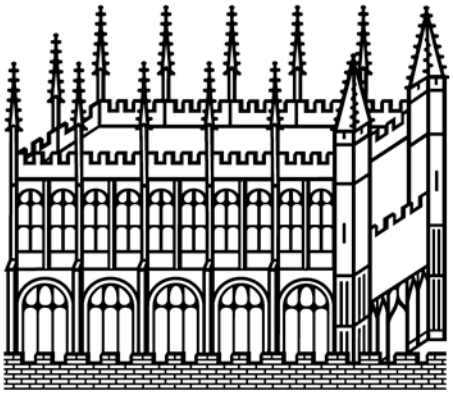
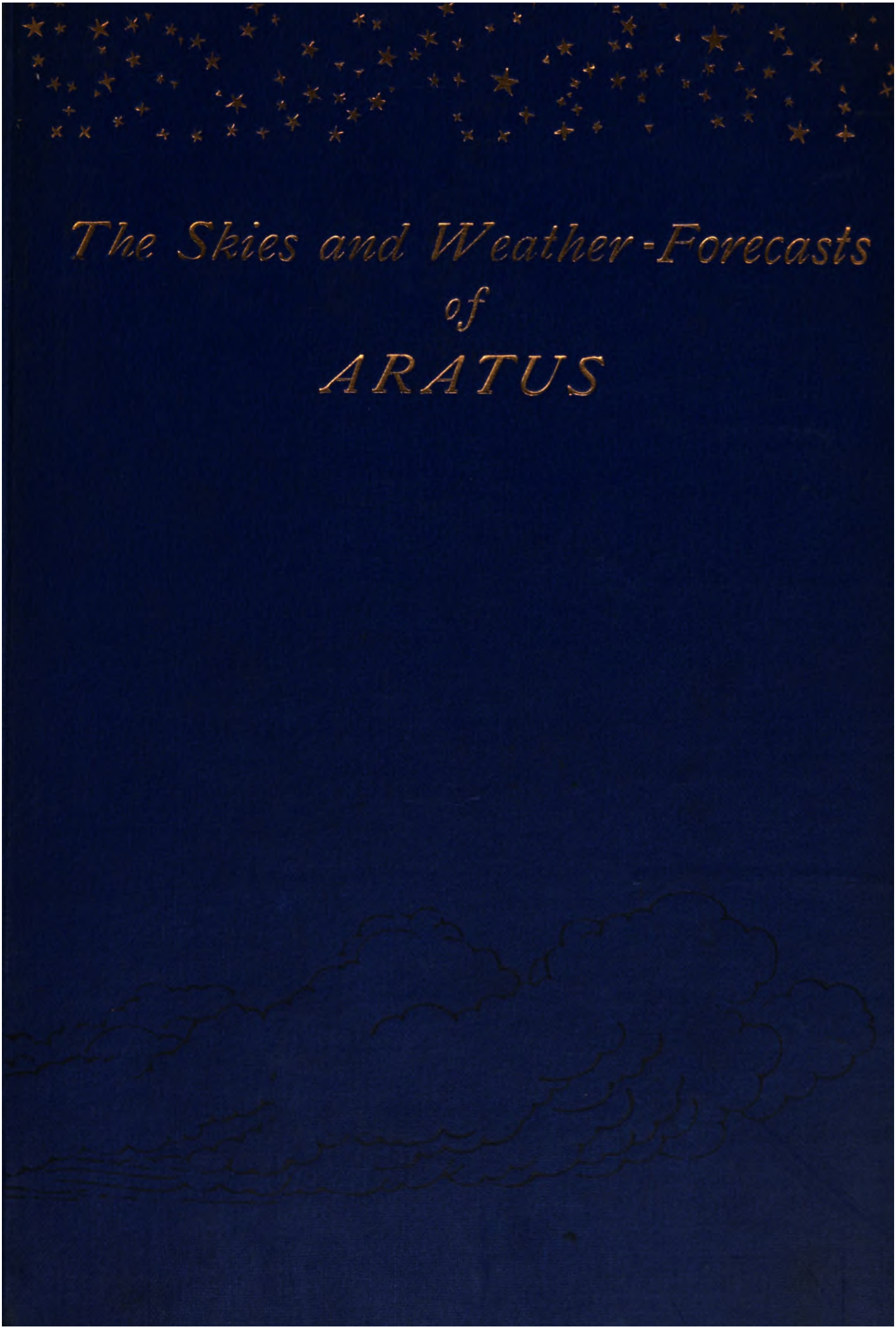


The Skies and Weather-Forecasts of ARATUS



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ARATUS

TRANSLATED, WITH NOTES, BY

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London

MACMILLAN AND CO.

1880

LONDON : PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
AND PARLIAMENT STREET

PREFACE.

A LITTLE OBSERVATION of the nightly skies inspired a curiosity to see what an ancient poet, now seldom read, had to say on the subject; and a moderate amount of pleasure having been derived from the perusal, the thought occurred that other students of Astronomy or Meteorology, to whom Aratus in his Greek garb was inaccessible, might feel the same curiosity. Hence the following translation.

The monosyllabic character of our language, at least of that portion of it which poetry has appropriated, causes even a prose translation of foreign verse to assume more or less of iambic rhythm. A little malice prepense on the part of the translator has aided this tendency, though, bating a few slight sacrifices to euphony, he has never departed intentionally from the most simple and direct rendering of the original. Once

courted, however, the iambus intruded rather more than had been designed, and has prevented the following nondescript, which only aspires to the praise of fidelity, from being styled in the title-page, what at starting it was meant to be, a prose translation.

Of the life of Aratus little is known. He was by profession a physician, and lived about 270 B.C., and was therefore a contemporary of Euclid and Theocritus. He was a native of Soli, afterwards called Pompeiopolis, in Cilicia; but being invited to the court of Antigonus Gonatas, King of Macedonia, he spent there the remainder of his life.

The 'Skies,' or 'Phenomena,' owe such astronomic doctrine as they contain to the works of Eudoxus, who was a contemporary of Plato, and, as an ethical speculator, placed Pleasure on the throne of attainable goods; as an astronomer, invented the theory of the crystalline spheres. The 'Weather-forecasts,' or 'Diosemia,' borrowed their materials from a treatise on the same subject by Theophrastus, disciple and successor of Aristotle. This treatise, at least in the form of copious extracts, is still extant.

The 'Skies' of Aratus, about a century after it was written, was the subject of a commentary by Hip-

parchus, the illustrious astronomer who discovered the Precession of the equinoxes, and who respectfully but unrelentingly points out many inaccuracies of Aratus and Eudoxus. This commentary still exists. The 'Skies' and 'Weather-forecasts' were translated by Cicero, who has unadvisedly incorporated many fragments of his indifferent verse in his immortal prose. The 'Skies' was translated by Germanicus, adoptive grandson of Augustus; and, three hundred years after, both the 'Skies' and 'Forecasts' were translated, or rather paraphrased, by Festus Avienus. These versions, which are of considerable poetic merit, are still extant. To Englishmen Aratus probably is most extensively known from the fact that half a line in the beginning of his poem was quoted by his countryman, the apostle Paul, in his address to the Athenians on the hill of Mars.

Ovid says of Aratus: 'Cum sole et luna semper Aratus erit.' Quintilian more soberly: 'Arati materia motu caret, ut in qua nulla varietas, nullus affectus, nulla persona, nulla cujusquam sit oratio; sufficit tamen oneri cui se parem credidit.'

The reader of Aratus should have before him a map or globe containing the imaginary figures of the

constellations. In the absence of maps containing these figures, he may with advantage check the statements of Aratus by means of the maps to Dunkin's 'Midnight Sky,' or Proctor's 'Half-hours with the Stars,' For instance, a comparison of the maps for March and October in 'Half-hours with the Stars' explains at once why Bootes takes so much shorter time to rise than to set: when he rises he is stretched at full length on the horizon; when he sets he is standing upright.

THE SKIES.

Let us begin with Zeus, the power we mortals never leave
Unsaluted. Zeus fills all the city streets,
All the nations' crowded marts; fills the watery deeps
And havens; every labour needs the aid of Zeus.
His children are we. He benignant
Raises high signals, summoning man to toil,
And warning him of life's demands: tells when the sod is fittest
For oxen and harrows; tells the auspicious hours
For planting the sapling and casting every seed.
'Twas he who set the beacons in the sky,
And grouped the stars, and formed the annual round
Of constellations, to mark unerringly
The days when labour is crowned with increase.
Him therefore men propitiate first and last.

Hail, father, mighty marvel! hail! mighty benefactor!
Thyself and those who begot thee! And ye too, Muses,
Gracious influences, hail! and while I essay to tell of skies
What mortal may tell, guide right my wandering lay.

With even pace, each in his several path, unnumbered stars
Move in high march continuous, eternal;
While the axis of the world is stedfast and ever utterly
Motionless, and, traversing the sphery globe
Of central earth, whirls round the mighty heaven.
Two poles his limits are at either end,
One hidden, the other in the north wind's seat
High raised above the horizon, and circled by
The heavenly Bears, that mortals call the Wains.
One She-bear's front is to the other's rear,
Her path directed down the other's spine:
They stand inverted, back to back. If tales are true,
Crete was their home ere by great Zeus' will
They climbed the sky, because the baby Zeus
On Ida's mount, by aromatic Dictus,
In secret cavern they nurtured for a year,
What time Dictæan Curetes baffled the quest of Cronos.

The name of one is Cynosura,
Of the other, Helice. By Helice Greek
Seafarers learn what way to steer their ships:
The other guides Phœnicians o'er the main.[1]
Large and bright is Helice,
Easily noted through the livelong night:
The other less in size, but valued more by sailors,
Circles with all her stars in smaller orbit,
And guides Sidonian ships in straightest course.
Between the She-bears, like a river flood,
Coils the monster Dragon, winding through and bending round
With myriad stars; sundered by his spires
They circle, ever shunning the blue waves of Ocean.
Along the side of one extends his tail,
His spires enfold the other: his tail
Ends by the head of She-bear, Helice;
His spire winds round the head of Cynosure: winds round
Her head, reaching her hindmost paws,
Then backward bent rolls upward. The spires
Blaze many-starred, and many-starred the head:
With two stars flame the temples, and the eyes,
With one the baleful monster's ravening jaw.
Sideways bends the head, and points

The tip of Helice's tail; his folded tail
Waves near to her right temple and her jaw.
That Dragon-head, I ween, whirls in the declination where the tips
Of setting with the tips of rising blend.[2]
Near to the Dragon's head, in toil-spent posture,
Revolves a phantom,[3] whose name none can tell,
Nor what he labours at; they call him simply
The Man upon his knees; his knees seem bent
In desperate struggle; while from both his shoulders
His hands are high uplifted and outspread
As far as he can stretch; his right foot's sole
Is planted on the crest of the coiled Dragon.
And there that Crown by sheeny Dionysus fixed,
Monument of dead Ariadne,
Revolves behind the back of the kneeling phantom;
Behind his back the Crown; near to his head
Descry the head of Ophiuchus, and beyond
See all the lucid form of Ophiuchus.
So bright below his head the shoulder stars,
They face the full-orbed Moon
Undimmed; his hands may not compare,
For pale the rays that dart from both;
Yet they may be distinguished; strong their grasp.
Both grip the Serpent, who coils

Round Ophiuchus. He in resolute attitude
Plants both his feet on a huge monster,
The Scorpion, standing on his eye and on his breast
Erect, and holds the Serpent with both hands,
With right the tail, with left the towering breast.
Near to the head sparkles the Northern Crown ;
Below the coils observe the mighty Claws,
Thin-scattered stars of constellation dim.

Near Helice, like one who drives a car,
Circles Arctophylax, called the Waggoner,
Because he seems to guide the ursine Wain.
Bright all his stars, and underneath his belt
Arcturus with his brightness dims the rest.

Below the Waggoner's feet
Lo the Virgin, in her hand a glittering ear of corn.
Whether born of Astræus, whom they call
The old sire of heaven, or from whomsoever sprung,
Her favour be upon us. The story runs,
That earth was once her home,
And that she mixed in human throngs, nor ever shunned
Society of man or woman of the olden times ;
But sate among them, immortal though she were,
And bore the name of Justice : and summoning the elders
In solemn senate or wide market-place,

She sang in thrilling strains the notes of equal law.
As yet they knew not baleful strife
Nor parted interests' bitter feud nor battle;
But lived a life all unalloyed, far from the dangerous sea,
And no ships brought their food from foreign lands;
But oxen and the plough and throned Justice
Yielded ten thousandfold to all their needs, with distribution due.
These things were when earth nurtured the golden race.
The silver race she visited more rarely with somewhat altered mood,
No longer finding the spirits of former days:
Yet she consorted with the silver race.
At eve she would come from the echoing mountains [4]
Uncompanioned, nor had she gentle words for any:
But when she hill-ward drew the thronging crowds,
Her voice was stern, upbraiding their crimes.
No more, said she, at their invocations would she meet them face to face.
'How base a progeny sprang from golden sires!
And viler shall they be whom ye beget,
And wars shall break forth, and unholy blood
Stain the earth, and sin bring penal woe.'

After such speech she would hie mountain-ward, and leave the human tribes
Straining eager gaze on her retiring form.
But when that generation died, and there was born
A brazen generation, more pernicious than their sires,
Who forged the felon sword
For hostile foray, and tasted the blood of the ox that drew the plough,
Justice, loathing that race of men,
Winged her flight to heaven; and fixed her station in that region
Where still by night is seen
The Virgin goddess, near to bright Bootes.
Over her shoulders rolls a starry group[5]
In brightness and dimension
Like that beneath the tail of the huge Bear.
For three groups glisten near bright Helice;
Easily noted by the seeker's eye.
Near her bright paws two goodly caravans,
One by her fore, and one by her hind paws,
A third by her hind knees: but lacking forms
Constellate, all three whirl without a name.
Beneath her head are the Twins, the Crab below her belly,

Below her hind-paws the majestic Lion.
Most scorching is the chariot of the Sun,
And waving spikes no longer hide the furrows,
When he begins to travel with the Lion.
Boisterous north-winds periodic then fall on broad ocean
With all their weight: no time is that for oar-sped barques:
Broad-beamed ships be then my choice,
And, helmsman! keep the stern before the wind.
If thou would'st gaze on starry Charioteer,
And hast heard legends of the wondrous Goat,
The Goat and Kids, that on the purpling deep
Oft look to rescue foundering mariners,
Vast-looming shalt thou find on the Twins' left
His form bowed forward: Helice's high head
Points at him from afar[6]; on his left shoulder
Lies the sacred She-goat, storied to have suckled Zeus.
Arm-borne She-goat is the title given her by priests of Zeus.
And near to their bright mother with faint rays
Glisten the two Kids o'er the giant's wrist.
Below the Charioteer may be descried
The Bull bright-horned: conspicuous are his stars,

And well-defined his head: no other marks
Thou needest to discover where he stands
Beside the stars that shine upon his head.
Wide-spoken is their name, and not unfamed
Revolve the Hyades,[7] whitening all the Bull's
Broad forehead. Shining in his left horn's tip
And the right foot of neighbouring Charioteer,
A single luminary links their race.
But the Bull ever is the first to dip
Beneath the west, together though they start.[8]
Nor shall blank silence whelm the harassed house
Of Cepheus; the high heavens know their name,
For Zeus is in their line at few removes.
Cepheus himself by She-bear Cynosure,
Iasid king, stands with uplifted arms.
Equidistant from the tip of her tail
And from each other are his feet.
From his belt thou castest not a distant glance
To see the first spire of the mighty Dragon.
Eastward from him, heaven-troubled queen, with scanty stars
But lustrous in the full-mooned night, sits Cassiopea.
Not numerous nor double-rowed
The gems that deck her form.

But like a key which through an inward-fastened
Folding-door men thrust to knock aside the bolts,
They shine in single zigzag row.
She, too, o'er narrow shoulders stretching
Uplifted hands, seems wailing for her child.
For there, a woeful statue-form, is seen
Andromeda, parted from her mother's side. Long, I trow,
Thou wilt not seek her in the nightly sky,
So bright her head, so bright
Her shoulders, feet, and girdle.
Yet even there she has her arms extended,
And shackled even in heaven: uplifted,
Outspread eternally are those fair hands.
Beneath her head the huge body of the Horse
Rolls, touching her with his belly: a single star
Flames on his navel and the maiden's head.
Three others on his flanks and on his shoulder
Shine equidistant
Of goodly size. His head is not so bright,
Nor his long neck; and yet the furthest star
Blazing in his distended nostril vies
With the four-cornered splendour of his flank.
Nor four legs has he, for, parted at the navel,
With only half his body rolls the sacred steed.

He, as they say, from lofty Helicon
Brought the flashing water of wholesome Hippocrene.
No streams gushed from the top of Helicon
Till the steed pawed; then gurgling they out-welled
Where his fore-foot stamped; and shepherd swains
First named that drink the fountain of the Horse.
Rock-born it gushes, nor ever may be seen
Outside of Thespian land, while Pegasus
In Jove's high palace sets the world a-gaze.
Near him is the race-course of the Ram, fleetest of stars,
Who, chasing round the amplest circle,
Is ne'er outstripped by She-bear Cynosure.
Dim himself, and starless in the presence of the Moon,
He may be discovered by the girdle
Worn by Andromeda, waving o'er his lair.
Midway he paths the mighty heaven on that equatorial line where whirl
The Claws of Scorpio and Orion's belt.
Another group is formed below
Andromeda, a ruled figure of three sides,
Deltoton;[9] two nearly equal; the subtending base
Narrower, but not difficult to find,
Delineated by no pallid stars.
And southward of Deltoton is the Ram.

Westward and further in the south-wind's path
The Fishes float; one ever uppermost
First hears the boisterous coming of the north.
Both are tied by a band
Round their tails, which point to an angle
Filled by a single goodly star,
Called the Conjoiner of the Fishes' tails.
Below Andromeda's left shoulder thou may'st spy the upper
Of the two Fishes sporting in the wave.
Her feet point to her bridegroom
Perseus, on whose shoulder they rest.
He in the north-wind stands gigantic,
His right hand stretched towards the throne
Where sits the mother of his bride: as one bent on some high deed,
Dust-stained [10] he strides over the floor of heaven.
Near his left knee cluster
The Pleiads: small the region
They fill, and pale the light they dart.
Seven journeyers men call them,
Though only six are visible to ken.
No star, I wis, has vanished from heaven's floor
Within mortal tradition, and idly is that number
Fabled: natheless seven the names they bear:

Alcyone, Merope, Celæno, Electra,
Sterope, Taygete, and stately Maia.[11]
Though small their size and pale their light, wide is their fame,
Both when they rise at dawn and when at eve; such Zeus' will,
Who bade them mark the entrances of summer and winter,
And the season when the fallows ask the plough.[12]
And small the compass of yon tortoise-shell, that in his cradle
Hermes pierced and bade be called the Lyre,
And fixed in front of the mysterious phantom[13]
High in heaven. Lowly stooping
He nearly grazes it with his left knee:
His face turns eastward towards the Bird:[14] the Lyre
Hangs just betwixt the Bird's beak and his knee.
For heaven's floor has a fleet-winged Bird,
Airy his body, his wings roughened
With stars not largest-sized and yet not dim.
Exulting in the blue deeps of the sky,
Down the gale westward floating, his right pennons graze
The right hand of Cepheus,
His left the feet of prancing Pegasus.

Westward and southward of the prancing steed
Glide the two Fishes. Under the Horse's head
The Waterbearer next to Capricorn
Stretches his right hand: on his left and south
Stands Capricorn, the goal that turns the Sun.
Be it ne'er thy lot in that month to be tossed
On the mid ocean; neither by the day
Far sailest thou, for few the hours of light,
Nor early on thy perils breaks the dawn
For all thy invocations: pitiless
Siroccos [15] lash the main when Capricorn
Lodges the Sun, and Zeus sends bitter cold
To numb the frozen sailors. Not the less
Throughout the year the sea beneath the keels
Purples: and, like the diving sea-gull,[16] living on the waves,
Oft from the deck we peer around the ocean
To spy a friendly shore, but that is washed
By distant breakers; thin planks part us from the nether world.
Ay! earlier still after much ocean tossing,
When the Bow feels the Sun and the Bow's drawer,
Shalt thou seek the evening haven [17] nor defy the night.
A warning of that season and that month

Be Scorpio rising just before the Sun.
For near the Scorpion's sting the Archer bends
His mighty bow, and short the interval
That parts the Archer's rise from Scorpio's.
Then, too, the head of Cynosure in the top of the nightly sky
Culminates just before the dawn; and all Orion sets,
And Cepheus from his hand down to his waist.
Another Arrow flies on high
Launched by no bow. Near it to the north
Flies the Bird, and on the south another
Of smaller size, but dangerous when he rises
Before the dawn;[18] the Eagle of the winds men call him.
The tiny Dolphin floats o'er Capricorn:
His middle dusky; but he has four eyes
Two parallel to two.
Betwixt the north wind and the wandering sun
All these are scattered; another host revolves
Betwixt the solar walk and the south wind.
Eastward beyond the region of the Bull
Stands great Orion; whoso kens not him in cloudless night
Gleaming aloft, shall cast his eyes in vain
To find a brighter sign in all the heaven.

And, guardian grim, behind him as he towers
Stands the Dog, on his hind legs uplifted,
Many-starred; yet not bright all his form;
His belly shadowy; but in his fell jaw
Flames a star above all others with searing beams [19]
Fiercely burning, called by mortals
Sirius. Him rising with the eastern sun
No plants deceive with false luxuriance.
With sure discrimination fierce he rushes through their ranks,
And strengthening these blasts those with all their foliage.
His puissance, too, we feel when he declines.
Less withering fires flame in his other limbs.[20]
Below Orion's feet the Hare
Is chased eternally: behind him
Sirius ever speeds as in pursuit,
And rises after, and eyes him as he sets.
And there towards the tail of the monstrous hound is Argo, hauled
Stern-foremost; no path of onward speeding ship her path.
Sternwards she glides, like to a ship whose helm
Her crew have turned to landward,
Coming to anchor; all the oars back-water,

And lapping surges splash upon the strand.
Thus sternward Jason's Argo makes her way.
Spectral her frame and starless from the prow
To the central mast; but radiant all her after-hull.
Her rudder[21] is detached and hangs
Beneath the hind feet of the westward Dog.
And yonder, distant from her cowering form,
The on-coming Monster scares Andromeda.
She in the blasts of Thracian Boreas
Is stationed, while the south wind brings her foe,
The Whale, beyond the Fishes and the Ram,
Just northward of the starry River-stream.
For yonder, trod by heavenly feet,
Wind the scorched waters of Eridanus, tear-swollen flood,
Welling beneath the left foot of Orion.
There too the chains that shackle the Fishes' tails
Meet south of the ecliptic
On the mane of the sea-monster,
Jointly ending in a single star that forms
The topmost vertebra of the Whale's spine.
Of small dimensions and in pale beams clad
Betwixt the rudder and the Whale revolve
Below the glaucous body of the Hare
Some nameless stars, not imitating limbs

Of any shapely creature, like those hosts
In marshalled ranks that travel constant paths
Through waning ages: whose similitudes some mortal noting in days long agone
Assigned judiciously a common name
To aggregated multitudes. It had passed his skill,
Nor aided recognition to have given particular names to every luminary,
Thronged as they are, and each to other like
In size and hue and in their circling orbs.
So he devised to group them in such wise
That standing in succession side by side
They simulate living forms. Easily thus he named
Heaven's host; and now no star rises unrecognised
Of those that are arranged in definite forms
Conspicuous. Those beneath the hunted Hare
Wander unformed and nameless in the gloom.[22]
Under Capricorn, in the quarter whence breathes the South,
His head towards the Whale, floats another Fish,
Far from the coupled two; the Southern Fish men call him.
Sprinkled below the Water-bearer's feet,
Between the Whale ethereal and the Fish, hangs a cluster

Wan and nameless; and near to them
From the right hand of sheeny Water-bearer,
Like a thin spirt of water, in wavy line
Stream others fair to see of tiny size.
Among them travel a more lustrous pair
At no great distance, yet not close:
One of goodly bulk under the feet
Of Water-bearer, the other under blue Sea-monster's tail.
All this stream is named the Water. Others afar
Beneath the fore-feet of the quadruped Archer
Whirl ever nameless in their circling paths.
Below the fiery sting of the huge portent
Scorpio, in the Southwind's bosom, the Altar hangs.
Few are the hours that thou beholdest it
Above the horizon. As far south of the equator it rises as Arcturus to the North.
And therefore high in heaven long careers
Arcturus; the Altar soon dips in the western wave.
About that Altar ancient Night,
Pitying human woes, of ocean storms
Has raised a mighty beacon: foundering ships
Grieve her soul: in many quarters she displays
Signals in pity to tossed mariners.
Surrounded by an ocean of wild clouds

Pray that thou never see those stars in heaven
Unclouded and resplendent, and above them
High surges of black clouds, their canopy
Before the rising of autumnal gales.
For oft that signal of the coming South
Sovereign Night displays, warning toil-worn sailors.
And they, if they obey her timely signal,
And straight haul down the yards and reef the sails,
Have lighter toils: but if upon the ship
Dash from on high the furious rushing gale
All unexpected, and strike her outspread canvas,
Perchance beneath the waves they end their course:
But if Zeus near at hand they haply win
To hear their invocations, and the might of lusty Boreas drive back the South,
Fierce troubles are their portion e'er again
They see each other's faces on the deck. It is the south wind that this signal
Bids thee fear, till thou descry the lightnings of Boreas.
But if, when Centaur's shoulder is midway between
The west and east horizon, only thin mist veil his form;
When afterwards her storm-signal Night uplifts
Above the radiant Altar, 'tis not from the south,

But from the east she bids thee dread the gale.
Thou findest that constellation south of two:
The human limbs are south of Scorpio,
The horse's trunk and tail south of the Claws.
His right hand ever seems to stretch
Towards the round Altar; and his clenched fingers
With strong compression grip another form,
That men of other days have called the Beast.[23]
Another constellation from the east
Comes trailing westward, called the Hydra; like
A thing of life roll her long coils: her head
Reaches the Crab, her middle folds the Lion,
And over the huge Centaur hangs her tail.
The Cup stands on her middle; on her tail
A phantom Crow that seems to peck her spires.
And southward of the Twins shines Procyon.
These thou may'st see renew year after year
Their constant evolutions, for in fixed
Order they grace the onward march of Night.
In different guise five other orbs licentious
Whirl in all quarters of the Zodiac.
From no near constellations canst thou learn
Their whereabout, for they are homeless wanderers.
Long are the periods of their revolutions,
And distant the goal of their reassembling.

Not adventuring to define their devious courses, turn
we to the Fixed stars and trace
Their Circles and companions in the sky.
True as the products of the turning-lathe,
Four Circles have most value and esteem
If thou seek measures of the waning year.
Defined they are throughout by famous stars
That never change their close proximity.
Lengths are they without breadth; connected all;
But two circumferences match not two.
On a clear night when all the stars
In the skyey vault are lustrous,
When none are dimmed by the full-orbed moon
But all dart keen rays through the gloom;
If thou hast ever marvelled at
A broad zone that cleaves the sky,
Or wiser hand has pointed out to thee
The many-gemmed belt of the Galaxy:
Know that in brightness none of the four Circles
Compare with this; but in dimension two of the four
Are equal to it, the other two inferior.
Of the lesser Circles one is in the north.[24]
On it revolve the two heads of the Twins;
On it the knees of the joined Charioteer,
And the left shoulder and left knee of Perseus.

Above the elbow Andromeda's right arm
It crosses; raised above it is her hand
Nearer the pole: her elbow southward lies.
The hoofs of Pegasus, and the Bird's neck
And head, and Serpent-bearer's shoulders bright
All whirl upon this circle.
A little to the south beneath its track
The Virgin: on its line the Lion and Crab,
Neighbouring signs. The Circle cuts
The Lion through breast and belly to the loins;
The Crab right through his shell,
Carving him in two halves
Lengthways, passing just between his eyes.
Divide this circle into eight equal parts,
And five are ever high above the horizon,
Three under [25]: 'tis the limit of the summer Sun.
This is the northern Tropic of the Crab.
The southern Tropic crosses Capricorn,
The feet of Water-bearer, and the tail of the Sea-monster.
It traverses the Hare; of Sirius
It touches but the feet; it crosses Argo,
The huge spine of the Centaur, and the sting
Of Scorpio, and the Archer's radiant bow.
This Circle is the barrier that the Sun

Descending southward from bright Boreas reaches: 'tis the goal
That bends his course in winter. Three portions out of eight of his career
Then whirl above the horizon, five below.
Between the Tropics of the Crab and Goat, vast as the orbit of the Milky Way,
A circle girding Earth bisects the skyey sphere.
When this the solar path, night equals day,
At ending summer or beginning spring.
It passes by the Ram and the Bull's knees;
The Ram reclines upon it at full length,
The Bull just touches it with his bent knees.
On it Orion's belt of goodly gems,
The spires of gleaming Hydra, and the Cup,
Light burden, and the Crow, and scanty-starred
The Scorpion Claws, and the Ophiuchian knees.
No portion has it in the Eagle, though not far
Flies Zeus' mighty messenger; on it revolve
The head and neck of winged Pegasus.
These parallel Circles the axis of the sphere
Transfixes at right angles: the fourth slopes
Aslant, bisected by the Equator, and
Touching the Tropics with opposing arcs.
Just so artistic hands trained by Athena

Would fashion rolling wheels,
So regularly curved about a sphere,
As those ethereal orbs, bound with slant-scarfing band,
Whirl round from dawn to night throughout all time.
All the three circles rise and sink beneath the wave
In parallel courses: single are the points of the horizon
From which they mount and down to which they slope.
But the fourth covers all the horizontal arc
That parts the rise of southern Capricorn
From rising Cancer; and equal to its eastern span
Is the horizon's arc it measures in the west.
The visual ray that shoots from earth to the utmost sky
Multiplied six times measures its circumference[26]; each equal sixth
Is the range o'er which extend two constellations.
The Circle of the Zodiac is its name.
It crosses first the Crab, and next the Lion, then
The Virgin, then the Claws and Scorpio's body,
The Archer and Capricorn, and, after Capricorn,
The Water-bearer, after him the starry Fish;
The Ram, and the bright Bull, and last the Twins.
Through these twelve constellations drives the Sun,
Bringing the year, and, as he hastens through

This circle, generates all the fruitful seasons.
Large as its arc that girds the nether sky,
The arc that towers high above the earth.
Each night sees six-twelfths of the Ecliptic set,
And six-twelfths rise; and numbers the more hours
The further north at sunset the eastern point
Of the half Zodiac ascends the sky.[27]
Useful it were to him who longs for day
To know what sign is climbing the steep east.
For ever simultaneous with a sign
Rises the Sun.[28] Well mayest thou recognize them
By their own forms; but if black clouds obscure them
Or mountain barrier conceal,
Their places thou may'st know by noting stars
Linked to them by fast bands indissoluble
And wreathing with large chaplets either horn
Of ocean,[29] as he upheaves each sign from his deeps.
They are no pallid stars that touch the horizon
When Cancer rises,
These sinking, those ascending from the deep.
The Crown sinks and the Southern Fish's tail.
Half of the Crown is visible in heaven,
Half has descended to the lower world.
The Kneeler, moving backwards, sunk not yet
Beyond his navel, hides his head in gloom.

From knees to shoulder labouring Ophiuchus
The rise of Cancer sends beneath the horizon, and the
Serpent's tail and throat.
No more in twain Arctophylax is parted,
One fourth above the horizon, three below.
For four signs sink below the ocean in the time
Bootes takes to set: when he is sated with the sky
He consumes more than half the night in loosening his
oxen from the yoke,
As southward from the equator slopes the sun.
Those nights to which Arcturus lends his name are the
long nights that see him set at eve.[30]
So sink these constellations: but, opposite, a goodly
form,
With lucid belt and lucid shoulders,
Exulting in the puissance of his sword,
The last reach of the River at his feet, Orion mounts
the eastern sky.
The Lion's coming sends quite below the west
The stars that half set when the Crab arose, and with
them sends the Eagle. The Kneeler
Dips his whole body but his knee
And left foot in the waves of ocean.
And uprise Hydra's crest, the Hare's bright eyes,
And Procyon, and the forefeet of blazing Sirius.

Nor few the stars that sink beneath the earth
When Virgo rises. The shell made musical by the power that haunts Cyllene's top,
The Dolphin, and the slender Arrow, set.
With them the out-stretched pinions of the Bird
And the Stream's foremost reaches join the shades.
Set Pegasus' head and neck,
While uprise Hydra's middle coils as far as the Cup;
And Sirius extricates his hinder paws;
And in his rear is dragged the stern of starry Argo.
Up to her midmast heaved above the earth,
As soon as Virgo has quite cleared the horizon.
Nor do the following Claws, few though their rays,
Unmarked enter the scene: for all Bootes, giant sign,
At one bound rises, with Arcturus gemmed.
And Argo's whole hull now is high in heaven.
But Hydra—huge o'er heaven trail her spires—
Still shows not all her tail. The Claws bring
Only the right knee and thigh
Of that form still kneeling, still stooping low before the Lyre,
Whoseever be that unknown skyey shape,
Whom setting and ascending from the deep
We often in a single night behold.[31] Of his limbs only the knee

Emerges at the rising of the Claws:
The rest of him, head downward, below the horizon
Waits for the rise of Scorpio and the drawer of the Bow.
These two bring him aloft: Scorpio all his trunk,
The Archer brings his left hand and his head;
So by three signs he is hoisted, limb by limb.
Half too the Northern Crown and just the tail
Of Centaur rise aloft with the rising Claws.
All Pegasus then follows his vanished head,
And the sunk Bird withdraws the feathers of his tail.
Sinks Andromeda's head, and towards her form her grim foe,
The Sea-monster, is floated by the gloomy south; while opposite stands her sire,
Cepheus, in the northwind, lifting high hand of command.
Up to his mane the Sea-monster near the maiden
Dips averted; Cepheus sinks with head, and hand, and shoulder.
All the windings of the River at the approach
Of Scorpio fall into the fair ocean-flood.
His approach daunts even mighty Orion.
Dread Artemis list unoffended! Tis the tale of hoary eld,

That bold Orion laid hands upon her robe, when in Scio
With mighty club he chased the monsters of the forest,
By huntsman toils winning guerdon from famed Oenopion.
She, dashing in twain the island's central mountain range,
From the yawning gulf sent against him far other monster,
The Scorpion, who him struck and slew, gigantic though he stood,
Foe more gigantic; because he outraged Artemis divine.
And therefore, say they, still when the horizon shows
The Scorpion, Orion o'er the western rim retreats.
Nor are Andromeda's unvanished limbs nor the ocean monster's
Not conscious of his rising: both
Flee helter-skelter. The belt of Cepheus then
Touches the earth: his royal head
Is dipt in ocean: the rest fate forbids to sink, and the weird Bears
Detain on high his feet and knees and waist.
The queen too hastens after her phantom child,
Sad Cassiopea: in no majestic guise

Above her throne are raised her feet and ancles,
As topsyturvy diverlike she dips
Up to her knees: she was not like, I wot,
With Doris and Panope unpunished to contend.[32]
Below the horizon she is borne. Others from the deep
Heaven upheaves on the opposite side; the Crown's remaining semi-circle,
And the lagging spires of Hydra: upheaves Centaur's
Body and head, and the Beast that in his right
Centaur grips: the forefeet
Of the Man-steed wait the arrival of the Bow.
The Bow raises all the Serpent's coils, all the frame of Ophiuchus,
When it arrives: Scorpio himself
Reared their heads: reared the hands of Ophiuchus
And the starred Serpent's highest-lifted coil.
The Man-upon-his-knees, head-downwards
Ever rising, when first Scorpio climbs the east,
Upheaves his feet and girdle, breast and shoulders,
And right hand: his left hand and head
Wait the rising of the Bow and the Bow's lord.
With him the Lyre of Hermes, and head and breast
Of Cepheus emerge from the eastern ocean,
What time the lightnings of Sirius [Orion
Descend below the marge; descends the huge bulk of

And all the stars of vainly hunted Hare.
But the Chariot-driver's Kids and shouldered Goat
Descend not yet; still in his mighty hand
They glitter; and no fires in his body are so potent
To rouse the fury of the storm, when they drop level with the rising sun.[33]
His head, left hand, and waist,
Capricorn sends below: the lower limbs
Sank at the Archer's rise. Nor Perseus stayed
Nor remained all of starry Argo's hull.
Perseus sank except his right knee
And foot; Argo to the curling of her stern.
These too vanish at the rise of Capricorn
With vanishing Procyon; while soar above the east
The Bird and Eagle and the winged Arrow's
Stars and the southern Altar's awful sanctuary.
Soon as the Waterbearer climbs the sky
Reappear the winged Steed's feet and head; and, opposite the Steed,
The western gloom drags Centaur by the tail.
His head, and shoulders broad, and manly breast
Are not yet swallowed by the abyss; but gleaming Hydra's
Coiled throat has sunk below and all her crest.
Her hinder coils still trail in heaven; natheless they

And all the Centaur enter the western gulf
When the Fishes rise. With them rises that Southern Fish,
Stretched westward far as azure Capricorn;
Nor clears the horizon till the next twelfth of the zodiac has emerged.
So too Andromeda's tortured hands and knees
And shoulders are divided; part are seen,
Part lag below the horizon, when the Fishes
Mount the heaven. Her westward limbs
The Fishes rear from out the nether gloom: her eastward form
The ascending Ram. As the Ram upward whirls,
Sinking below the western verge is seen the Altar, and in the east
Perseus upraises just his head and shoulders.
Whether his belt appears with the last limbs of the Ram
Or with the Bull whose rise unrolls it all,
Were matter of grave controversy.[34] Nor far behind the Bull
Loiters his companion fast,
The Charioteer; yet of his form a part
Rises not with this sign but with the Twins.
The Kids, the sole of his left foot, and the Goat

Rise with the rise of Taurus, what time the mane and tail
Of the Sea-monster show above the marge.
And now Arctophylax begins to set with Libra, first
Of the four signs that setting drag him down,[35] all but his left hand
That ever grasps the circumpolar Bear.
Ophiuchus sinking below the verge from feet
To knees be taken for a sign
Of the Twins rising. Then nought of the Sea-monster
Remains in gloom, but all his body ascends.
And now the River-flood's first winding reach
The becalmed mariner may see in heaven,
As he watches for Orion to espy if he hath aught to say
Of the night's measure or the slumbering winds:
For from all quarters heaven speaks to man.

WEATHER FORECASTS.

A slender-horned Moon in the western sky,
Thou oft hast seen her, marks the beginning
Of a new month: when she casts sufficient light
To make a shadow, the month is four days old:
Eight, when half her orb is bright: half-spent, when it is full.
Each varying phase and changed position
Tells thee how many dawns the month has brought.
The night's duration the twelve members of the Zodiac
Determine; and the seasons through the orbed year
To plough the fallows and to plant the tree
Zeus has declared by bright notorious signs.
Full many a mariner the sea-heaving storm
Anticipates, remembering grim Arcturus,[36]
Or other stars, that rise from ocean
Before the morning or at night's first fall.

Round them journeys every year
The Sun in mighty orbit, on fixed days
Visiting each: we see them ere he rise and when he sets:
And each sign gazes on a different dawn.
Known are their laws; in harmony unroll
The nineteen-orbed cycles of the Moon.[37]
And all the signs through which Night whirls her car
From belted Orion back to Orion and his dauntless Hound,
And all Poseidon's, all high Zeus' stars,[38]
Bear on their beams true messages to man.
Study them, friend! Dear it concerns thee, if to ships
Thou trust thy life, to know oracular signs
Of stormy winds and ocean hurricanes.
Small is the trouble and thousandfold the gain
To the mortal by prevision always armed.
He safeguards his own fortunes and his fellows'
By warnings of the imminent typhoon.
Full often when the evening is calm
The sailor shortens canvas if the morn gave ugly signs.
Sometimes the third day brings the danger or the fifth,
And sometimes the mischief rushes unforeseen. Not yet all

Has Zeus revealed to mortals, but much still
Continues hidden. This too Zeus, if he so will,
Shall manifest hereafter. He his human offspring clearly aids,
In all quarters disclosing himself, by all elements signalling.
Some messages the Moon gives with half orb
Growing or waning; some with all her disk:
Some by his rise, some by his dropping orb
The Sun: and other elements shall give
Thee other signals both by night and day.
Scan well the two horns of the infant Moon
For vesper paints with differing hues
And variously shapes her horns,
When she is young and three or four days old.
These teach the character of the coming month.
If she be sharp-defined and clear on the third night,
She tells of calm; sharp-defined and ruddy-tinted
She announces a gale: ill-defined with blunted horns
On the third and fourth nights, and shining with wan beams,
The south wind blunts her or the coming rain.
If neither of her horns on the third night
Project forward, nor lean back shortened,
But vertical her yard-arms bend their points,

A western breeze will blow by the morrow's dawn.
If vertical her cusps on the fourth night
Continue, long the mustering storm shall rage.
Her higher horn pointing forward
Ushers Boreas; backward drawn, the coming South.
If on three nights she show sharp-pointed tips
And a red crescent,[39] look out for great squalls,
The greater, the more fiery red her blush.
Scan too her full orb and her quadratures,
Both waxing from and waning to a horn;
And from her hue infer the following day.
Shining quite clear she indicates fair weather;
Ruddy throughout she means careering gales;
And stained with dark spots she announces rain.
Not the same range of prediction have all her phases.
Three or four days old she fortells what shall be
Till she has half her size; half-orbed, her promise holds
To full moon; her full orb has equal range:
Half-orbed again she prophesies four days,
And four her crescent: the new moon foretells the weather till her crescent reappear.[40]
Sometimes she is girdled round by halos,
Now three, now two, and now by only one.
A single halo portends wind or calm:

Wind, rudely-broken; slowly-fading, calm.
Two whorls of halo prophesy a storm;
Three whorls a greater; the most furious blasts
A shattered halo of three dusky whorls.[41]
Such every month the warnings of the Moon.
Note too the Sun at the ends of his career;
His signs are even surer than the Moon's,
Both when he sets and when he climbs the east.
'Tis ominous if his orb be variegated
When his first arrows hit the earth, if thou fair weather wish.
Sharp then his limb and spotless be his orb.
If again clear when the oxen are unyoked
He sink unclouded with mild, tempered, ray,
Fair weather will continue on the morrow.
But not so, when his disk seems cavernous,
Nor when the rays he shoots to north and south
Are discontinuous, and only his mid zone bright;
For then he walks through rain or gales of wind.
Scan closely, if his beams permit thy gaze,
The disk of the Sun; the scrutiny is instructive.
If he blush red, as often
Heaven's other orbs are tinged by trailing clouds;
Or bear dark stains, the dark stains portend showers
Impending, crimson blushes tell of wind;

Blushes and simultaneous dusky stains
Of showers accompanied by gusty squalls.
If rising or setting he shoot across the sky
A cone of rays converging towards a point,[42]
Or dense clouds pen him closely when he mounts
To dawn from night or sinks to night from dawn,
Showers will pour down throughout the livelong day.
So if thin mist precede his rise
And he lift an orb shorn of beams,
Look for showers. A broad marge of cloud
That seems to melt, and ever grows in breadth
When first he mounts, but afterward narrows,
Heralds fair weather. Fair, too, the omen if
His wintry orb wax yellow as it sinks.
The morrow's rain to forecast, note the clouds
Turning thy face towards the setting sun.
If a thick cloud with growing murkiness
Shadow the Sun, and round its edges
The outer beams are darted in two curves,
Great need hast thou of shelter on the dawn.
If unclouded he dip in the western stream,
And as he sinks, or after he has sunk,
Red clouds stand near him, neither on the morrow
Nor in the night needest thou augur rain.
But when his beams in long lines through the sky

Grow wan all of a sudden,
As they sicken when shaded by the moon
Standing just level between the earth and sun;
Or when before the dawn and the sun's rise
Reddening clouds are scattered here and there;
Well drenched will be the furrows on that day.
So, while the Sun is still below the east, if his precursor beams
Are flecked with shadows ere the break of day,
They portend showers or down rushing wind.
The darker the shadows are that mar his beams,
The surer they predict the coming showers;
But fainter shadows flickering o'er his rays,
Such as thin misty vapours often cast,
Are thrown by the body of on-striding wind.
Nor are dark-centred halos near the Sun
Auspicious signs; and, the closer and more persistent,
The stormier are they[43]: two whorls of halo usher wildest storms.
Note too if near the rising or setting Sun
The mock suns that men call parhelia[44]
Blush on his south or north or on both sides.
Nor heedless be thy observation:
For when on both sides of the Sun at once
Such clouds blush near the horizon,

There is no lingering of the Zeus-sent storm.
One only, gleaming purple on the north,
Sends northern blasts; southward stationed, it sends the south wind,
Or big drops of the swiftly rushing shower.
Most crucial signs and constant in their sequence
Are mock-suns shining in the west of heaven.
And watch the Manger: like a little mist
Far north in Cancer's territory it floats.
Its confines are two faintly glimmering stars.
Not distant are their orbs nor yet quite close,
Sundered to fancy by a cubit's length,
One on the north, the other on the south.
These are two Asses that a Manger parts.
Which suddenly when all the sky is clear
Sometimes quite vanishes, and the two stars
Seem to have closer moved their sundered orbs.
No feeble tempest then will soak the leas.
A murky Manger with both stars
Shining unaltered is a sign of rain.
If while the northern Ass is dimmed
By vaporous shroud, he of the south gleam radiant,
Expect a south wind: the vaporous shroud and radiance
Exchanging stars harbinger Boreas.

Premonitory of wind are the heaving sea,
And louder, longer, murmurs of the shore,
And jutting promontories vocal in still air,
And moanings of the distant mountain tops.
And when the heron in disordered flight
Comes landward from the sea with piercing cries,
It is that gales begin to sweep the main.
And stormy petrels oft through a calm sky
Fly in dense bands to meet the coming breeze;
And ducks and sea-gulls of the circling swoop
Alighting on the main-land wave their vans;
And clouds lie level mid the mountain peaks.
And pappus, the white thistle's winged seed,
Foretokens wind, when on scarce heaving waves
It sails in long continuous lines.

The quarters whence come summer thunder-peals
And lightning-flashes are the winds' sally-ports.
And through the livelong night when shooting stars
Fast fleeting leave behind them whitening trails,
They show by their direction whence will stream
The coming gale. If others front them,
And others cross their paths, thou must anticipate
Gales from all quarters, veering winds
Unstable, baffling the predictor's skill.[45]

When lightning flashes both from east and south,

And sometimes from the west and from the north,
The mariner fears a double buffeting
By the billows and a deluge sent from Zeus;
For water chariots all those lightnings.[46]
Frequent precursors of coming showers
Are clouds that image woollen fleeces,
Or a double rainbow spanning the mighty sky,
Or a sombre halo girdling round a star.
Often the birds that haunt the lakes or seas
Bathe, plunging insatiably:
Or incessant round a pool the swallows dart,
Smiting with their belly the just dimpled wave.
Or, timid tribe, food of the water-snake,
Louder from the deep croak the sires of the tadpole;
Or drones a matin note the lonely treefrog,[47]
Or chattering on a jutting ridge of sand
Before a storm the crow dips in the brine;
Or in a river plunges head and neck
And shoulders or all her feathers;
Or loiters hoarsely cawing on the brink.
And oxen oftentimes the midday shower
With upturned gaze scent in the sky.
And from their caverned homes the ants
Bring up in hurry all their eggs; and swarms of scolopendra

Crawl up the walls, and wander forth the worms
That mortals call dark Earth's intestines.
And the tame progeny of Chanticleer
Plume their wings, and cluck with voice
Like noise of water dropping upon water.
Oft too the raven tribes and jackdaw clans
Predict the showers that are to come from Zeus,
Wheeling in bands, and screaming with high notes
Shrill as the falcon's: and oft the raven's voice
Mimics the big drops of the gathering flood:
Or after two croaks from her deep-toned throat
She makes loud whirring with her fast-clapped wings.
And ducks in sheds, and daws beneath the eaves
Perched on rafters, beat noisy pinions.
And wave-ward speeds the heron with shrill cries.
Slight not their instinct when thou seekest signs of rain
Impending; nor if flies beyond their wont
Sharpen their stings and raven more for blood:
Nor if snuffs clot the lamp's wick
In the dark night: nor if in winter's hour
It now burn equably with steady flame,
Now splutter, as it were, light-floating
Bubbles; nor if it fringe itself
With fitful rays: nor if mid-summer's sky be streaked

With winged emigrants from all the isles.
Nor if the pot or cauldron astride the fire
Be girt with spark-spray, be this unnoted.
Nor if the ashes of the blazing coals
Gleam with minute spots like to millet seeds,
Is this not worthy heed as sign of rain.

If white mists wreathing a huge mountain's base
Form a straight cloud-bank while the high peaks
Shine clear, right fair shall be thy sky.[48]
Fair shall it be when on the ocean's marge
Lies a low cloud that never rears its head,
But, flattened, seems long level shelf of rock.

Look in fair weather for signs of foul,
For signs of calm, in storm; and ever closely
Inspect the Manger encompassed by the Crab,
When it first purges off its misty gloom;
For as the Manger clears, so wanes the tempest.
And steady-burning lamps and nightly owl
Gently hooting, of declining tempest
Are a presage: and at eventide the crow
Croaking varied notes pitched high:
And solitary ravens singly uttering
First two notes and then loud continued cries;
Or rooks gregarious, ere they court repose,
Noisily vocal, as with excess of glee;

So shrill their wanton outcries, and so restless
Now on the branches where they wont to roost
They settle, now wheel round with eddying wings.
And cranes when they foresee a balmy sky
Fly steadily right onward in vast bands,
Nor vacillate except before a storm.
    But when the stars' clear light grows dim,
Though neither clouds thick-heaped obscure,
Nor misty veil nor rising moon,
But sudden wanness takes them unexplained,
The calm, still sky erelong shall be defaced
By violent storm : or if the higher clouds
Are motionless, while, underneath, the scud
Drifts by in opposite paths.
    And geese loud cackling as they haste to pasture
Foretoken coming storm ; and the nine-generations-living crow
Nightly singing, and the twilight-cawing daws,
And the siskin early piping, and all birds
From ocean fleeing, and the golden-crested wren and redstart
Retreating into crannied clefts, and jackdaw tribes
Deserting rich repast for evening perch.
Nor when a mighty storm is on its way
Far go the tawny wax-collecting bees,

But near their hives whirl in their honey-quest.
Nor keep the cranes' long ranks a constant path
On high, but wheel in vacillating flight.
And windless air wafting thin spider-webs
And flickering flame of wanly-gleaming lamp,
And fires and torches under rainless sky refusing to be lighted
Portend a tempest. Why try to enumerate
The warnings given to mortals? Squalid ashes
Clotting where they fall tell of coming snow;
The lamps tell of snow when a circlet of spots,
Minute as millet seeds, surrounds the blazing wick;
Live embers tell of hail, when bright
Their outer surface, but in their centre seems
Fine lurid mist of inward smouldering fire.
Nor are the holm-oak [49] acorn-laden and the schinus sable-hued
Not questioned: everywhere with many a glance the owner of the threshing-floor
Peers observant, fearing lest the summer through his fingers slip.
The holm-oak bearing moderate wealth of acorns
Presages showers to last for many a day.
May no excessive burden bend to earth its branches,
But watered well may wheat-stalks fill the furrows.

Thrice blue schinus blossoms, thrice produces
Fruit, and each crop is index of the harvest
From the corresponding ploughing; for the times of ploughing
Are triple, middle, earliest, and latest.
The first capsules of the schinus indicate the first wheat harvest, its second the second,
The latest the result of latest sowing.
A wealthy fruitage of the teeming schinus
Points to a wealthy garnering of sheaves,
Scanty to scanty, average pods to average ears.
So the spike of the squill thrice blossoming
Is index of the correspondent harvest.
For all the ploughman learns from azure-clustered schinus
Is taught him by the squill with blossoms white.
But autumn wasps in large societies
Swarming obnoxious bode tempestuous days
To come before the Pleiads rise at eve,
Such whirling cyclones quickly follow swarming wasps.
And sows and ewes and she-goats
Inflamed with passion and beyond the males
Insatiate of hymeneal rites,
Like swarming wasps foreshadow winter's strength.

But goats and sheep and swine adjourning marriage rites
Rejoice the poverty-stricken wretch, ill-housed and thinly clad,
Promising by their coldness winter's genial warmth.
And early flights of cranes gladden the early plougher,
Later migrations the tardy husbandman.
For winter's advent corresponds to the advent of the cranes.
Early coming in large bands they announce
Early winter: late and singly when they come
And at intervals and in small caravans,
Late-coming winter favours the late plough.
If, after opulent autumn, oxen and sheep
Butt the ground, and towards the blasts of Boreas
Turn their heads, rude winter comes
Just when the Pleiades begin to set.[50]
Incessant if they butt the earth, inordinately keen
Will be the winter, disastrous to trees and corn.
But let thick snow cover the mighty leas
Ere the blade has all appeared and shot on high,
That prosperous harvest may cheer the toiler's hope.
And shine the stars with ordinary rays,
Nor be there many comets, no, nor one;
For many comets mean a rainless spring.

Nor loves the mainland husbandman to see large flocks of birds
From all the islands lighting on the furrows
At the approach of summer: fear torments him
Lest he harvest empty ears of grainless chaff
From straw drought-pined: joyous visions fill the herdsman's soul
At sight of the same birds in moderate flocks,
And hopes of foaming milk in brimming pails.
For thus we struggling and benighted men
Live by various crafts, and in his own sphere every worker strives
To note successions, and by such lore forecast the coming days.
Sheep warn the shepherd of down-pouring rain,
To pasture when in hurry huge they race:
Or leaving the main body by the way
Old and young dally, pushing with their horns:
Or when they gambol, the younger from the earth
Flinging four heels, the large-horned patriarchs two.
Or when from pasture they are hard to move,
Though twilight fall before the shepherd thinks of folding, at every step
Nibbling the grass, in spite of chiding showers of stones.

Oxen warn the ploughman and the cowherd
Of tempest on its way. When with their tongue
The hoof of their forefeet all round they lick,
Or on right side recumbent take their rest,
The old ploughman knows his labours are adjourned.
And when with lowings loud at twilight hour
The mustering oxen wend their way to the fold . . .
And heifers grieve to quit meadow and ox-lea
They foresee tedious storms must spend their rage ere they again shall browse.
And goats attacking prickly ilex with greedy haste
Presage foul days, and swine in miry litter madly wallowing.
And when the huge solitary wolf loud howls,
Or, lightly recking arms of rustic swains,
Comes down to cultivated fields in search of covert
Near haunts of men, for closer ambuscade,
By the third morn expect tempestuous weather.
And so the other forecasts all portend
Or wind or wintry cold or rain,
The same day, on the morrow, or the third dawn.[51]
And mice with louder squeaking than their wont
And midday gambols imitating dance,

Were not unnoticed by our grandfathers;
Nor dogs: they dig the earth with active paws
When they are prescient of coming cold.
[And from the ocean comes the crab ashore
When storms are starting on impetuous paths.
And mice by day manipulating straws
To make their couches and sleep through the rain
Show they prognosticate inclement times.]
Set light by none of these: confirm one warning
By a second: two pointing to one end
Strengthen belief; a third breeds confidence.
And count the passing season of the year
Among thy signs: comparing the forecast with the normal promise of the stars
About the weather when they rise or set,
To see if they accord.[52] It deeply imports
To mark the last four days of the dying
And first four of the nascent month. Of meeting months
They join the edges, when most changeable is the atmosphere
Wanting eight nights the mild rays of the moon.[53]
Such notes, collated with the calendar,
Shall furnish solid forecasts of the sky.

NOTES.

THE SKIES.

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39 1 Compare Milton's:

> 'And thou shalt be our star of Arcady,
> Or Tyrian Cynosure.'—*Comus.*

'Star of Arcady' is an allusion to a different legend, in which Callisto, an Arcadian maid, takes the place of Helice.

As a means of orientation both the greater and the lesser Bear have been superseded in modern times by the magnetic needle.

62 2 The elevation of the pole above the horizon of any spectator is equal in number of degrees to the latitude of the spectator; for instance, Athens being in latitude 38°, the elevation of the pole above the horizon of Athens is 38°. The Dragon's head, therefore, being only 38° from the pole, to a spectator at Athens is circumpolar, *i.e.* never sets.

The centre of the Dragon is in the Arctic circle, $23\frac{1}{2}°$ from the pole: that is, just as far from the pole as the tropic of Cancer is from the equator. It is therefore in the zenith of a spectator to whom, at the summer solstice, the sun never sets. If Aratus had not named the Head of the Dragon, we might have supposed he alluded to this phenomenon and have translated:

> 'That Dragon form is vertical o'er climes
> That join the tips of evening and dawn.'

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64 3 Now called Hercules.

118 4 Why echoing? A line of Cowper may suggest the answer:

'The fall of waters, and the song of birds,
And hills that echo with the distant herds'.—*Retirement.*

137 5 Called by later astronomers Coma Berenices.

The group beneath the tail, or, line 144, by the hind knees, of Ursa Major, seems to be Canes Venatici; that by her fore-paws, Lynx; that by her hind-paws, Leo Minor.

161 6 Beginners still find Capella by producing a line through Delta and Alpha of Ursa Major.

172 7 Hesiod gives their names:

'Nymphs like the Graces,
Phaesyle, and Coronis, and crowned Cleeia,
And charming Phaeo, and long-robed Eudora;
Called Hyads by the mortal tribes of earth.'

77 8 As seen from the equator, the paths of all the stars are vertical to the horizon and bisected by it; so that those which rise together will set together. As observed by a spectator at any other latitude, except at the poles, the parallels of the stars are oblique to the horizon, and cut by it into unequal portions, according to their distance from the pole. Of two signs, then, that rise together, like Taurus and Auriga, the one that is further from the pole will remain a shorter time above the horizon.

234 9 Triangulum Boreale.

252 10 In the dust of the Milky Way.

262 11 The enumeration by Hesiod, with whom Aratus challenges a comparison, seems to me more rhythmical:

Πληγέτη τ' ἐρόεσσα, καὶ Ἠλέκτρη κυανῶπις,
Ἀλκυόνη τε, καὶ Ἀστερόπη, δίη τε Κελαινώ,
Μαῖά τε, καὶ Μερόπη, τὰς γείνατο φαίδιμος Ἄτλας.

266 12 The rise of a star means in ancient writers its rise in a certain relation to the sun, its rising contemporaneously with sunrise or sunset. The exact moment of contemporaneous rising can only be a matter of computation, not of

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observation, for the star is then invisible: but sometimes the rise of a star designated not the true but the apparent rise; *i.e.* the time when the star at rising is only so far above the sun as to be visible on the horizon. This will vary with the magnitude of the star: a star of the first magnitude is visible on the horizon when the sun is only 12° below; a star of the second magnitude is not visible unless the sun is as much as 13° below; and so on.

Similarly the setting of a star denoted either its true or its apparent setting at sunset or sunrise.

As, in consequence of the earth's annual movement, the stars every night gain four minutes on the sun, the star that on a given day rises contemporaneously with the sun will not do so on any other day in the year. To say, then, that a given star rises or sets at sunrise or sunset is a mode of defining a particular period of the year, and was the method employed in the infancy of astronomy.

But this coincidence of the solar and stellar rising or setting varies, in the first place, with the latitude of the spectator: and when, as often happened, a calendar invented by astronomers for the latitude of Alexandria was used at Athens or Rome, it was very misleading. In the second place, even in the same latitude, the stellar risings and settings are changed in the course of ages by the precession of the equinoxes; and the period which they defined in the latitude of Athens in the time of Hesiod was very different from the period which they defined in the time of Aratus. It was then an escape from dire confusion when, on the invention of almanacs, based on exacter knowledge of the length of the year, this mode of defining epochs, grand and poetical as it is, was discontinued.

At Athens, in the time of Meton, about 430 B.C., the apparent morning rise of the Pleiads, about the middle of May, marked the beginning of summer; according to Aratus, their apparent evening rise about the end of September marked the season of ploughing and beginning of winter. I have no astronomic authority at hand to enable me to give the exact dates. Aratus would have done better, if he had followed Theophrastus and taken, instead

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of the evening rise, the apparent morning setting of the Pleiads (at Athens in the time of Meton, the true morning setting was on October 20) for the beginning of winter.

269 13 Hercules.

272 14 Cycnus.

291 15 Aratus makes the south wind characteristic of the Greek winter; as, line 151, he made the Etesian or north winds characteristic of summer. This accords with modern observation. In the Ionian Sea, says Admiral Smyth, the prevalent winter winds are from south-south-west to east-south-east; and those of summer from north to east-north-east (*The Mediterranean*, p. 260).

The south, or rather south-west winds would be the ordinary counter-trades, due partly to the rotation of the earth from west to east, and partly to the reflux towards the pole of the air piled over the equator by the heat of the torrid zone.

The north, or rather north-east winds would supplant these in summer, because the position of the sun at the summer solstice converts the tropic of Cancer into a kind of secondary equator, and produces in the temperate zone a flow of wind from the pole, a sort of extra-tropical trade-wind, to supply the void caused by the rarefaction and ascension of air from the sands of the Sahara beneath the tropic of Cancer.

295 16 Compare Callimachus:

ἀλλ' ἐμὸς αἰὼν
κύμασιν αἰθυίης μᾶλλον ἐσωκίσατο.
'My life,
More than the sea-gull, made the waves its home.'

301 17 The sailing rules of the ancient Greeks seem to have resembled those of their modern representatives who, according to Admiral Smyth, on the first appearance of foul winds, seek shelter under the lee of some headland or island, or bear up for any port they can fetch (*The Mediterranean*, p. 277).

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314 18 In December.

329 19 Compare Cowper:

'When summer *scars* the plains.'—*The Task*, iii. 30.

There is a play of words in Aratus, perhaps hardly worth reproducing.

336 20 The ancient Greeks and Egyptians ascribed to Sirius the heat of the dog days, because he apparently rose at sunrise about the summer solstice. But the period of the year at which any star rises at sunrise varies with the variation of latitude, and therefore such rise can furnish no general rule for the temperature of the atmosphere. Moreover the precession of the equinoxes, of which the ancients were ignorant, gradually changes the relation of the seasons both to the position of the earth in its orbit and to the coincident risings of the sun and any given star; for both the place of the seasons in the orbit and the celestial horizons of every latitude are gradually changed as the axis of the earth reels round the pole of the ecliptic. It can be calculated when the rise of Sirius with the sun will occur at the winter solstice; and then, it has been observed, it will hardly be supposed that Sirius plays any part in causing the heat of summer.

350 21 Canopus, visible, says Hipparchus, from Rhodes. Eudoxus was said to observe it from a tower in Cnidos.

384 22 Since named Columba. Under the fore-feet of Sagittarius is Corona Australis.

441 23 Lupus.

479 24 Any reader with a celestial globe before him will observe great inaccuracies in the following description of the circles, betraying the imperfect state of astronomy in the time of Eudoxus. These errors were pointed out, about a hundred years later, by the exact observer Hipparchus.

498 25 To the inhabitants of the latitude where $\frac{15}{24}$ths of the tropic of Cancer are above the horizon and $\frac{9}{24}$ths below, the longest day, *i.e.* the day when the sun is in the tropic of Cancer, will consist of 15 hours, and the shortest night

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of 9. The tropics, being small circles, that is, not bisecting the sphere, are not themselves bisected by the large circle of the horizon, but divided into unequal parts that vary with the latitude of the spectator.

Hipparchus notes that the statement of Aratus respecting the longest day, though true of latitude 41°, or the region of the Hellespont, is not true of Athens, in latitude 38°, where Aratus supposed the observer to be stationed when he spoke of the Dragon-head as just circumpolar, line 61. Aratus, then, has changed the station of his observatory without duly warning his reader.

541 26 Aratus assumes roughly that the circumference of a circle is six times the length of the radius. It is observable that he treats the globe of the earth as a point compared with the distance of the fixed stars. Archimedes, the great geometer, thought that Aristarchus, who held the heliocentric theory, must have been misunderstood, when he was represented as having maintained that the apparent orbit of the sun, or real orbit of the earth, was a point compared with the immensity of the distance of the stars. —Lewis, *Ancient Astronomy.*

557 27 If the equator and ecliptic were luminous rings and constantly visible, the equator would be immovable, always passing through the east and west points of the horizon; but the ends of the ecliptic would be constantly shifting in cycles of 24 hours between two northern and southern limits, which depend on the latitude of the spectator. These ends or the points where it cuts the eastern and western horizon are called respectively its ascending and descending points; and the distance of these from the eastern and western points of the horizon is called their amplitude.

Aratus says that the length of the night depends on the northern amplitude of the ascending point of the ecliptic at sunset. This is obvious on reflexion. The longest nights are in midwinter: then when the sun sinks below the west in Capricorn, Cancer, the most northern point of the ecliptic, rises in the east. The shortest nights are in

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midsummer: then when the sun sets below the west in Cancer, Capricorn, the ascending point of the ecliptic, rises far to the south. Being both great circles, the ecliptic and horizon always bisect one another.

561 28 The invention of clocks superseded this use of Astronomy.

567 29 The horizon, in Aratus, is always called the Ocean. The horns of Ocean are the east and west horizons.

584 30 The meaning is doubtful.

Hipparchus observes that the setting of Bootes is not synchronous with the setting of four signs, Libra, Scorpio, Archer, Capricorn, but only with that of the last three; nor is it synchronous with the rise of four signs, Aries, Taurus, Gemini, Cancer, but only with that of the last three. Bootes sets, according to Hipparchus, in four hours and forty minutes, though he rises in two hours, or as Aratus says, line 608, at a single bound.

At Athens, in the time of Meton, the apparent evening setting of Arcturus, as a single star, was on October 24th.

616 31 Any star whose circle is so divided by the horizon that more is above the horizon than below may disappear in the west and reappear in the east in the course of a single night, and with a wider margin, the longer the nights are, compared with the days.

Aratus contrives to stimulate the attention of his reader by the mystic way in which he always indicates the constellation now called Hercules, and seems himself to have regarded it as something peculiarly mysterious. What would he have said if he had heard, what some astronomers tell us, that the whole solar system is rushing at the rate of five miles a second towards the Kneeling Phantom?

656 32
Or that starred Ethiop queen, that strove
To set her beauty's praise above
The Sea-nymphs, and their powers offended.

Il Penseroso.

680 33 The Kids, as we may infer from the next line, set at sunrise when the sun was in Capricorn, *i.e.* in December. This must be the epoch at which they brought stormy

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weather; though the words of the text rather suggest the epoch when they rise with the sun; which would be when the sun was near the longitude of the Kids in Taurus, in the months of April or May.

712 34 Hipparchus explains the hesitation of Aratus by informing us that Eudoxus made two inconsistent statements in his two treatises, and that Aratus was at a loss which to follow. He adds that, without any doubt, not only the belt but the whole body of Perseus rises with the Fishes, except the right knee and foot, which rise with Aries.

720 35 The mention that Arctophylax has begun to set when Taurus, including the Pleiads, begins to rise, suggests the true reading of a passage of Euripides.

In the *Rhesus* the Chorus who are on guard inquire who is going to relieve them. As the text stands at present we read:—

τίνος ἀ φυλακά; τίς ἀμείβει
τὰν ἐμάν; πρῶτα
δύεται σημεῖα, καὶ ἑπτάποροι
Πλειάδες αἰθέριαι, μέσα δ' αἰετὸς
οὐρανοῦ ποτᾶται . . . . .
οὐ λεύσσετε μηνάδος αἴγλαν;
ἀὼς δὴ πέλας ἀὼς
γίγνεται, καί τις προδρόμων ὅδε γ' ἐστὶν ἀστήρ.

'Whose turn is it to watch? Who relieves me? The first signs are setting, the seven Pleiads are above the east horizon, and the Eagle is soaring in mid heaven. . . . See ye not yon moon-like orb? Morn, Morn is about to break, and that is one of her precursor stars.'

The 'first signs' are explained to mean those that were visible at some earlier hour; but every one must feel that a more individual designation was wanted: and in place of the trochee πρῶτα, the metre of the antistrophe requires a spondee.

For πρῶτα read Βώτα, Doric for Βοώτου. ['Bootes has begun to set.'] The moon-like orb would be the morning star, more moon-like than Euripides suspected.

WEATHER FORECASTS.

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743 36 Grim Arcturus was remembered in marine contracts. Demosthenes against Lacritus speaks of a contract of bottomry, which stipulated that, subject to the safe return of a ship from the Borysthenes, the interest paid on a sum of money, lent on security of the ship, should be at the rate of 22½ per cent.: provided that the ship was within the Bosporus on its way home 'before Arcturus.' [At Athens in the time of Demosthenes the apparent morning rise of Arcturus was about mid September; his apparent evening setting was on October 24. The former date was probably meant.] If she delayed her return till 'after Arcturus,' interest was to be paid at the rate of thirty per cent. If the ship were lost, neither interest nor principal would be paid.

751 37 B.C. 433 Meton announced his cycle of nineteen years, a cycle after which the new and full moons, important in Paganism as in the Christian church for fixing the date of various festivals, would recur on the same days of the solar year. By the discovery of this cycle a single table covering nineteen solar years sufficed as a religious calendar for all time, for the festivals fell on the same days in the corresponding years of successive cycles. The number which showed the current year in this cycle (1, 2, 3 . . . . . 19) was called the golden number, because every year it was inscribed in letters of gold on the Parthenon. The same cycle also showed the recurrence of lunar and solar eclipses, which depend on the conjunction and opposition of the sun and moon.

754 38 The gods of navigation and agriculture. It is curious that Aratus says nothing about the religious and political uses of the calendar.

As indicating the progress of discovery to which Aratus presently refers, I may be allowed to quote a curious echo, though in a different form and in a different tongue, after

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a lapse of two thousand years, of the sentiment expressed so emphatically by our poet:

'It is, I hope, becoming daily more and more evident that the owners of all vessels should be obliged to furnish them with good barometers; and, indeed, if they knew their own interests, they would always do so. The cost of a very small portion of the delay and mischief arising from damage occasioned by the want of one—and these are frequently not losses falling upon underwriters—would far more than repay the cost.'

The writer had remarked a few lines before that a barometer on board a floating light vessel had marked the passage of a hurricane over its meridian at a distance of at least 120 miles with the regularity of a clock.—Piddington, *Ten Memoirs on the Law of Storms.*

795 39 The meaning of this line is not clear. I have avoided a mere repetition of lines 782–3. But perhaps Aratus is speaking of a halo, or of the ashy light, the phenomenon popularly called 'the old moon in the new moon's arms,' caused by the reflection of the earth's light on the portion of the moon unilluminated by the sun. The word vertical, if the right word to use, lines 788, 790, must mean vertical not to the horizon but to the line joining the centres of the moon and sun.

808 40 The new and full [moons divide the lunar month into halves; the half-moons divide it into quarters or quadratures; the bisection of the quarters divides it into octants. At each of these divisions the moon has a distinctive phase, and at each phase the appearance of the disk was supposed to indicate the impending weather. If any weather-change occurred, it was assumed it would occur at one of these divisions. *μάλιστα γὰρ, ἐὰν μέλλῃ μεταβάλλειν, ἐν ταῖς διχοτομίαις μεταβάλλει.*—Theophrastus, *De signis pluviae.* For some reason, however, as appears from both Theophrastus and Aratus, the phases of the second and third octant, the gibbous moons before and after full moon, were not consulted, so that the preceding phases, the first quarter and

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full moon, had a double range of prediction. All the other phases were supposed to be predictive for the eighth of a month. Theophrastus applies a similar doctrine to the divisions of the day and the year.

Schneider's notes to Theophrastus give the true reading of lines 807–8:

δέχεται δέ μιν αὐτίκα τετρὰς
Μηνὸς ἀποιχομένου· τὴν δὲ τριτάτη ἐπιόντος.

This theory, that the divisions of the lunar month are the epochs of weather-change, though it has descended to modern times, does not appear to stand the test of the most exact modern observations.

In reference to the appearance of the horns of the moon, the truncation of the upper or lower cusp, producing a pronation (falling forwards) or supination (falling backwards) of the crescent, Arago observes (*Popular Astronomy*, book xxi. ch. 38) that the clouds which obscure either cusp of the crescent are quite close to the earth, so close that the same cloud which to one observer obscures the upper horn, to another observer at a distance of only a few hundred yards will obscure the lower horn. It follows that these appearances, being so accidental, cannot furnish any valid basis for predicting the direction of the wind.

The same consideration seems to dispose of the forecasts derived from the appearance of Ara, lines 428–434, from parhelia, lines 885–6, and from the Manger, lines 903–6.

815 41 Aratus speaks of lunar, solar (line 875), and stellar (line 939) halos, and in each case applies the epithet 'dark' or 'darkening.'

The description of a shipwreck in *Paul and Virginia* begins with the words: 'La lune était levée; on voyait autour d'elle trois grands cercles noirs.'

This phenomenon may be explained by the following statement taken from the *Encyclopedia Metropolitana*. Halos round the moon are sometimes formed of a luminous white circle. The white circle is sometimes well defined on the inner side, so as to make the included space appear dark.

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The significance of halos is attested by the same authority. The Cirro-stratus, it says, precedes wind and rain, and the approach of foul weather may be inferred from its abundance. The Cirro-stratus is the cloud which commonly exhibits the beautiful phenomena of the solar and lunar halo. Hence the reason of the prognostic for rain and tempestuous weather commonly drawn from the halo.

Halos are of two kinds, those of large diameter, produced by refraction in hexagonal ice crystals; and those of small diameter, called for the sake of distinction Coronæ, produced by refraction in globules of water. There are sometimes two or more concentric Coronæ. The diameter of the inmost one varies from two to four degrees. The diameter of the second is double that of the first; that of the third, triple. The three whorls of Aratus show that he is speaking of Coronæ.

839 42 The line is obscure, but seems to refer to the phenomenon of convergent rays. This phenomenon, says Brewster in his *Optics*, is the effect of perspective. When seen, it is always on the part of the sky opposite the sun, where his rays converge to a point as far below the horizon as he is above it. It seems as if another sun, diametrically opposite to the real one, were throwing out diverging beams from below the horizon. A black cloud is necessary as a back-ground to render visible these feeble radiations, and this may be the reason why they are ominous of rain.

877 43 The larger the spherules of water that produce the Corona, *i.e.* the readier they are to drop, the smaller is the diameter of the Corona; hence the diminution of the diameter is a sign of impending rain.

879 44 The alternate faces of a hexagonal ice-prism are inclined at an angle of 60°, and rays refracted through them produce a halo with a radius of 22°.

The terminal plane of the ice crystal is inclined to any one of its faces at a right angle, and rays refracted through them produce a halo with a radius of 46°.

The light reflected from the terminal plane of the

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hexagonal prisms produces a horizontal white circle passing through the sun.

The intersections of this horizontal circle with the halos of 22° and 46° form mock suns or parhelia to the right and left of the sun.

Elliptic curves, produced by thin hexagonal ice plates, and touching the halos at their upper and lower points, form at the points of contact parhelia above and below the sun.—*Chambers' Encyclopædia.*

930 45 Aratus has not given us any general rules for predicting the direction of the wind, though he might have found something to the point in Theophrastus. He might have found Dove's law, that the wind goes round the points of the compass like the hands of a watch, in the following words: *Ὅταν δὲ μὴ ὑπ' ἀλλήλων διαλύωνται τὰ πνεύματα, ἀλλ' αὐτὰ καταμαρανθῶσι, μεταβάλλουσιν (οἱ ἄνεμοι) εἰς τοὺς ἐχομένους ἐπὶ δεξιὰ, ὥσπερ ἡ τοῦ ἡλίου ἔχει φορά* (*De signis ventorum*). 'When winds are not arrested by other winds (this is a confession of some undefined perturbations), but cease of themselves, they are transformed into the adjacent winds, rotating from left to right, like the sun in his (diurnal) course.' Theophrastus derives the doctrine from Aristotle. *Αἱ δὲ περιστάσεις (τῶν ἀνέμων) γίνονται, αὐτῶν καταπαυομένων, εἰς τοὺς ἐχομένους, κατὰ τὴν τοῦ ἡλίου μετάστασιν* (*Meteorologica*, 2, 6). 'The cycle of winds when they cease of themselves (*i.e.* without being disturbed by opposite winds) is a continuous transformation of wind from one quarter into a wind from the adjacent quarter, following the direction of the (diurnal) movement of the sun.'

When speaking of the Moon and Sun and Manger, Aratus wanders backwards and forwards from signs of Wind to signs of Rain. Afterwards, following the footsteps of Theophrastus, he arranges his matter more methodically according to the thing portended, and treats separately of the signs of Wind, of Rain, of Fair weather, and of Foul weather. Lines 907–930 give the signs of Wind; 931–985 of Rain; 986–1010 of Fair weather; 1011–1139 of Wintry storm or Foul weather. This last term is unfortunately

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ambiguous. The context shows that it sometimes means violent Wind, sometimes violent Rain, sometimes excessive Cold, sometimes Winter.

935 46 Electricity, according to modern meteorologists, cannot diffuse itself in the atmosphere without the presence of aqueous vapour.

The woollen fleeces of Aratus or lanae vellera of Virgil are the cirro-cumulus of the moderns. The cirro-cumulus, according to Dove, is formed by an ascending current of warm air which reaches, dislocates, and masses the cirrus, or light wisps of cloud, brought by a current of air from the equator. He says that, whatever may be the case in the south of Europe, cirro-cumulus is by no means invariably followed by rain in northern Germany.

946 47 The lexicon leaves the meaning of Ololȳgon uncertain. Theophrastus says that the Ololȳgon singing alone at daybreak is a sign of tempest; and, elsewhere, that the green frog singing on a tree is a sign of rain. This seems one of the many cases where the same phenomenon was regarded as a symptom of rain *or* storm. The belly of the tree-frog (Rana arborea) is white, its back a beautiful green. In beauty of colours, says Lacépède, it rivals the plumage of birds; while its charming tricks, the ruses and ambuscades of its little insect-chase on the tops of trees, make it a very interesting object of observation.

988 48 The abstract term, Mountain, is substituted by our poet for the famous individual peaks, Athos and Olympus, which are introduced in connection with this subject by the prose writer Theophrastus. The grandson of Augustus, more studious of his poetry, in his translation of line 563, substitutes for the plain 'Mountain' of Aratus, a whole catalogue:

'Altus Athos, vel Cyllene, vel candidus Haemon,
Gargaron, aut Ide, superisve agitatus Olympus.'

1041 49 There is some doubt whether the tree meant is Quercus ilex, the holm oak, called also holly oak and evergreen oak; or Quercus coccifera, the kermes oak. Both have prickly leaves (line 1120).

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Schinus was a bulbous plant, akin to the Squill. Plutarch mentions that Pericles was called Schinocephalous, because he had an oblong head. See Schneider's index to Theophrastus. The scanty data which we possess about the characters of Schinus seem about equally satisfied by the Hyacinth squill, Scilla hyacinthoides, and by Muscari, or the Grape hyacinth, some of whose species (Comosum, Racemosum, Commutatum), like the Hyacinth squill, have dark blue flowers and are natives of Greece.

To soften the use of a foreign name, I have added the epithets, blue and azure, assuming the Schinus to be some kind of Squill or Grape hyacinth, though Aratus only once gives it an epithet, and that is the term which I have translated, sable-hued.

Cicero and Avienus suppose the plant mentioned to be Lentiscus: but there is nothing dark or black about Pistacia lentiscus. The leaves of the Mastic are green, its flowers apetalous, its berries red, its bark generally a reddish brown; though Sir J. Hooker speaks of gnarled and *charred* stems of Lentiscus which he saw in Marocco (*Journal*, p. 31).

The white squill of Aratus is probably the plant once called Ornithogalum scilla, then Scilla maritima, now Urginea scilla. This is the squill of medicine, and has white flowers, whereas all the squills proper are blue. As Loudon says that its bulb is pear-shaped and nearly as big as the human head; and Galen says that Schinus was either a particular species of squill or the bulbous root of any squill, perhaps the plant contemplated in the nickname of Pericles was not the Schinus proper but Urginea scilla.

In Greece, as in England, wheat was sown in autumn, winter, or spring. If the Schinus and Squill flower in winter, spring, and summer, or for any shorter but considerable period, capable of tripartite division (Vaucher, vol. ii. p. 365, mentions that the top of the spike of Ornithogalum scilla is quite undeveloped when the base is already laden with capsules), we can understand how their three stages of fructification might be supposed to indicate the results of the wheat-sowings at the three corresponding periods. Or

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perhaps the three fructifications belonged, not to a single plant, but to three kinds or varieties of the Squill or Grape hyacinth, which Greek botany had not distinguished by specific names.

1083 50 At Athens, in the age of Meton, 433 B.C., the true morning setting of the Pleiads was on October 20.

1129 51 It seems at first sight a plausible postulate that a forecast should be allowed a margin of two or three days for its fulfilment; but Arago (*Popular Astronomy*, 21, 39), points out that, without great precautions, this assumption will give to the most baseless hypothesis the appearance of being supported by statistics. The larger the unit of time that we assume in our observations, the greater scope there is for casual combinations and vicious inference.

Suppose we are testing a forecast which alleges a connection between any two phenomena, A and B; and let us assume that there is no connection whatever between them, and that this absence of connection results in the fact that if we count the number of *days* on which A occurring is accompanied by B, and those on which it is not followed by B, every 100 occasions on which A is conjoined with B are balanced by another 100 in which A occurs without B. If we now include the day before and the day after the occurrence of A, and count as a fulfilment of the forecast the occurrence of B on any one of those three days, we clearly thereby treble the chances of their combination; and, although this mode of statistics gave 300 positive instances or fulfilments of the forecast to 100 negative instances or failures, yet it would be utterly fallacious unless we were careful to treble the chances in favour of non-fulfilment as well as those in favour of fulfilment.

But this caution is seldom practised, and this fallacy vitiates much of the statistics that have been adduced to connect weather-changes with the phases of the moon. The statist forgets that if he counts as a fulfilment of the forecast an occurrence on any one of three or five or seven days, he ought to count as a non-fulfilment its non-occurrence on any one of those days, and not require the non-

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occurrence to be extended over the whole of the period, and thus statistics, that at first sight appear overwhelming, lose all probative force.

Similar vices of statistical method probably account for the tenacity with which many other erroneous weather saws hold their ground and are supposed to be attested by experience.

1146 52 Astronomy and Meteorology went hand in hand in their infancy. The astronomer who put out a calendar (parapegma) showing the risings and settings of the stars, added notices of the average weather of each month. Aratus (line 749) implies the existence of such calendars. Specimens of them are preserved in the works of the astronomers Geminus and Ptolemy. A few zoological and botanical notices were interspersed. A mention of the Kite, misunderstood by Ovid, has induced him to create a new constellation called the Kite, which none of his commentators has since been able to identify.

Theophrastus says that weather forecasts are either constant and astronomic, or variable and abnormal. He and Aratus confine themselves to the latter: Germanicus, who here deserts Aratus, gives in his *Prognostics* a versified weather-calendar.

1150 53 Aratus overestimates the absence of the moon. She is invisible when she is 30° from the sun; that is, summing the times while she is approaching and receding from his disk, while she is traversing 60° of her orbit. If she traversed 360° in thirty days, she would traverse 60° in exactly five days. But her synodic orbit is rather more than 360°, because the earth is on the move, and a synodic month is rather less than thirty days, and she really takes a few minutes under five days to traverse 60°. Perhaps, however, Aratus only means to assert that the rays of the moon are too feeble to produce any effect until she is four days old. Compare lines 733–4.

LONDON : PRINTED BY
SPOTTISWOODE AND CO., NEW-STREET SQUARE
AND PARLIAMENT STREET