Popular Astronomy.

Vol. XXXV, No. 1 JANUARY, 1927 Whole No. 341

ELGIN OBSERVATORY.

By W. W. PAYNE.

[*This paper, aside from its intrinsic value, will have special interest because of its authorship for those who have been acquainted with this magazine for eighteen years or more. Those who have become readers of it more recently will be interested to learn that the writer of this paper is the person who founded the magazine, "Popular Astronomy," and who carried the responsibility of its management through the first eighteen volumes. We have in these pages an account of some of the things he has accomplished since he retired from the editorship of "Popular Astronomy," the directorship of Goodsell Observatory, and a professorship of mathematics and astronomy in Carleton College in 1908. At the time of his promotion from the position of Director of the Elgin Observatory to that of Director Emeritus, on November 1, the editors requested him to prepare an account of the founding and development of the Elgin Observatory. This request was promptly and graciously acceded to by him. We are greatly pleased to have this contribution from him in his ninetieth year as the opening paper of Volume XXXV of his magazine.*—EDITORS.]

In the year 1909, the month of May, the Elgin National Watch Company employed me to assist in planning and building an astronomical Observatory, for the purpose of getting, keeping, and signaling to the Watch Factory correct Central Standard Time. The use of such time continuously is much needed, in testing and regulating the thousands of watches that are made daily at the Factory.

To build an astronomical Observatory, the Watch Company needed someone of experience in astronomical work, to assist in choosing a proper site, to approve details of the building, and to secure needed astronomical instruments for its equipment. After conference with the General Superintendent, George E. Hunter, at the time above mentioned, I was employed for one year to give this desired assistance. Mr. George Hunter, an architect, father of Supt. Hunter, was given the task of making the plan for the new Observatory, and it was made my duty to report to him.

The choice of a proper place for the Observatory was soon made. It was located a short distance from the Factory, on high ground of deep, gravel formation, the very best for bases for the piers for the Telescope

KEY TO PLATE

1	Jones	14	Miss Slocum	26	Butler	38	Mrs. Elmer	51	Mrs. Dunham	63	Turner
2	Elmer	15	Miss Walton	27	Mrs. Duncan	39	Yalden	52	Jordan	64	Schlesinger
3	Mrs. Shapley	16	Irvin	28	Mowry	40	Godfrey	53	Dunham	65	Mrs. Boss
4	Miss Gill	17	Brown	29	Hertzsprung	41	Schilt	54	Boss	67	Bailey
5	Miss Fairfield	18	Slocum	30	Clement	42	Agassiz	55	Mrs. Morris	68	Miss Clough
6	Cunningham	19	Allen	31	Miss Young	43	Miss Burton	56	Kearons	69	Mrs. Craig
7	Henry	20	Duncan	32	King	44	Olcott	57	Miss Harwood	70	Daghlian
8	Miss Cushman	21	Potter	33	Miss Farnsworth	45	Mrs. Holmes	58	Miss Cannon	71	Fisher
9	Waterfield	22	Miss Woods	34	Currier	46	Shapley	59	Stetson	72	Campbell
10	Davidovitch	23	Prentice	35	Whitehorn	47	Mrs. Olcott	60	Rowley	73	Pickering
11	Miss Roper	24	Tarwater	36	Reardon	48	Dugan	61	Mrs. Kearons	74	Chisolm
13	Luyten	25	Miss Potter	37	Havard	50	Lutz	62	Miss Gushee		

PLATE I

Fifteenth Annual Meeting of the American Association of Variable Star Observers at Harvard College Observatory, October 23, 1926.

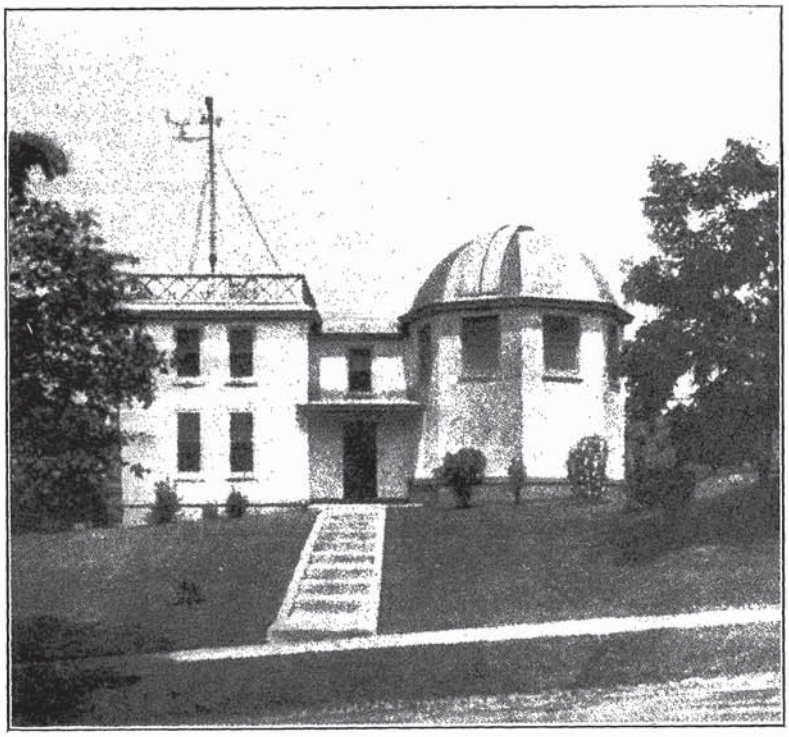
and for the astronomical clocks. The elevation of the site above the Fox river is 84.85 feet; above mean sea level it is 803.33 feet. This latter value was obtained by the city engineer, from a Government bench mark, in the city, to the zero point in the Barometer of the Observatory.

Before I came to Elgin the Watch Company had purchased and had in possession a three-inch Transit instrument by Warner and Swasey, Cleveland, O., and two fine astronomical clocks of the Riefler make in Germany. To test the site of the new Observatory still further, it was thought best to build a temporary house there, mount the Transit instrument in it and take star observations. After this was done two things occurred worthy of notice. One was the finding of the difference between the astronomical and the magnetic meridians. That was found to be about four degrees. The other was the occurrence of a very distinct earthquake that shook the Transit instrument visibly. This shock took place on Wednesday morning at 8:45, May 26, 1909.

Star observations in this temporary house were continued favorably, while the building of the new Observatory, near by, was going on. The latitude of the place was found easily; but to get its longitude would require telegraphic signals from Washington, or from some established Observatory with which time signals could be exchanged. After a thorough study of the condition of the Transit instrument, it was decided to secure the aid of Madison Observatory and the Postal Telegraph Co. for the longitude work desired. It took several weeks to complete all the details of it, in which Professor Comstock of Madison Observatory and the officers of the Postal Co. cordially and efficiently co-operated. Four nights of observation of nineteen stars, at Madison and Elgin, with exchange of telegraphic time signals, each night, were used in this part of the work. The nights of observation were September 23, 24, 25, and October 1, 1909. The instruments used at each place were Transits with object glasses three inches in diameter. The observers were Professors Comstock and Payne. The work of reducing the observations of the same stars, made at the different places was done independently by the persons named above. A careful comparison of the results obtained was made at Madison a few days later. The difference in longitude between Elgin and Madison found by Professor Comstock was $4^m\,32^s.21$. The result of the Elgin observations was $4^m\,32^s.22$. The result adopted was $4^m\,32^s.21$, because in the Madison work, for the four nights, the star results were in better agreement than were those made at Elgin. The longitude of Elgin is that much, in time, east of Madison. The position of the 3-inch Transit Instrument in Madison is 0.21 of a second, in time, east of the position of the Meridian Circle of the Observatory; so this small change was needed to connect our result with that of Madison Observatory, as published in the *American Ephemeris* for the year 1909. The position of the Elgin Observatory was found to be, in latitude 44° 1′ north; in longitude $5^h\,53^m\,5^s.30$ west from Greenwich. But, as true Central Standard Time was

wanted at the Elgin Observatory, a change from the local time was made to that kind of time. That made the time of the daily Radio time signals from Washington, at noon there, one hour early at the Elgin Observatory.

While this work was going on and for some time longer the new Observatory building was being constructed, the details of which were receiving careful attention by all interested. For example, it was decided that the octagonal part of the building, which was to contain the even temperature room for the standard, astronomical clocks, should



Elgin Observatory of the Elgin National Watch Company.

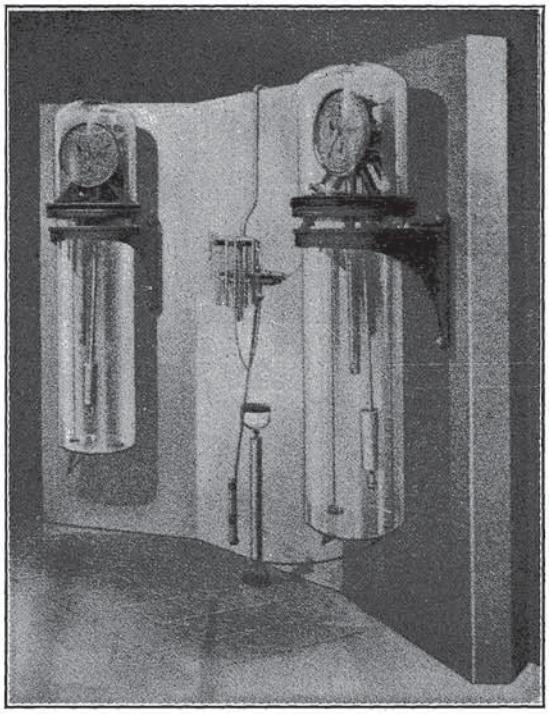
be made of four-inch hollow tile, laid in cement, four courses in thickness, separated from one another by tarred paper to prevent moisture and quick changes of temperature from outside.

The work of completing the Observatory building, the securing of the astronomical and the meteorological instruments and properly mounting them consumed more than one year. During this time, Frank D. Urie, who had done special work in astronomy, at the Detroit Observatory of Michigan University, in Ann Arbor, was appointed assistant to the Director of the Elgin Observatory. Among his duties were the important tasks of oversight of all the instruments and the making

of regular star observations for time. The reduction of these observations to secure the errors and the rates of the clocks from them, and to make needed adjustments of them were to be done by the Director.

In describing the Observatory building and the instruments, in detail, we wish to do it fully enough so that those who have not had experience in this kind of work may be aided, although it may seem to some astronomers to be needlessly full.

The building is unique in form, substantial in structure, attractive in appearance and is fire proof, in all essential parts for the protection

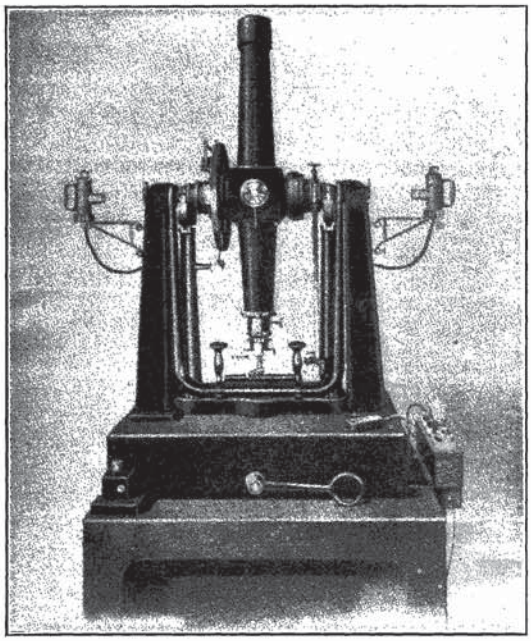


Riefler Astronomical Clocks and Thermoregulator in Constant Temperature Room.

of the instruments. The walls outside are smooth in cement finish and painted white. The roof, cornice, and dome are painted yellow. The dome is nearly a hemisphere in form, with an opening in the meridian three feet wide. It is covered by two steel shutters of about a half ton in weight; yet they are opened and closed so easily that a boy six years old has done it.

The east part of the building has the clock room below and the Transit room above. In the clock room are placed the sidereal and the mean time Riefler clocks mounted on a pier independent of the building. These precision, high grade, self-winding clocks are in air-tight

glass cases, which contain barometers, thermometers and hygrometers to measure the pressure, the temperature, and the moisture of the air inside the clock cases; for the motion of the pendulums is and must be controlled by these conditions to secure a steady rate for the clocks to keep correct time. The temperature of this clock room is kpt at 81 degrees quite steadily by the aid of a thermoregulator and a pair of Electro Magnetic Switches and 57 electric lights. The Thermoregulator controls a current of electricity that puts on and off 18 lights, as needed, to correct the small changes in temperature in the air of the room so that the same may not vary, at any time more than one tenth of a

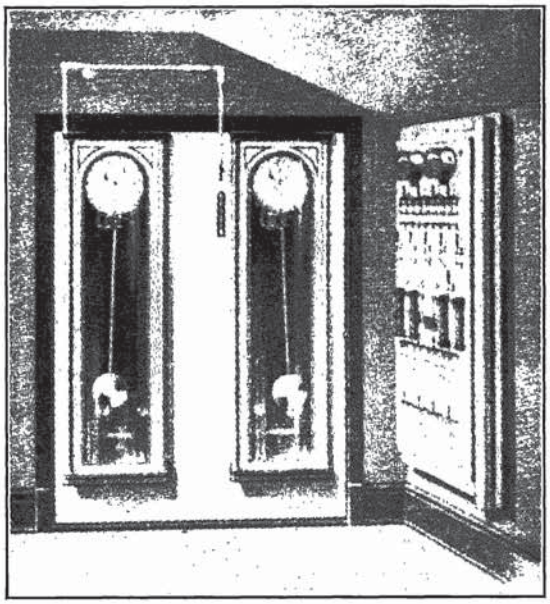


The Transit Instrument.

degree whatever may be the temperature outside. In the past the extreme heat, at one time, was 105 degrees; at another time, the temperature fell to 20 degrees below zero. During such severe tests the clock room remained quite steadily at 81 degrees.

The room above in this part of the building has the Transit Instrument with a three-inch object glass, made by Warner and Swasey of Cleveland, Ohio, at a cost of $1,000. In testing it thoroughly, it was found defective. Machine experts from the Factory were called to examine the pivots and the V's of the mounting. It was soon found that the pivots were unequal frustrums of cones, instead of being equal cylinders, and that the V's were unequal and not right angled as they should be. These errors were corrected, after many hours of work,

with tools made for this special purpose. The final measurement of the pivots showed that they varied in size only one two-thousandth of an inch. No further trouble was experienced in observation. The Transit room also contained a Level Tester, by which the observer could know the error of the observed time, by the change of one division of the level during the time of observation. It was found generally to be about one-tenth of a second of time. This Level Tester was made by the Gaertner Scientific Corporation of Chicago, at a cost of $75. This instrument and the Personal Equation Machine are not shown in the accompanying cuts.



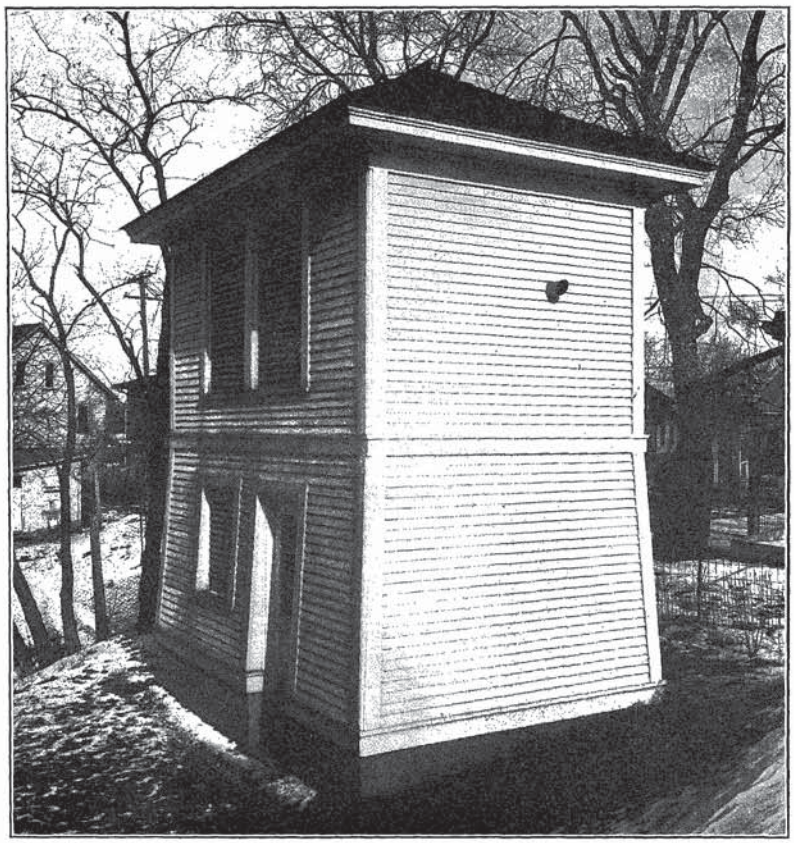
Riefler Astronomical Clocks and Switch Board.

The small room above between the east and west parts of the building contains two Rifler Clocks and Switch Board shown in cut herewith given. These clocks are hung on an independent, cement pier and have dust-tight, wooden cases, with pendulums adapted to open air and small changes of temperature.

When these clocks were put in place, near to each other, on the same pier, it was thought to be a good time to determine the question, whether or not, they would influence one another in any way. Both were set together on the same kind of time, and allowed to run, undisturbed, for several days. The result of this apparently careful test seemed to indicate that the clocks were influencing one another; for there was not any variation of time between them for the entire period. Later these clocks were set, one on star time and the other on standard

time, as intended for use in the Observatory when purchased. Then they did very well, as compared with the precision clocks, in the temperature room which are hung, at an angle, on the same pier.

There is also a Chronograph made by Warner & Swasey, Cleveland, Ohio. It is a very useful instrument for clock comparisons and for making the records of star observations. Also by it fine clocks may be tested, whether in beat or not, more exactly than by the eye and



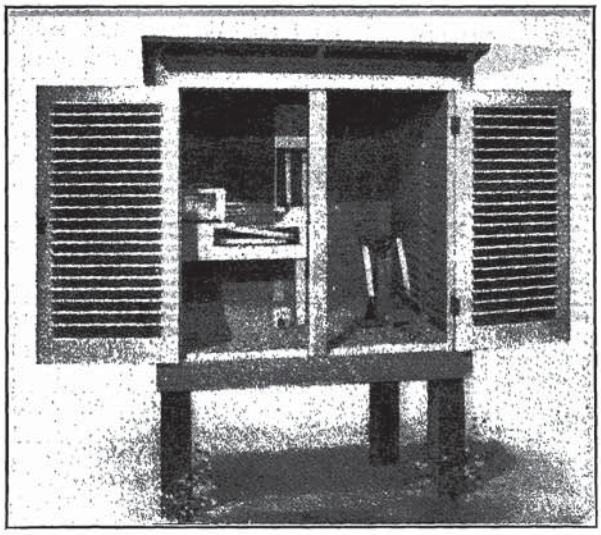
Mark House.

ear method, as formerly used. It is a surprisingly interesting fact, that Mr. Urie of the Elgin Observatory has been able to show, on the chronograph, that the Government clock, at Panama, was out of beat, by aid of the Radio, with other connected, electrical apparatus.

The Personal Equation Machine, made by M. E. Kahler of Washington, D. C., is one of the very useful instruments of the Observatory in getting exact star observations. It is an important fact, that every experienced observer knows, that he has a personal equation, that is

liable to change somewhat, on account of his variable physical condition. Hence it is necessary that his personal equation should be tested at the time star observations are made, if the most accurate results in time are to be secured.

The Meridian Mark is placed in a building, one hundred feet north of the Observatory, and is shown in the accompanying cut. The Mark is made like the apparent star in the Personal Equation Machine. It consists of a thin plate of metal, with a smooth round hole through it, one three-thousandths of an inch in diameter. Behind this hole is placed an electric light to shine through it, to form the apparent star desired. In front of this apparent star, at its focal length, is placed a three-inch object glass. When the Transit Instrument in the Observatory is turned



Thermometer Cage.

into line with the object glass and the apparent star in the meridian, a fine star of the second magnitude is seen in the Transit Instrument; at once showing the observer whether his telescope is in the meridian or not; which he wishes to know before the work of star observation begins.

The Observatory has a complete set of meteorological instruments, except those for recording the tremors of earthquakes. A cut shows the thermometer cage which is placed fifteen feet north of the Observatory building. This distance is needed to prevent the heat of the building from disturbing the temperature of the thermometers in it. The cage is painted white so that sunlight may not disturb the instruments. Any other color would influence them. There are five thermometers shown in the cut, of the best quality of the Green make, tested for uniform calibration throughout. The two placed nearly

horizontal are the self-recording, maximum and minimum thermometers. These are set daily, at true temperature, at a given time, and they then give the highest, the lowest and the mean temperature during the next twenty-four hours. The two thermometers at the right are so mounted that the dry bulb of one and the wet bulb of the other, may be used to find their difference in temperature, by which the amount of moisture in the atmosphere may be determined. When the per cent in amount nears one hundred, rain or snow is probable, if the barometer reading is also favorable. This instrument is named the Psychrometer. The other thermometer is used for ready test comparisons of other thermometers asked by persons outside.

On the roof of the building are seen dimly, the wind vane, the anemometer, the rain gauge, and the sunshine instrument. The anemometer measures the wind velocity; the rain gauge, by the aid of tipping buckets, measures the rainfall to the hundredth of an inch; and the sunshine instrument, by the use of air and mercury in glass tubes, makes a record of sunshine that is steady or that which is interrupted by clouds. All these instruments have electrical connection with a Quadruplex Recorder in the office of the Director in the room below. The clock, in this Recorder, runs a prepared paper sheet, on a cylinder, on which is recorded, in time, electrically and independently the wind velocity, wind direction, the sunshine and the rainfall.

When it was known to the officers, at the head of the Department of Agriculture in Washington and Springfield that the Elgin Observatory was prepared to make meteorological observations, they requested that our daily observations be sent to them regularly. This we agreed to do, provided a government officer would examine our meteorological instruments regularly, as is done for all Government offices. By this examination and other important aid to the service freely given by these officers, our observations have been spoken of as first class for cooperative observers.

The wiring of the Observatory building for the service needed for all the instruments is very complete and easily handled through a fine Switch Board, shown in the cut of the upper clock room. The electric wires connecting the Observatory with the Factory, for the constant time signals, and for light and telephone service are laid under ground and always have given most reliable service.

The time of the Observatory is kept usually within an error of one-fifth of a second, and is sent, in seconds signals, to all rooms in the Watch Factory needing correct time. These time signals are also sent to the chief business office of the Watch Factory in Chicago, and from thence to the Drake Hotel for broadcasting daily except on Sundays. The fine watches made at the Elgin Factory are regulated so thoroughly by the Observatory time that when they are tested at Washington, D. C., for Government use, year after year, they stand these severe tests, which is an honor rarely given to other American watches.