—both stars bluish white.

θ^1 (3) and θ^2 (5)— $18^{\text{h}} 49^{\text{m}} \text{ N } 3^{\circ} 59'$. A splendid double star in the dark space which separates the two star beds of the galaxy; on the tip of the Serpent's tail, running into the constellations of Aquila and Antinous; 4° E. S. E. of Altair, nearly on a line with γ , α , β Aquila (see Map XVI), θ within the outline of Antinous.

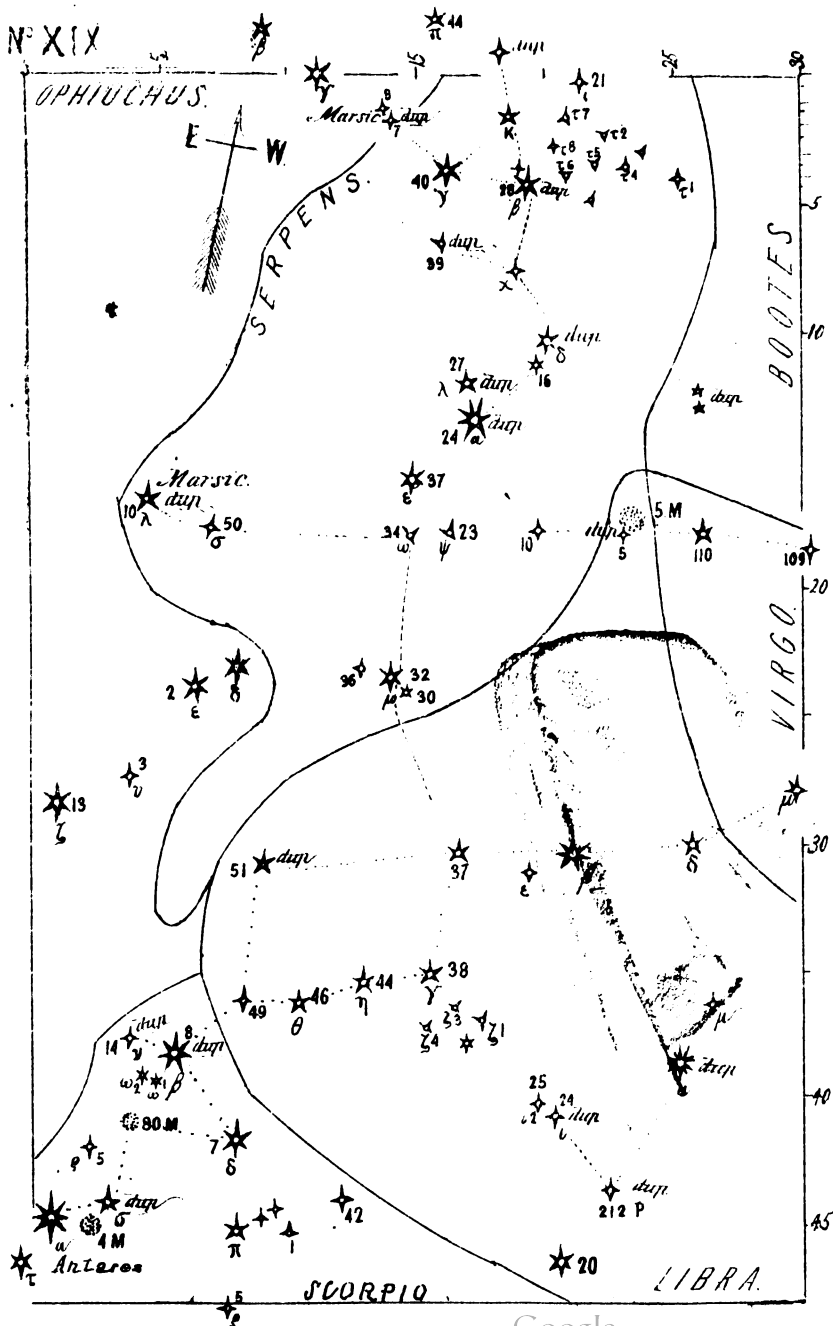
43.—LIBRA (THE SCALES).

A constellation difficult to recognise, situated between Virgo, Ophiuchus, and Scorpio. It comes to the S. meridian about 10 to 11 p.m. in May and June.

NEBULA.

5 M— $15^{\text{h}} 11^{\text{m}} \text{ N } 2^{\circ} 37'$ (Plate II, Fig. 5). A resolvable nebula, greatly condensed to the centre; almost a rival of

N° XIX



the great star cluster, 13 M in Hercules. "This superb object is a most noble mass, with outliers in all directions, and a bright central blaze which exceeds even 3 M."—*Smyth*. It is easily found from the pointers. It lies on the beam of the balance, and is in the field of the telescope with the star 5.

DOUBLE STARS.

α (2)— $14^h 43^m$ S $15^\circ 27'$. A fine star, with a distant companion—pale yellow and light grey. 10° S. by W. of β .

212 P (6)— $14^h 49^m$ S $20^\circ 46'$. A most delicate triple star—straw colour, yellow, and pale red. Nearly midway and a little S. of the line from α to the star 20.

51 (5)— $15^h 57^m$ S $10^\circ 19'$. A fine triple star—bright white, pale yellow, and grey. A beautiful object.

β (2)— $15^h 8^m$ S $8^\circ 47'$. A fine star, with a distant companion—pale emerald and light blue.

44.—SCORPIO (THE SCORPION).

A small but very rich constellation, under Ophiuchus and Libra. It appears above the horizon from July to September. Antares, the principal star, is about 40° high in the S. W. on the 15th August, at 10 p.m. Some fine objects in the constellation may be easily observed.

NEBULÆ.

80 M— $16^h 9^m$ S $22^\circ 39'$ (Plate III, Fig. 7). A splendid nebula, in a fine field, midway between α and β . Sir W. Herschel considered it "the richest and most condensed mass of stars which the firmament can offer to the contemplation of astronomers."

4 M— $16^h 15^m$ S $26^\circ 10'$. A large pale granulated nebula, with a very luminous centre; $1\frac{1}{2}^\circ$ to the W. of Antares; near one of the dark openings in our star cloud.

DOUBLE STARS.

α (1)— $16^h 21^m$ S $26^\circ 7'$. The celebrated star, *Antares*, almost a rival of *Sirius*—fiery red in colour; a contrast to the “brilliant white” of *Sirius*. The colour of *Antares* has been involved in much mystery to observers—“flashes of deep crimson alternating with a faint green light”—until Professor Mitchel, of the Cincinnati Observatory, discovered a companion of *Antares*, an 8th magnitude star, $3''$ distance, of a greenish hue.

β (2)— $15^h 58^m$ S $19^\circ 25'$. A fine double star—pale white and lilac.

ν (4)— $16^h 4^m$ S $19^\circ 6'$. A very close double star, only separated by first-class telescopes—pale yellow and dusky. The northernmost star in *Scorpio*.

γ (5)— $16^h 13^m$ S $25^\circ 15'$. Yellowish white and grey. 2° N. W. of *Antares*.

MAP XX.—VIRGO.

45.—VIRGO (THE VIRGIN).

For *nebulæ*, this is the most remarkable constellation in the whole northern hemisphere. One region in the left wing is described as “a very ocean of *nebulæ*.” They are mostly far more distant and require greater optical power for satisfactory observation than the generality of *nebulæ*. The great nebular region is indicated by a line through the stars ϵ , δ , γ , η , β Virginis, and β Leonis. Like Orion, Virgo is intersected by the equinoctial, on which the beautiful double star γ is placed. This star is on the S. meridian at 10 p.m. in May. The constellation may easily be distinguished by means of its principal star, Spica, which is one of the first magnitude. Spica, Deneb (Leo Major), and Arcturus, form a large triangle. Spica becomes visible above the eastern horizon about 9 p.m. in March ; is on the S. meridian at 10^h 51^m on the 28th of April, and remains visible till June. Bode chronicled 411 stars within the boundary of this constellation, and Sir W. Herschel enrolled 323 *nebulæ*.

NEBULÆ.

60 M—12^h 37^m N 12° 9'. 5° W. of Vindematrix. (Plate I, Fig. 3.) A double nebula, about 2' or 3' from centre to centre. 59 M and a companion nebula are on the verge of the field ; so that there are really four *nebulæ* visible at once, of different degrees of lustre, and, it follows, of distance also. 60 M and its companion are believed to belong to the class of *spirals*, and are instances of *nebulæ* that furnish indications of a

spiral arrangement, though not fully confirmed by observation. Sir John Herschel expressed the opinion that all the double nebulae are really stellar systems revolving around each other—each a universe in itself. It is strange, with this conclusion before them, that it never occurred to the Herschels to examine the nebulae with especial reference to the great question of their proper motion in space.

98 M— $12^{\text{h}} 6^{\text{m}} \text{ N } 15^{\circ} 47'$. A large pale elongated nebula, close to the star 6 Coma Berenices; one third of the way from ϵ Virginis to β Leonis.

35 H— $12^{\text{h}} 7^{\text{m}} \text{ N } 14^{\circ} 3'$. A long pale white nebula— 2° due S. of the star 6 Coma Berenices, and of the above nebula, 98 M. Resembling in shape a weaver's shuttle.

88 M— $12^{\text{h}} 25^{\text{m}} \text{ N } 15^{\circ} 12'$. A long elliptical nebula, more than half-way from β Leonis to ϵ Virginis, a little to the S. of the line. In the same neighbourhood will be found the nebulae, 87 M, 89 M, 90 M, and 91 M.

43 H— $12^{\text{h}} 31^{\text{m}} \text{ S } 10^{\circ} 44'$. A lucid white elliptical nebula; the elliptical form seems to prevail in nearly all the elongated nebulae—"this must be another of those vast flat rings seen very obliquely." It will be found 11° due W. of Spica, in the tip of the Raven's wing. A line from ϵ Virginis southwards, carried just to the W. of the star δ , and produced twice as far again, will strike it. A beautiful low power field.

99 M— $12^{\text{h}} 10^{\text{m}} \text{ N } 14^{\circ} 3'$. A large round nebula, one-third of the distance from ϵ Virginis to β Leonis, and S. of 98 M. This is the astonishing "open spiral" of the Earl of Rosse; perhaps the most singular in form of all the Rosse Nebulae. It resembles the naked fibres of an enormous leaf, spread out in all directions from a long sinuous central stem, and clustering all over with gems of every hue and every degree of brilliancy.

DOUBLE STARS.

γ (3)— $12^h 35^m$ S $0^\circ 41'$. One of the most interesting of all the binary stars—with the exception, perhaps, of the star Castor—silvery white and pale yellow ; period, about 180 years. In 1836 they appeared as one star ; have been widening since, and can now be separated by a very moderate telescope.

β (3)— $11^h 42^m$ N $2^\circ 40'$. A fine star, with a minute companion—pale yellow and light blue.

δ (3)— $12^h 47^m$ N $4^\circ 16'$. A star, with a distant companion—golden yellow and red.

α (1)— $13^h 17^m$ S $10^\circ 19'$. Spica, a splendid first-magnitude star, in the Virgin's right hand. The brightest star of the constellation, with a distant companion—brilliant flushed white and bluish tinge.

θ (4)— $13^h 3^m$ S $4^\circ 47'$. A very close triple star ; a severe test for a $3\frac{1}{2}$ -inch aperture—pale white, violet, and dusky ; on a line from γ to Spica.

ϵ (3)— $12^h 54^m$ N $11^\circ 49'$. Vindematrix, a fine star, with a minute distant companion—"bright yellow and intense blue."—*Smyth*.

17 (4)— $12^h 15^m$ N $6^\circ 5'$. A beautiful double star—light rose tint and dusky red ; N. of η .

32 and 33 P (4)— $12^h 11^m$ S $3^\circ 11'$. A fine double star ; both stars equal in magnitude, and both silvery white ; S. of η .

81 (5)— $13^h 30^m$ S $7^\circ 9'$. A close double star ; $4\frac{1}{2}^\circ$ N. N. E. of Spica—bright white and yellow ; a fine object.

"The nebular region," marked on Map XX, in the constellation of Virgo, will be invested with increased interest to the observer by the recently reported discovery by the Earl of Rosse—that the nebulae (or many of them, and it may be presumed the rest also) have really a *proper*

motion in space, as well as the stars; and that several of the bicentral nebulæ have an *orbital motion*, and are really *binary nebulæ* like the stellar binary systems. If this discovery be confirmed (of which there is little doubt, as all Lord Rosse's announcements have been characterised by superior judgment and caution), it will rival in importance the discovery of the stellar proper motion, and the revolution of the double stars; will sweep away the last vestige of "*the nebular theory*;" and will also establish the interesting fact—that many of the nebulæ are much nearer to us than has hitherto been supposed. They must, therefore, really alter their Right Ascensions and Declinations, contrary to the hitherto received doctrine of astronomers; and we may reasonably expect, as a consequence, that future observations by the great astronomers may establish the *parallax* of many of the nebulæ; so that their distances can be calculated with the same certainty as have been the distances of Alpha Centauri, 61 Cygni, &c. The grand conclusion will follow—that Creation is one vast whole; constructed on the same principles, obeying the same laws, exhibiting the same harmony throughout all its systems—displaying the same Divine perfections—the wisdom, power, and glory of the Almighty CREATOR; and that all its myriads of worlds, suns, systems, and universes, are really revolving around one grand centre—the throne of Him, the High and Lofty ONE, who "inhabiteth eternity," and who "filleteth all in all."

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The following Nebulæ have been particularly observed, and their extraordinary character revealed, by the Earl of Rosse, with his 6 ft. reflecting telescope, and are generally known as

“THE ROSSE NEBULÆ.”

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