NOTES FROM PACIFIC COAST OBSERVATORIES.

The change in the heading of this department of the *Publications* has been under consideration for some time. The substitution of the broader title "Notes from Pacific Coast Observatories" for the "Notices from the Lick Observatory" does not mean that there has been the least change in the intimate and cordial relations that have existed between the Lick Observatory and the Astronomical Society of the Pacific from the time of the Society's inception. It is rather a recognition of the steadily increasing importance of the Pacific Coast as an astronomical center, of which the recent founding of the great Solar Observatory of the Carnegie Institution at Mt. Wilson is substantial evidence; and it is in harmony with the policy of the Directors to make the Society what its name—the Astronomical Society of the Pacific—indicates, representative of the astronomical interests of the entire Pacific Coast.

Notes relating to the observatories west of the Rocky Mountains or to the work of astronomers in this section of the country will be printed in this department. These notes will be signed, and the author will in every case be responsible for the statements made. Notes relating to astronomical work elsewhere, items of interest taken from other periodicals, reviews of astronomical publications, etc., will be printed under the heading "General Notes." These notes may or may not be signed, the Editors accepting full responsibility for those unsigned. Longer articles will, as heretofore, precede these departments.

The co-operation of all members of the Society—and especially of those connected with observatories on the Pacific Coast—in sustaining and increasing the value and interest of the *Publications* is cordially invited.

The Committee on Publication.

An Electric Lighting, Power, and Pumping Plant for the Lick Observatory.

The Observatory has always been behind the times in the matter of an adequate supply of electric current. The plans for the institution were made in the late seventies and carried out in the early eighties, before it was known what electricity would do, or that it would become a necessity, and an electric plant was not included in the installation. Partly to remedy this defect, the Edison Electric Company presented a three-horse-power plant to the Observatory in 1892. It included a steam-engine and boiler, a one-kilowatt generator, and a small storage battery. This has been indispensable in the scientific work, and for many years has been drawn upon every clear night, on many occasions at a dozen different points in the observing-rooms. However, the capacity of the plant has long since been outgrown, even for exclusively scientific purposes. The work frequently suffers, both in quantity and quality, from the shortage in the supply of current. Facts bearing upon this and other points are brought out in the following paragraphs.

The Crossley dome, set up on Mt. Hamilton in 1895, moves unduly hard, and its operation is a serious tax upon the physical strength of the observers. This dome should be operated by means of an electric motor. The winding of the clock which propels the Crossley reflector has also been a wasteful tax upon the observers' strength, and this work should be done by electric power. Current is needed to illuminate the circles and the guiding mechanism of the telescope and for various other minor purposes in the dome.

The 75-foot steel dome covering the 36-inch refractor is operated by a triple hydraulic engine. This system is only fairly satisfactory, in that the speed of the dome is too slow, the engine requires very frequent attention to keep it in adjustment, and every few years demands a general overhauling. Electric motive power would save valuable time and be more economical in maintenance. The automatic winding device for the driving-clock of this telescope is operated by the same hydraulic system. This device has been in use for two years, and has been very valuable. Nevertheless, it has required frequent attention and repair, due to the fact that the automatic opening and closing of the water-valve is a violent operation.

A satisfactory system can not be installed until electricity is available for power.

The quantity of current which can be drawn upon to maintain the spectroscopes at a constant temperature is entirely too small, and the efficiency of the work suffers in consequence. When the temperature in the great dome falls rapidly, the spectroscopic work must stop for the time, and the enforced idleness of the telescope is uneconomical.

The photometric observations of stars demand a current of constant intensity. This is not practicable with the present small supply.

Current is needed in various other parts of the main building, in the Crocker dome, and elsewhere, for scientific purposes; but it is not at present available.

The Observatory buildings, including all the residences, are illuminated by kerosene lamps. This system is unsatisfactory for many reasons. The work demanded of the janitor and others to fill the lamps and keep them in order is a serious tax. More important still is the element of danger from fire. Our fire risks are unusually great, on account of the general use of lamps and matches, of the proximity of the buildings to each other, and of the prevalence of high winds. The subject is on my mind literally from week to week, and every precaution to guard against the danger is taken; but the greatest source of danger should be removed by the substitution of electric illumination.

Small power plants have been installed here and there to perform our heavy work as required, and they are of various kinds. For example, the water used for domestic and photographic purposes is pumped from the spring into the distributing reservoirs by means of steam generated with wood fuel. For many reasons this work should be done by electric power generated at a central station. Another complete system of waterworks, which supplies power for moving the great dome and its floor, is operated by wind power. This system is satisfactory as to the moving floor, except in the months when there is little wind. During these months the supply in the distributing reservoirs is low, and nearly every fall is entirely exhausted. The result is that work with the great telescope sometimes practically ceases for a week or more in the best season of the year, and—what is far more serious—when the reservoirs are empty, the Observatory is without adequate fire protection. A pump operated by electric current from a central plant should be installed at once, and be ready to lift water to the distributing reservoirs when the wind fails.

Fuel for the Observatory is purchased in the form of four-foot wood from the neighboring ranchers, who cannot be prevailed upon to supply it in shorter lengths. The Observatory workmen cut the wood into the desired lengths by means of a buzz-saw operated by a separate steam plant.

The machine tools in the instrument-making and carpenter shops are operated by a gasoline engine. Small pieces of work are occasionally performed by means of the current leading directly from the present little generator. At least a dozen small primary batteries are maintained at various points to supply special needs.

The drinking-water system, obtaining its supply from the spring, is of sufficient capacity in ordinary years, provided great care is exercised to avoid all leaks in the pipes; but in years of small rainfall the supply is inadequate. On three occasions in recent years the shortage of rainfall made it necessary for us to reduce to the lowest limits the quantity which could be used for domestic and photographic purposes.

A perfectly practicable method exists for increasing the present supply several fold. One of the largest springs in this vicinity is located on the south slope of the peak which carries the storage reservoirs for drinking-water, at a level 680 feet lower than that of the reservoir, and at a distance of only 1,400 feet down the slope. A responsible pump manufacturer guarantees that an automatic pump, located at a point two hundred feet in level below the spring, will be able to lift one seventh of the total flow up to the reservoirs, the remaining six sevenths being required to operate the pump. Last year the flow in June was approximately fifty thousand gallons per day, and in July thirty-six thousand a day. The daily flow at the end of the last dry season, which was of unusual length, placed it at eighteen thousand gallons. If one seventh of these amounts can be placed in the distributing reservoirs, the necessary demand of the Observatory will be fully met, as the average daily consumption heretofore has been less than two thousand gallons.

With the spring upon which we depend at present held in reserve, there would be little doubt that a considerable surplus of available water would exist, even in years of low rainfall. Should this prove to be the case, plans would be instituted to cover the bare slopes immediately surrounding the Observatory with forest trees. An attempt to develop shade-trees in the early years of the Observatory failed because they could not be irrigated during the dry season. This question is of considerable importance from the scientific point of view. There is little doubt that our atmospheric conditions for observational work, already excellent, would be still better if shade-trees covered the ground. They would prevent the excessive heating in the daytime of the rock and soil surrounding the Observatory, and the consequent rapid radiation of heat in the evening.

It requires no argument to establish that our heterogeneous systems for supplying power and illumination should be replaced by a simple and central electric plant, operated by a gasoline engine. The officers of the General Electric Company have most generously examined into all the above-mentioned requirements and have drawn up plans to meet them, making no charge for the expert services of their engineers. The subject was brought to the attention of the University of California authorities, who petitioned the Governor and the Legislature of the State to make a special appropriation of ten thousand dollars for the expense of installation. This appropriation was generously made at the recent session and the construction will begin at once.

W. W. Campbell.

March, 1905.

Note on the Orbit of Comet *e* 1904.

In an address on "The General Applicability of the Short Method of Determining Orbits from Three Observations," delivered before the Astrometry Section of the International Congress of Arts and Science at St. Louis in September of last year, a criterion was given which makes it possible to decide in the case of a newly discovered planet or comet the limits within which the elements may lie. Comet *e* 1904 (Borrelly) having been found to be periodic by Aitken and others from longer arcs, the criterion has been applied to the short arc of one-day intervals of the first three observations secured by Dr. AITKEN at Mt. Hamilton, in order to decide whether the period could be approximately determined from these first three observations, and it was found that the period in this case is indeterminate. A parabola will satisfy the first three observations, and a number of practical solutions exist. The indeterminateness is due to the nature of the problem, and not to the method used. A. O. LEUSCHNER.

BERKELEY ASTRONOMICAL DEPARTMENT.

LICK OBSERVATORY LECTURES BEFORE THE CLASS IN MODERN ASTRONOMY, UNIVERSITY OF CALIFORNIA.

Director CAMPBELL has announced the following dates and subjects for the annual Lick Observatory lectures to be delivered this spring before the class in Modern Astronomy:—

By Director W. W. CAMPBELL:

1. Tuesday, March 21, 11 A.M.—"Current Eclipse Problems."
2. Saturday, March 25, 9 A.M.—"Current Eclipse Problems," continued.

By Astronomer W. J. HUSSEY:

3. Tuesday, March 28, 11 A.M.—"Present State of Double-Star Astronomy."
4. Thursday, March 30, 11 A.M.—"Concerning Nebulæ and Clusters."

By Assistant Astronomer C. D. PERRINE:

5. Tuesday, April 11, 11 A.M.—"The New Satellites of *Jupiter*."
6. Thursday, April 13, 11 A.M.—"The Solar Parallax from *Eros* Observations."

Dr. TOWNLEY, of the International Latitude Observatory at Ukiah, will follow with two lectures on "Variable Stars." The lectures will be delivered in the lecture-room of the Students' Observatory, and will be open to the public.

A. O. LEUSCHNER.

BERKELEY ASTRONOMICAL DEPARTMENT.

THE SIXTH SATELLITE OF *JUPITER*.

Owing to its brightness, the sixth satellite has been photographed readily in ten minutes with the Crossley reflector. Plates have been obtained on thirty-six nights, the last observation being on March 22d. The planet is now too near the Sun for the satellite to be observed.

A preliminary investigation of the orbit shows the inclination to the ecliptic and the planet's equator to be about 30°. It has a period of about two hundred and fifty days, its mean distance being about seven million miles.

It is not possible to say yet with certainty what the direction of its orbital motion is.

The large inclination of the orbits of both the sixth and seventh satellites to the plane of the planet's equator suggests that these bodies have not always belonged to *Jupiter*, but that they may be captures.

The actual diameter of these satellites can not be measured, but the brightness indicates a diameter for the sixth of one hundred miles or less.

C. D. PERRINE.

1905, March 30.

THE SEVENTH SATELLITE OF *JUPITER*.

An examination of negatives of the sixth satellite taken with the Crossley reflector on January 2d, 3d, and 4th, showed a much fainter object which apparently belong to *Jupiter*. It was then north and west of *Jupiter*, and its motion was toward the planet. The difficulties which presented themselves in determining the true character of the sixth satellite were greater in the case of the new one. Being so much fainter, observations were much more difficult to secure, owing to the long exposures required. Its motion was likewise harder to interpret. However, observations on February 21st and 22d made it clear that it belonged to *Jupiter*.

The seventh satellite is not shown on the negatives of December, it being just outside those fields.

Observations have been secured on twenty nights, the last being on March 9th.

A preliminary investigation of its orbit shows it to be quite eccentric, the mean distance from *Jupiter* being about six million miles, with a period of about two hundred days. Its orbit is inclined to the plane of *Jupiter's* equator, at an angle of about 30°. The direction of motion is as yet uncertain.

Its photographic magnitude is estimated to be not brighter than the sixteenth. In comparison with the other satellites and the asteroids this indicates a diameter of about thirty-five miles.

C. D. PERRINE.

1905, March 30.

COMET *a* 1905.

The first comet of the present year has just been discovered by M. GIACOBINI at Nice. According to the telegram received here on Monday, March 27th, the date and position of discovery are as follows: March 26.3212, G. M. T., R. A. $5^h\ 44^m\ 14^s.0$; Decl. $+10°\ 56'\ 56''$.

An observation secured here with the 12-inch telescope on Monday evening gave the position, March 27.6692, G. M. T., R. A. $5^h\ 48^m\ 54^s.85$; Decl. $+12°\ 35'\ 42''.9$.

The comet is small and faint, even when viewed through the 12-inch telescope.

R. G. AITKEN.

March 28, 1905.

NOTE ON THE WORK OF THE D. O. MILLS EXPEDITION TO CHILE.

A recent letter from Professor WRIGHT, in charge of the D. O. Mills Expedition to Chile, informs me that the work of measuring the radial motions of the stars proceeds substantially in accordance with the original programme. The southern winter was an unusually wet and stormy one, but the late spring and early summer (to date) were unusually favorable. As by-products of the investigation Professor WRIGHT reports that he and Dr. PALMER have discovered seventeen spectroscopic binary stellar systems. A recent press dispatch from Santiago, published in the papers of this country, refers to the discovery of twenty new stars. This is a palpable error, and the number undoubtedly refers to the spectroscopic binary systems discovered up to a date considerably later than that of the letter spoken of above.

W. W. CAMPBELL.

St. Louis Exposition Awards for the Lick Observatory Exhibit.

In accordance with the decision of the University of California authorities to make an exhibit at the St. Louis Universal Exposition of 1904, the Lick Observatory prepared an extensive collection of transparency views of the buildings and surroundings, of the instruments, and especially of the principal celestial objects and their spectra, together with a complete set of our publications, to form a section of the University exhibit. Unofficial information reached me in November that the departmental juries awarded two grand prizes to the Lick Observatory,—one for the exhibit as a whole, and one for the photographic exhibit. Official confirmation of the awards was received late in March.

W. W. Campbell.

The establishing of the Solar Observatory of the Carnegie Institution on Mt. Wilson, California, is an event which gives great pleasure to the members of the Lick Observatory staff. Although the Lick Observatory and the Solar Observatory are separated by four hundred and fifty miles of railroad, twenty-seven miles of stage-road on Mt. Hamilton, and eight miles of trail on Mt. Wilson, yet the two institutions are neighbors in comparison with the distance that separates us from the Central and Atlantic States. We wish complete success to our neighbor's plans. And may the interchange of neighborly courtesies be numerous and helpful to both institutions.

W. W. Campbell.

The members of the Lick Observatory staff have learned with deep regret that Mr. Edward Crossley, the donor of the Crossley reflector, died at Halifax, England, on January 21st. His name is a household word on Mt. Hamilton. Scarcely a day passes that it is not spoken in connection with the work of the Crossley reflecting telescope. The direct results secured with this telescope on Mt. Hamilton indicate only in part the high value of Mr. Crossley's gift; it is not too much to say that Professor Keeler's work established for the first time the splendid efficiency of reflecting telescopes in many branches of astronomical photography, whereupon the possession of powerful reflectors became the ambition of astrophysical observers.

W. W. Campbell.

Measurement of Photographic Plates at the Students' Observatory.

Something less than a year ago an instrument for the accurate measurement of photographic plates was received from the makers, Repsold Sons, of Hamburg, Germany. It is of a type which is generally conceded to give the highest accuracy possible in work of this character at something of a sacrifice in the way of speed of manipulation. Much time has been spent investigating the various adjustments of the instrument, the straightness of the bars, scale errors, errors of micrometer-screws, etc., which investigations are a necessary preliminary to the attainment of results of a degree of accuracy which the instrument is capable of giving. In the mean time, over seventy-five plates have been made with two portrait-lenses temporarily attached to the new mounting described by Dr. Gillihan in *Publications of the Astronomical Society of the Pacific* (Vol. XVI, p. 89). Most of these were made with a view to determining the position of some of the Watson asteroids, the orbits of which are now under investigation at this observatory. Measurements have already been made on some of these plates, and others will be measured in time to utilize the results in the final correction of the elements of the asteroids.

Burt L. Newkirk.
Berkeley Astronomical Department.

Tables for the Reduction of Photographic Plates Made with Lenses of Wide Angle.

In connection with the work of the measurement and reduction of the photographic plates made with two portrait-lenses at the Students' Observatory, it has seemed advisable to construct certain numerical tables to simplify the reduction. Three tables, with the help of which the transformation from standard rectangular coordinates to $\alpha - \alpha_0$ and $\delta - \delta_0$ and the converse transformation are to be effected, are at present in course of construction. The tables are to be of such an extent as to be applicable to all stars on a plate covering 10° of Declination and 20° of Right Ascension, and will give results accurate to about 0".01 for stars within 1° of the center, and to about 0".1 for stars farther from the center. These tables can of course be used in reducing measures made on a plate taken with any photographic telescope.

Another series of tables is to be constructed to facilitate the introduction of corrections for refraction and other corrections which are troublesome in reducing measures made on plates covering large areas of the sky.

The formulæ taken as the basis of these tables are those given by Professor TURNER, but the refraction-table will give all of the differential refraction so that the four-constant solution for the plate constants which is recommended by Professor JACOBY may be employed if desired.

BURT L. NEWKIRK.
BERKELEY ASTRONOMICAL DEPARTMENT.

NOTE ON A CORRECTION TO THE SECOND EDITION OF SCHÖNFELD AND KREUGER'S "ATLAS DES NÖRDLICHEN GESTIRNTEN HIMMELS."

Upon comparing two photographic plates taken at the Students' Observatory the night of 1905, March 7, with this map, a star of about 8.5 magnitude contained upon the map in $\alpha = 11^h\ 14^m.1$ and $\delta = +11^\circ\ 25'$ was found missing on the plates. Reference was then made to the Durchmusterung positions, and no star was found having these coordinates, showing the Atlas position to be an error.

RUSSELL TRACY CRAWFORD.
BERKELEY ASTRONOMICAL DEPARTMENT.

THE VARIABLE RADIAL VELOCITY OF *SIRIUS*, AND THE INCLINATION OF ITS ORBIT-PLANE.

The determination of a double-star orbit from micrometer observations of the primary star and its companion leaves an ambiguity as to the inclination of the orbit-plane to the line of sight. There are two positions of the orbit-plane which satisfy the observations equally well. At any given instant the companion may lie beyond the primary or at an equal distance this side of the primary. The orbital motion of the companion may be carrying it either further from the observer or nearer to him. The observations do not permit us to decide which of the two positions is the correct one.

If the two stars are also observable accurately by means of a spectrograph for motion in the line of sight, a comparison of their speeds toward or from the observer will remove the ambi-