be pasted upon the slide, instead of the disk of varnish, to serve as a dark background. A cell ring is then applied around the edge of the disk, and the object is fastened in the centre of the cell by means of mucilage or glue. This done, the cover is placed upon the ring and cemented down as described above.—(*Compendium of Microscopical Technology.*)

THE DEARBORN OBSERVATORY.

The annual report of the Board of Directors of the Chicago Astronomical Society, together with the report of the Director of the Dearborn Observatory, dated May, 1881, is now published.

The first report is brief, and states that the Society has entered into a contract with the city of Chicago for furnishing standard time to the City Hall. In order that this contract may be more satisfactorily fulfilled, the Directors of the Society have ordered from Messrs. Howard & Co., of Boston, two new clocks, which will cost about $1000. The cost of running wires and other equipments has been $574.

The friends of the Society have contributed the funds required to meet the immediate wants of the Observatory, but the Society reiterate the often-repeated call for a permanent endowment, which will not only enable it to continue its present course of action, but to enlarge its sphere of astronomical work and take an honorable place among the prominent astronomical Observatories of Europe and America. The Directors express a hope that the time has arrived when the public-spirited citizens of Chicago will contribute the amount to accomplish this object, and we heartily trust that the confidence expressed in this respect may receive a prompt confirmation. The Dearborn Observatory is built and equipped with one of the finest equatorials in the United States; the question of endowment is therefore one which calls for immediate action.

In the second report Professsr G. H. Hough states the nature and amount of the astronomical work carried on at the Dearborn Observatory during the past year by himself and Messrs. Elias Colbert and S. W. Burnham.

The planet Jupiter has received the attention of a large number of astronomers during the past two years, especially of amateurs, and much writing of a miscellaneous character has appeared on the subject. As the proper study of markings and spots on celestial objects require the use of a telescope of great optical power, combined with good definition, the following report of observations on the planet Jupiter, made with the Dearborn equatorial, which possesses these conditions, will be read with interest, especially as they do not confirm many observations made under less favorable circumstances.

The planet Jupiter was made a special study during the past year. The first observation was secured on May 6, 1880, and the last on January 30, 1881. During this period the various spots and markings on his disc were subjected to micrometer measurements whenever practicable. It is readily apparent to any one who has examined contemporaneous drawings or sketches made by different observers and telescopes, that they are generally unreliable, unless based on micrometer measurement, and frequently give rise to erroneous deductions with regard to the phenomena in question. We believe the time has passed when mere estimations or sketches are of value in any department of practical Astronomy. Jupiter presents such a variety of phenomena on his disc, at different times, that it has been accepted as an established fact that his surface is subject to sudden and rapid changes, which may be accomplished in a few days or even a few hours.

The observations made at the Dearborn Observatory during the past two years does not confirm this statement. On the contrary, all minor changes in the markings or spots have been slow and gradual, such as might be produced by the operation of measurable mechanical forces. In fact, the principal features have been permanent, no material change being detected by micrometer measurement.

The following is a summary of the observations on Jupiter:

GREAT RED SPOT.

Longitude,	37 nights	560	measures.
Latitude,	12 "	34	"
Length,	20 "	67	"
Breadth,	10 "	32	"
Position of maj. axis,	5 "	16	"
Total		709	"

EQUATORIAL BELT.

Observed on 26 nights—		
Position of the North Edge	87	measures.
Latitude " "	34	"
Width of the Belt	53	"
Total	174	"

EQUATORIAL WHITE SPOTS.

Observed on 18 nights—		
Longitude	240	measures.
Latitude	15	"
Total	255	"

POLAR SPOTS.

Observed on 22 nights—		
Longitude	144	measures.
Latitude	40	"
Total	184	"

Being a total of 1,379 micrometer measurements.

From the micrometer measurements for longitude of spots, the equatorial diameter of the planet is deduced on 50 different nights, and from the latitude measures, the polar diameter on 13 nights.

The following deductions have been drawn from these observations.

ROTATION OF JUPITER.

The period of the planet's rotation, as obtained by different observers, has varied between $9^h\ 49^m$ and $9^h\ 56^m$. The observations made on the great red spot during the opposition of 1879, gave for the rotation period about $9^h\ 55^m\ 34^s$; being 8 seconds greater than the previously accepted value.

The discussion of our longitude measures on the great red spot, made from September 25, 1879, to January 27, 1881, comprising a period of 490 days, gives for the mean value $9^h\ 55^m\ 35.2^s$,

When the individual observations are compared, however, with this value, there is found to be a well marked maximum displacement of the center of the spot amounting to 1".4 of arc, indicating that the center gradually oscillated to this extent in longitude, corresponding to an actual displacement on the surface of Jupiter 3,200 miles.

The observations are all well represented by making the rotation period depend on some function of the time.

The period $9^h\ 55^m\ 33.2^s + 0.18^s \sqrt{t}$ satisfies all the observations with a mean maximum error of 0".5 of arc. In which the zero epoch is September 25, 1879, and t is the number of days after that date.

This formula gives for the rotation at the date January 27, 1881, $9^h\ 55^m\ 37.2^s$, agreeing essentially with the value deduced directly from the observations made during the two months previous to that date.

The rotation period derived from the observation of polar spots was as follows;

	Latitude.	Longitude.	Interval Between Extreme Observations.	Rotation.
White Spot	+10″.46	3^h 00^m	2 months.	9^h 55^m 39.3^s
White "	−11″.62	3^h 57^m	2 "	31.0^s
White "	−11″.62	4^h 26^m	2 "	33.6^s
Black "	+10″.40	0^h 00^m	2 "	31.0^s
Black "	+ 9″.70	2^h 22^m	1 "	40.5^s
Mean of all				9^h 55^m 35.1^s

The latitude is simply the measured distance north or south of the Jovian equator, reduced to the mean distance of the planet from the earth. The zero of longitude is the center of the great red spot.

The white spots were egg-shaped, about 1″ of arc in length, and were only visible under favorable atmospheric conditions.

The rotation period derived from the small spots indicates an average displacement during two months of 2″ of arc, or 4,600 miles, or an average drift in longitude of nearly 3 miles per hour.

ROTATION FROM EQUATORIAL SPOTS.

From July 8 to October 1, 1880, comprising a period of 85 days, the longitude of a white spot, between the equatorial belts, in latitude 2″.3, was observed on 10 nights. The rotation, as deduced from this spot, was 9^h 50^m 00.56^s, representing all the observations within 0″.3 of arc, showing that the motion, so far as we know, was absolutely uniform. From October 28, 1880, to January 30, 1881, during a period of 94 days, another white spot, in latitude 2″.8, and differing 20 deg. in longitude from the first, was observed on 8 nights.

The rotation was 9^h 50^m 09^s.8, with uniform motion.

If the great red spot is supposed fixed, then the mean drift of the equatorial spots would be about 270 miles per hour in the direction of the planet's rotation, or the spot made a complete revolution around the planet in about 42 days.

The approximate diameter of the equatorial white spots was 1″.2 of arc, or 2,800 miles.

These observations leave the true period of the rotation of Jupiter in a very unsettled condition. The great red spot was frequently measured to ascertain whether it was subject to any marked change, in position, size or shape.

The following are the mean results for the two oppositions of 1879 and 1880, reduced to the mean distance of the planet from the earth:

	1879.	No. of Obs.	1880.	No. of Obs.
Length	12″.25*	9	11″.55	20
Breadth	3″.46	8	3″.54	10
Latitude	6″.95	8	7″.14	12

* Re-computed with the constants of 1880.

The position of the major axis of the spot was measured as follows, the number indicating the inclination of the axis of Jupiter's equator as compared with Marth's ephemeris.

1880, July 27 + 2°.3
" Aug. 6 + 2°.5
" Sept. 4 + 2°.9
" Dec. 3 + 2°.2
1881, Jan. 17 — 0°.8. Definition poor.

These numbers indicate a remarkable degree of permanency with regard to the size, shape and position of the spot, during the two oppositions. Our observations do not warrant the assumption of any considerable change since September 25, 1879.

The actual size of the object, as seen with our telescope, was as follows:

Length, 29,600 miles.
Breadth, 8,300 "

The smaller telescopes make the approximate length considerably less than the real value.

POLAR BELTS.

During the opposition of 1880 the polar belts were not as sharply defined as during 1879, with the exception of Nos. 2 and 3, the latter of which became very conspicuous. During the month of June, when the planet was at about mean distance, no trace of polar markings could be seen. And it was not until July 4, when the distance was 0.948, that the belts 2 and 3 were barely visible. Markings on the southern hemisphere were first seen on July 24, when the distance of the planet from the earth was 0.888.

The latitude of 2 and 3 was as follows:

	1879.	1880.
No. 2,	+ 9″.78	+ 9″.75
No. 3,	+ 5″.98	+ 5″.89

EQUATORIAL BELT.

The great equatorial belt remained without any material change in size or position, as the following measurements will show:

	1879.	1880.
Latitude N. Edge,	+ 2″.59	+ 2″.35
Width	6″.77	7″.04

During both years the position of the north-edge was parallel to Jupiter's equator, as given in Marth's ephemeris.

PHENOMENA.

When a satellite crosses the disc of the planet it usually disappears in our telescope, when one-fourth to one-third across the disk, and reappears at an equal distance from the preceding limb, proving that the center of the disc is more luminous than the satellite.

In the case of the first satellite, it is sometimes seen to transit as a grayish spot, and remains visible when on the middle of the disc; such a phenomenon was observed on December 10, 1880.

On July 3, 1880, the second satellite during transit passed almost directly over the center of the great red spot, when it appeared sensibly as bright as when off the disc.

On November 1, 1880, I had the good fortuue to witness the transit of the shadow of the second satellite over the center of the red spot, and, at the same time, the transit of the shadow of the first satellite over the disc of the planet.

The shadow of the satellite, when fully projected on the red spot, was distinctly visible, but not quite as black as the shadow on the disc, proving that the red spot, although much less luminous than the disc, was yet much more luminous than the shadow.

THEORY OF JUPITER.

The generally accepted theory is, that the planet Jupiter is surrounded by a dense atmosphere, that the belts are the solid portions of the planet, and that the minor spots are clouds floating in the atmosphere. It is difficult, if not impossible, to reconcile the known phenomena with any theory yet proposed. But whether there are a sufficient number of well determined facts to form a better one, is doubtful.

Accurate observations are needed on the markings seen at different times on his disc; not sketches and general statements, but suitable micrometer measurements, from which may be deduced the motions and changes taking place on the surface. And until this method is pursued there is but little hope of solving the problem of his physical constitution.

It has occurred to me, however, that the known phenomena might be explained in the following hypothesis, viz: the surface of the planet is covered with a liquid

semi-incandescent mass; that the belts, the great red spot and other dark markings, are composed of matter of lower temperature. The egg-shaped, polar white spots are openings in the semi-fluid crust. This hypothesis would account for the slow and gradual changes occurring on the surface, which does not seem reasonable on the simple atmospheric theory.

Over the liquid surface is an atmosphere in which is formed the equatorial white spots which are of the nature of cloud.

In conclusion the director expresses what we can well believe to be his sincere regrets at the loss of the valuable services of Mr. S. W. Burnham, who has accepted a position in the Washburne Observatory, at Madison, Wis. During the past year Mr. Burnham, as heretofore, had the use of the great equatorial for double-star observations, and reported the discovery since May, 1880, of about fifty new double-stars, all of which were measured at least three times. About one-half of the number are close double, not exceeding 1".5 in distance. Among the more prominent stars are 9 persei, 5 persei, κ pegasi, γ foracis and 60 arietis. He also made about 600 measures on previously-known double-stars.

DR. COPELAND and Mr. Dreyer have been compelled to change the title of *Urania*, as it appears that name was appropriated by some *astrological* serial. In future, then, *Urania*, the astronomical serial, will bear the title *Copernicus*.

IT is rumored that Prof. Huxley will be asked to allow his name to be entered for the Linacre professor of physiology vacant by the death of Prof. Rolleston.

COMET (*b*) 1881.

The following observations of the Great Comet of 1881, made at Australian Observatories, have been kindly furnished for publication by Professor Wm. Harkness, U. S. N., to whom they were communicated by Mr. Todd, Superintendent of the Adelaide Observatory.

DATE.	R. A.	Dec. South.	Station.	* Of Comparison.
	h. m. s.	° ′ ″		
May 22, —	—4 58 —	35 30 —	Windsor	B. A. C. 1573
" 23, —	—4 59 —	35 14 —	Melbourne	Lacaille 1685
" 25, —	—4 59 46.	34 13 30.	Sydney	----------
" 26, 6	17 5 0 16.62	33 40 44.9	Melbourne	----------
" 27, 18	10 5 1 3.07	32 31 2.	Windsor	Lacaille 1785
" 28, 8	0 5 1 25.	32 22 7.	Adelaide	Columbæ
" 28, 18	0 5 1 35.67	32 3 48.	Melbourne	B. A. C. 1564
" 29, 5	39 5 1 48.52	31 42 42.	"	" 1615
" 29, 7	20 5 1 51.7	31 39 39.	Adelaide	" 1564
" 30, 5	5 2 21.8	30 51 2.	"	" 1615
" 30, 7	33 5 2 26.12	30 50 49.	"	----------
" 31, 7	8 5 2 54.6	30 0 1.	"	----------
" 31, 18	23 5 3 12.38	29 34 14.	Melbourne	----------
June 1, 5	25 5 3 26.26	29 6 40.	"	----------
" 1, 6	48 5 3 32.8	29 2 58.	Adelaide	Washington 2173
" 3, 6	4 5 4 37.6	26 51 36.	Melbourne	----------
" 5, 6	10 — —	24 5 —	Adelaide	----------
" 12, 6	0 5 11 38.4	8 11 39.	"	Rigel
" 12, 18	0 5 12 13.4	6 26 21.	"	r. Orionis

	° ′ ″		h. m. s.	
Windsor---Lat.	33 36 29 S.,	Long.	10 3 21.8	E. of Greenwich.
Sydney ---- "	33 51 41 "	"	10 4 50.8	"
Melbourne - "	37 49 53 "	"	9 39 54.8	"
Adelaide--- "	34 55 34 "	"	9 14 21.3	"

WASHINGTON, Aug. 9, 1881. W. C. W.

METEOROLOGICAL REPORT FOR NEW YORK CITY FOR THE WEEK ENDING AUG. 6, 1881.

Latitude 40° 45′ 58″ N.; Longitude 73° 57′ 58″ W.; height of instruments above the ground, 53 feet; above the sea, 97 feet; by self-recording instruments.

JULY AND AUGUST.	BAROMETER. MEAN FOR THE DAY. Reduced to Freezing.	BAROMETER. MAXIMUM. Reduced to Freezing.	Time.	BAROMETER. MINIMUM. Reduced to Freezing.	Time.	THERMOMETERS. MEAN. Dry Bulb.	Wet Bulb.	MAXIMUM. Dry Bulb.	Time.	Wet Bulb.	Time.	MINIMUM. Dry Bulb.	Time.	Wet Bulb.	Time.	MAXI'M In Sun.
Sunday, 31	30.094	30.164	9 a. m.	30.044	9 p. m.	67.6	66.3	73	4 p. m.	69	12 p. m.	63	1 a. m.	63	1 a. m.	123.
Monday, 1	30.060	30.096	9 a. m.	30.036	9 p. m.	74.3	70.3	80	3 p. m.	73	3 p. m.	68	5 a. m.	67	5 a. m.	140.
Tuesday, 2	30.014	30.058	9 a. m.	29.966	6 p. m.	75.0	71.0	81	4 p. m.	74	5 p. m.	70	2 a. m.	69	2 a. m.	141.
Wednesday, 3	29.975	30.006	7 a. m.	29.942	4 p. m.	76.6	71.0	85	4 p. m.	75	7 p. m.	67	6 a. m.	67	6 a. m.	141.
Thursday, 4	29.970	29.996	9 a. m.	29.940	6 p. m.	81.7	74.0	91	4 p. m.	79	4 p. m.	70	5 a. m.	69	5 a. m.	142.
Friday, 5	29.930	29.976	9 a. m.	29.898	6 p. m.	82.3	75.6	91	3 p. m.	79	2 p. m.	75	5 a. m.	73	5 a. m.	141.
Saturday, 6	29.864	29.914	7 a. m.	29.804	7 p. m.	83.0	76.3	91	2 p. m.	80	2 p. m.	78	12 p. m.	73	12 p. m.	139.

			Dry.	Wet.
Mean for the week	29.986 inches.	Mean for the week	77.2 degrees	72.0 degrees.
Maximum for the week at 9 am., July 31st	30.164 "	Maximum for the week, at 2 pm. 6th	91. "	at 2 pm 6th, 80. "
Minimum " at 7 pm., Aug. 6th	29.804 "	Minimum " " 1 am. 31st	63. "	at 1 am 31st, 63. "
Range	.360 "	Range " "	28. "	17. "

JULY AND AUGUST.	WIND. DIRECTION. 7 a. m.	2 p. m.	9 p. m.	VELOCITY IN MILES. Distance for the Day.	FORCE IN LBS. PER SQR. FEET. Max.	Time.	HYGROMETER. FORCE OF VAPOR. 7 a. m.	2 p. m.	9 p. m.	RELATIVE HUMIDITY. 7 a. m.	2 p. m.	9 p. m.	CLOUDS. CLEAR, 0 OVERCAST, 10 7 a. m.	2 p. m.	9 p. m.	RAIN AND SNOW. DEPTH OF RAIN AND SNOW IN INCHES. Time of Beginning.	Time of Ending.	Duration. h. m.	Amount of water	OZONE. 0 10
Sunday, 31	n. e.	e.	s. s. e.	132	1½	4.00 am	.596	.635	.658	100	90	90	10	9 cu.	10	1.30pm	4 pm.	2.30	.03	0
Monday, 1	w. s. w.	s.	s.	119	2	4.00 pm	.644	.717	.706	85	70	90	10	2cir.cu.s	3 cu.	-----	-----	-----	--	0
Tuesday, 2	s. s. e.	s.	s.	118	2½	3.30 pm	.706	.717	.693	90	70	85	10	3 cir. cu.	8 cu.	-----	-----	-----	--	0
Wednesday, 3	n. w.	n. n. e.	s. w.	61	¼	2.00 pm	.648	.663	.744	95	57	77	3 cir. cu.	1 cir.	0	-----	-----	-----	--	0
Thursday, 4	n. n.w.	n. w.	s. s. w.	57	¾	5.00 pm	.641	.765	.816	76	56	74	0	3 cir. cu.	0	-----	-----	-----	--	1
Friday, 5	w. n.w.	s. s. e.	s. w.	82	¾	3.40 pm	.757	.855	.787	82	62	74	2 cir.	0	0	9.15pm	10 am.	0.45	.07	0
Saturday, 6	s. s. w.	s. s. w.	s. w.	176	5¼	2.20 pm	.772	.874	.814	78	60	82	2 cir.cu.	1 c. s.	6 cu.	-----	-----	-----	--	3

Distance traveled during the week	745 miles.	Total amount of water for the week	.10 inch.
Maximum force	5¼ lbs.		

DANIEL DRAPER, Ph. D.

Director Meteorological Observatory of the Department of Public Parks, New York.