# NOTES ON ASTRONOMY, TOGETHER WITH A COLLECTION OF EXAMINATION QUESTIONS

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Notes on astronomy, together with a collection of Examination Questions by Swift P. Johnston



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SWIFT P. JOHNSTON

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## EXAMINATION QUESTIONS.

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# PREFACE.

THESE "Notes" are designed to aid the student in mastering the difficulties connected with the more purely mathematical portion of the Science of Astronomy. No greater mathematical attainments are presupposed than a knowledge of Euclid, and of the elements of Algebra and Plane Trigonometry. For the physical department of the elements of Astronomy, the student may consult Brinkley's "Astronomy" (edited by Dr. Stubbs) and Dr. Ball's excellent text-books.

With respect to the style of the demonstrations given in the text, the aim is rather clearness and fulness, than mathematical elegance. The Author has had great practical experience of those points which are most perplexing to the beginner, and accordingly, has endeavoured to render assistance at such places, even at some sacrifice of conciseness.

The diagrams are numerous, an essential condition of clearness. One caution, however, should be constantly remembered; the diagrams are not drawn to scale. It would be a practical impossibility to give diagrams in which the sun, moon, and earth would appear, with any approach to accuracy of relative magnitude. Such must be the excuse for the absurdities of some of the cuts. The best preventive for any evils, likely to arise from this source, is to bear in mind the numbers expressing the actual lengths of the lines depicted.

The test-questions at the end of the volume are all selected from examination papers.

In conclusion, the Author wishes to make acknowledgment of his indebtedness to Mr. James Lowe. To him is owing not only the appearance of these "Notes" in print, and their judicious editing, but also the greater part of whatever is practically useful in this little treatise.

S. P. J.

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# NOTES ON ASTRONOMY.

## CHAPTER I.—THE SPHERE.

A SPHERE is a surface every point of which is at the same distance from a point within, called the centre. **The pole of any circle** on the sphere is that point on the sphere which is equidistant from all points of the circle.

**The pole of a great* circle** on the sphere is that point on the sphere which is 90° distant from every point of the circle. There are evidently two such points diametrically opposite to one another.

**The angle at which two great circles intersect is equal to the length of the arc joining the poles of the two great circles.**

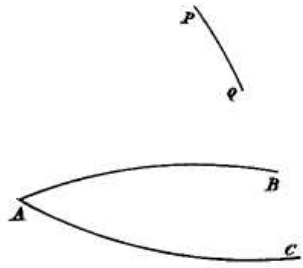


Fig 1

Thus if P be the pole of the great circle A B, and Q the pole of the great circle A C, then the angle at A is equal to the arc P Q.

* A circle on the sphere is called great or small, according as its plane does or does not pass through the centre of the sphere.

**Every great circle drawn through the pole of a great circle is perpendicular to the latter great circle.**

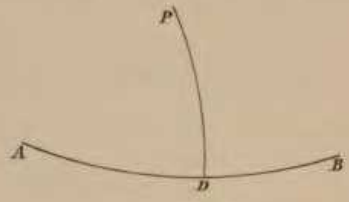


Fig II.

Thus if P be the pole of A B, and if P D be any great circle through P, the angles drawn at D are right angles.

Conversely: **If any perpendicular be drawn to a great circle it will pass (when produced if necessary) through the pole of that great circle.**

Thus if at the point D in the great circle A B we draw a perpendicular great circle, it will pass through P the pole of A B.

**The arcs joining the poles of two great circles will, when produced, cut both circles at right angles.**

Let P be the pole of A C and Q the pole of A B. Join P Q and produce; then will the angles at C and B be 90°. For P Q is a great circle drawn through P the pole of A C, and ∴ cuts A C at right angles: and also P Q is a great circle drawn through Q the pole of A B and ∴ cuts A B at right angles.

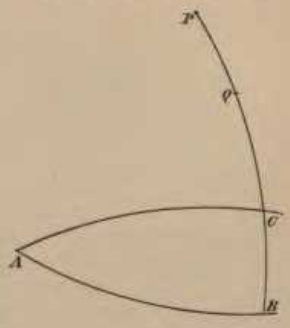


Fig III.

**If a great circle be drawn to cut two great circles perpendicularly, the length of the arc intercepted on it**

**by the two great circles is equal to the angle at which the great circles intersect.**

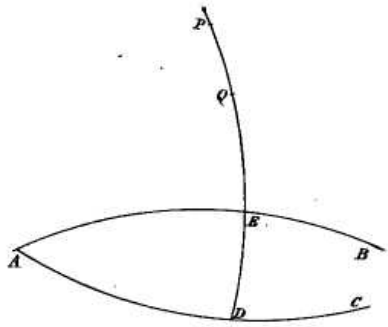


Fig IV.

If a great circle be drawn at D to cut both AC and AB at right angles in D and E, then the arc DE is equal to the angle at A.

For since DE is perpendicular to AC, when produced it passes through Q, the pole of AC. Also, for the same reason, DE produced passes through P, the pole of AB.

But since P is the pole of AB, PE = 90°, and since Q is the pole of AC, QD = 90° ∴ PE = QD : take away the common part QE, and PQ = ED. But PQ = angle at A ∴ ED = angle at A.

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## CHAPTER II.—DEFINITIONS.

The *celestial sphere* is a sphere, described with the eye of the spectator as centre and any radius, on which the relative positions of the stars are supposed to be indicated.

*The horizon* is the great circle in which the tangent plane to the earth, at any point, intersects the celestial sphere.