who is acquainted with the range of variation of structure in these groups possesses the key to every peculiarity which is met with in the primates, the carnivora, and the ungulata. Given the common plan of the insectivora and of the rodentia, and granting that the modifications of the structure of the limbs, of the brain, and of the alimentary and reproductive viscera which occur among them may exist and accumulate elsewhere, and the derivation of all eutheria from animals which, except for their diffuse placentation, would be insectivores, is a simple deduction from the law of evolution. I venture to express a confident expectation that investigation into the mammalia fauna of the mesozoic epoch will, sooner or later, fill up these blanks.

RECENT DISCOVERIES RELATING TO THE DOUBLE STARS OF THE DORPAT CATALOGUE.

BY S. W. BURNHAM.

The distinguished Russian astronomer, Struve, published in 1837 the results of a thorough examination of the heavens for the discovery of double stars between the north pole and 15° south declination. This great catalogue, *Mensuræ Micrometricæ*, included all the double stars within these limits known prior to the observations of Struve, mainly due to the researches of Sir William Herschel, and at the time of its publication presented all that was known on this subject of astronomy. The whole number of double stars catalogued and measured by Struve was about 3000. The superiority of the telescope used at Dorpat for this class of work, over the much larger reflectors employed by the Herschels, is repeatedly shown by the observations. Many of the Herschel pairs, observed with apertures from eighteen inches to four feet, were found by Struve with the 9.6-inch refractor to be really triple, one of the components being a close pair. When Sturve's great work was published, it seemed as though there was little left for subsequent observers to do except in the way of re-observing the Struve stars. So complete and systematic had been his scrutiny of the northern heavens, it was considered that new discoveries among the stars found by Struve to be single would necessarily be of rare occurrence, and particularly after the publication, in 1850, of the Pulkowa Catalogue of 500 stars, which comprised omitted stars and later discoveries, principally by Otto Struve, the successor of his father as Director of the new Imperial Observatory. This last mentioned catalogue was much more interesting, with respect to the class of stars it contained, than the other. The Pulkowa 15-inch refractor was in every respect superior to the Dorpat glass, as well as larger. Substantially all the wide and comparatively easy pairs had been collected in *Mensuræ Micrometricæ*, so that later discoveries were necessarily either very close pairs, or the components were very unequal, and, therefore, this catalogue furnishes a much larger proportion of binary and other interesting systems. In the twenty-five years following this epoch, the whole number of double star discoveries by all observers would not exceed fifty; but many important series of measures of the Struve stars were made by English, German and Italian astronomers, and this work was steadily continued at Pulkowa, resulting in showing the periods and motions of many of the more rapid binary systems, and the relations of other double stars.

That these catalogues were really very incomplete, with reference to the number of double stars actually existing, is apparent from the fact that the writer in the last ten years has discovered at least 900 new pairs, and more than half of them with a telescope greatly inferior in size to the smallest of the instruments used by the Russian astronomers. That there was left much that was new to discover in the Struve stars will appear from the number which have been again divided by later observers. In some instances, doubtless, the close pair was missed by Struve because it was single or much closer at that time, but certainly in the great majority of instances this is improbable, and the true explanation will probably be found in the improved defining power of the later refracting telescopes. For double star work more than any other, perfect definition is of the first importance. Something may be done in observing the moon, planets, nebulæ, etc., with a large instrument of poor definition, but for the discovery or measurement of close and difficult double stars it is practically useless. It should be mentioned as a fact that every star in the following table was discovered with a refracting telescope.

The following list comprises all the stars of the Dorpat Catalogue where a closer component has been discovered since the observations of Struve. More than half of these

No.	Σ	Star.	Struve's Pair.	New Comparion.	Discoverer.
1..	17	....	27″.06	2″.04	Burnham
2..	26	.....	13 .29	0 .60	O. Struve
3..	39	.....	19 .90	0 .40	Dembowski
4..	157	.....	12 .40	0 .85	Burnham
5..	171	.....	29 .69	3 .69	Burnham
6..	205	γ Andromedæ.	10 .33	0 .50	O. Struve
7..	258	.....	70 .30	1 .20	Burnham
8..	318	20 Persei.....	14 .04	0 .34	Burnham
9..	366	.....	48 .97	1 .99	Burnham
10..	439	.....	23 .70	0 .40	Burnham
11..	610	7 Camelopardi	25 .64	1 .24	Dembowski
12..	668	β Orionis.....	9 .14	0 .2?	Burnham
13..	692	Orionis S2	34 .86	0 .48	Burnham
14..	707	.....	27 .77	1 .11	Burnham
15..	721	.....	24 .32	0 .46	Burnham
16..	808	.....	16 .06	2 .60	Dembowski
17..	888	.....	2 .83	0 .27	Burnham
18..	1019	Canis Maj. 136	37 .84	6 .12	Dembowski
19..	1026	Canis Maj. 139	17 .85	0 .48	Burnham
20..	1057	.....	15 .87	0 .69	Burnham
21..	1097	.....	29 .34	5 .93	Dembowski
22..	1179	.....	19 .75	3 .76	Burnham
23..	1481	.....	20 .20	0 .80	Burnham
24..	1516	.....	7 .90	7 .61	O. Struve
25..	1780	86 Virginis (AC)	26 .94	1 .61	(AB) Burnham
				1 .72	(CD) Burnham
26..	1812	.....	14 .02	0 .47	O. Struve
27..	2005	Libræ 213	28 .54	1 .47	(AB) Burnham
28..	2214	.....	19 .49	1 .43	Dembowski
29..	2220	μ Herculis....	31 .09	0 .96	Alvan Clark
30..	2287	.....	22 .33	1 .71	Burnham
31..	2306	.....	12 .81	0 .95	Dembowski
32..	2342	.....	28 .80	8 .86	Burnham
33..	2435	(AC)	10 .73	1 .43	(AB) Burnham
				2 .90	(CD) Howe
34..	2479	Cygni 4	6 .72	0 .57	Dembowski
35..	2481	.....	4 .03	0 .40	Secchi
36..	2535	.....	26 .31	1 .22	Dembowski
37..	2538	.....	52 .81	4 .37	Burnham
38..	2539	.....	5 .60	4 .78	Burnham
39..	2549	....	22 .86	1 .93	Burnham
40..	2570	.....	4 .16	0 .29	A. G. Clark
41..	2589	ζ Sagittæ.....	8 .77	0 .25	A. G. Clark
42..	2607	Cygni 116....	3 .23	0 .3	O. Struve
43..	2630	(AD)	11 .30	6 .47	(AB) Burnham
				7 .75	(AC) Burnham
44..	2657	.....	11 .71	0 .60	O. Struve
45..	2690	.....	14 .88	0 .56	Dawes
46..	2704	β Delphini....	35 .06	0 .20	Burnham
47..	2777	δ Equulei....	37 .98	0 .35	O. Struve
48..	2793	.....	26 .51	0 .56	Burnham
49..	2815	.....	7 .50	0 .90	Dembowski
50..	2824	κ Pegasi.....	11 .76	0 .27	Burnham
51..	2959	.....	13 .77	8 .31	Burnham
52..	2966	.....	30 .72	0 .41	O. Struve
53..	3130	....	2 .86	0 .3?	O. Struve

stars have been discovered within the last eight years, and it is very probable that many new additions will be made as the large refractors now in use engage in this work. This list would be much extended by including stars to which more distant companions have been detected, but most, if not all of them, are too distant to make any physical relation probable, and are of very little interest. The first column gives a number for reference; the second column, Struve's number; the third, the name of the principal star, when found in Flamsteed or Bode; the fourth, the distance of the stars recorded by Struve; the fifth, the distance of the new star; and sixth, the name of the discoverer.

Many of the close pairs are known to be binaries, and in some cases it is probable the three stars form one system. When any change has occurred, the most recent measures of distance are given.

ASTRONOMY.

SWIFT'S COMET.

A new determination of the orbit of Swift's periodic comet has just been made by Mr. Winslow Upton of the U. S. Naval Observatory, based upon observations made at Washington, October 25, November 23, and December 22, 1880. No assumption was made with regard to the period of resolution or the eccentricity. The following are the elements obtained, and communicated to the *Astronomische Nachrichten:*

Epoch, 1880, Oct. 25. 5 Washington mean time.

M	357° 48′ 49.3″	
☊	296 41 55.4	1880.0
ω	106 18 13.8	1880.0
i	5 31 3.5	1880.0
φ	42 31 39.7	
log *a*	0.518438	
μ	592.0373″	

The period obtained from these elements is 2189 days, which confirms the fact already announced by Mr. Chandler and others that the comet has made two revolutions since its appearance in 1869. The period obtained is also nearly identical with that given by Prof. Frisby in "SCIENCE," which he derived from observations separated by intervals of only 13 days. The comet could not have been seen at its return in 1875, as the sun was between it and the earth, and it is probable that its next return in 1886 will be unobserved for the same reason, though a careful computation which shall take into account the perturbations of the comet due to the action of the planets will be necessary to determine the question.

Professor E. S. Holden, of the Naval Observatory at Washington, has accepted the managership of the Washburn Observatory in Madison, Wis., the position made vacant by the recent death of Professor Watson. Professor Holden will enter upon his duties in a few weeks.

ASTRONOMICAL MEMORANDA:— (Approximately computed for Washington, D. C., Monday, January 24, 1881.)

Sidereal time of Mean Noon. 20h. 16m. 37s.
Equation of time..... 12 29

mean noon *preceding* apparent noon.

The *Sun*, having passed the winter solstice, has reached a declination of 19° 3′ south.

The *Moon* reached its Last Quarter on Jan. 22d 16h., or 4 A. M. of Jan. 23.

New Moon comes on Jan. 29d. 8h., and the First Quarter on Feb. 5d. 8h. On the morning of the 24th the Moon crosses the meridian at about a quarter of seven.

Mercury, still invisible, comes into superior conjunction with the sun on the 26th, passes to his eastern side, and becomes evening star. Mercury is in conjunction with the Moon on the morning of Jan. 30.

Venus is evening star, and throughout the month increases her distance from the sun as she approaches the earth. She follows the sun by nearly three hours and is 3° south of the equator.

Mars is morning star, rising about six o'clock, and slowly traveling away from the sun.

Jupiter, evening star, crosses the meridian about half past four:—R. A. oh. 53m., Dec. 4° 21′ north.

Saturn also is evening star, having reached quadrature, or halfway from opposition to conjunction, on the 12th, when he was on the meridian at six. Saturn and Jupiter, it will be noticed, are still steadily approaching each other.

Uranus crosses the meridian at about 3 o'clock in the morning, at a declination of 7° 21′ north, and cannot claim any especial attention at present.

Neptune is in R. A. 2h. 39m; Dec. 13° 36′ north. It reaches quadrature on the 30th, and will be found in conjunction with the Moon on—Feb. 4th.

IN the *Popular Science Monthly* for January, 1881, Dr. Leonard Waldo gives an interesting description of the method employed at the Yale Observatory, for comparing with the standards of that institution, thermometers which have been sent there for verification by physicians, instrument makers and others. He calls attention to the fact that thermometers, even if from makers of established reputation, are liable to errors much greater than is commonly supposed, and he points out the necessity of having such errors carefully determined.

WE learn from the *Comptes Rendus* that Janssen has made preparations at Meudon to repeat Dr. Draper's experiments on the photography of the Nebula in Orion, and that for this purpose he proposes to construct upon a large scale a telescope of short focus quite similar to the one with which he obtained a very luminous spectrum of the Corona, in 1871. Janssen has also made some experiments in photographing the chromosphere. The exposure is continued so long that the solar image becomes positive to the very circumference, without going beyond it. The chromosphere is then shown in the form of a dark ring with a thickness of 8″ or 10″. He has compared positive and negative solar photographs taken on the same day and with the same instrument, and the measurement of the diameter shows that the dark ring in question is wholly outside of the solar disk.

DR. WARREN DE LA RUE has been elected a corresponding member of the Paris Academy of Sciences in the section of Astronomy, and M. Sella a corresponding member in the section of Mineralogy.

THE Rumford medal of the Royal Society has been awarded to Dr. William Huggins for his work on celestial spectroscopy, and the Copley medal to Prof. J. J. Sylvester of Johns Hopkins University for researches in pure mathematics. W. C. W.

ECLIPSE OF THE SUN.

To the Editor of "SCIENCE:"

I would like to add a sentence to the fourth paragraph of my letter in last week's "SCIENCE" giving my observations of the recent partial eclipse of the sun. After the words "solar limb" I would add, "on the eastern side of the sun the phenomenon was considerably less prominent and only visible at the time of greatest obscuration, and when the slit was quite close to the sun's limb."

L. TROUVELOT.

CAMBRIDGE, January 12, 1881.