

THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA  
FOR THE PROMOTION OF THE MECHANIC ARTS

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Hall of the Institute,  
Philadelphia, January 11, 1939.

Report No. 5065.

Investigating The Work of

Doctor Edwin Hubble

of Pasadena, California.

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Committee on Science and  
the Arts Case No. 3063.

The Franklin Institute of the State of Pennsylvania, acting through its Committee on Science and the Arts, has considered carefully the work of those who have contributed greatly to the advancement of science and to the application of physical science to industry, and has selected as the recipients of the two awards of the Franklin Medal for 1939 -

EDWIN HUBBLE  
of Pasadena, California,

and

ALBERT SAUVEUR  
of Cambridge, Massachusetts.

The award to Doctor Hubble is

In recognition of his extensive study of the nebulae, particularly those outside our galaxy, as a result of which the dimensions of observed space

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1 have been greatly increased.

2  
3 Doctor Edwin Powell Hubble was born at Marshfield, Missouri,  
4 on November 20, 1889. At the age of twenty-one he was graduated from the  
5 University of Chicago, where he had majored in mathematics and astronomy, and  
6 was appointed Rhodes Scholar for Illinois. He spent three years at Oxford,  
7 at the end of which he received the degree of Master of Arts in Jurisprudence.  
8 Upon returning to the United States he was admitted to the Bar in Louisville,  
9 Kentucky, in 1915. His legal career was, however, very short lived, for in  
10 a year's time he was back at the University of Chicago working for a doctor's  
11 degree in astronomy and serving as assistant to Professor Frost at the Yerkes  
12 Observatory. In 1917 he was awarded the degree of Doctor of Philosophy by  
13 Chicago University and immediately enlisted in the infantry. After two years  
14 of service in France he came home with the rank of major and was successful in  
15 being appointed at once to serve on the staff at Mount Wilson Observatory, where  
16 he still is.

17  
18 Of Hubble's work Professor Henry Norris Russell, of Princeton,  
19 has said, "Dr. Edwin P. Hubble is distinguished especially for his investigations  
20 upon the nebulae, which surpass in extent, variety and success those of any other  
21 astronomer, past or present."

22 The nature of nebulae and their size and distance from the solar  
23 system have been controversial problems since the earliest astronomical observa-  
24 tions were made. It is, however, not difficult to divide nebulae into two  
25 groups, - those within our own galaxy, and those beyond.



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Galactic Nebulae. These diffuse, irregular, luminous clouds

Hubble has found to shine by light reflected from neighboring stars. When these stars are comparatively cool their light, reflected from nebular dust clouds, produces a continuous spectrum; but when the stars are comparatively hot, their ultra-violet light excites the atoms of the nebula which then emits a bright line spectrum.

Extra-Galactic Nebulae. Working with the 100-inch telescope,

Hubble undertook a comprehensive study of the spiral and other "white" nebulae which are most numerous in the regions of the sky remote from the Milky Way. He was able to take advantage of the best atmospheric conditions and employ greater resolution than had previously been possible. His photographs showed that the outer part of one of the brightest and hence one of the nearest spiral nebulae (NGC 6822) was composed of great numbers of stars. Among the brighter of these he discovered many Cepheid variables, which enabled him to calculate, by means of Shapley's relation between period and luminosity, the distance of the spiral. This distance proved to be 700,000 light-years, which located the nebula NGC 6822 well outside our own galaxy.

Sir William Herschel had suggested that all the nebulae were

"island universes", which could be resolved into stars if only sufficient telescopic power be applied. During the first quarter of the present century this was revived as an explanation of the peculiar features of the spiral nebulae, notably by H. D. Curtis. This gave an explanation of the curious distribution of these nebulae in the sky, namely, that when we look in the direction of the Milky Way we must peer through vast clouds of thin haze in our own galaxy which

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1 thus obscure our view of very remote objects, but when we look in a direction  
2 at right angles to the Milky Way such obscuration is small, hence our vision  
3 penetrates the greatest distances. Doctor Hubble's observations proved that  
4 this is correct, and that the spirals actually are outside our galaxy.

5           During his extensive observations of the great nebulae in  
6 Andromeda, Hubble accumulated three hundred and fifty photographs of high reso-  
7 lution which he then undertook to examine in order to observe slight variations  
8 in the intensity of any of the thousands of pin points of light which had regis-  
9 tered themselves on his plates. Fifty Cepheid variables were discovered which  
10 provided the data for estimating the distance of Andromeda as 900,000 light-years.  
11 Later studies reduced this figure to 680,000 light-years. The dimensions of  
12 this nebula turned out to be comparable with those of our own galaxy. Employing  
13 similar methods of attack, Hubble has estimated the distance of the fainter and  
14 more remote clusters of nebulae as 200 to 500 million light-years. Dr. H. D.  
15 Babcock states, "The volume of space now subject to exploration is a thousand  
16 million times as great as that amenable to quantitative discussion only twenty  
17 years ago. ... It is not an over-statement to say that the convincing data  
18 assembled by him with the 100-inch telescope have been a powerful argument for  
19 the construction of the 200-inch reflector."

21           In 1929 Hubble found a linear relationship between the distances  
22 of a series of nebulae and their apparent velocities of recession as determined  
23 by observation of the red shift of lines in their spectra, or Doppler effect.  
24 In collaboration with Humason this spectrographic study was extended to nebulae  
25 as remote as 220 million light-years, with the result that the correlation between



1 distance and apparent velocity of recession was confirmed. The apparent velocity  
2 of recession was found to increase by about 525 kilometers per second for each  
3 increase of a million parsecs in distance. Hubble recognizes that the red shift  
4 may be due to some other cause than velocity of recession. A definite solution  
5 to this intricate problem may come with the completion of the 200-inch telescope.

6 Hubble has published some fifty papers in various astronomical  
7 journals. He is a member of the American Astronomical Society, the Astronomical  
8 Society of the Pacific, the National Academy of Sciences, the American Philosophical  
9 Society, and a Fellow of the Royal Astronomical Society of England.

10 He was Halley lecturer at Oxford in 1934, Silliman lecturer at  
11 Yale in 1935, and Rhodes Memorial lecturer at Oxford in 1936-37. He was awarded  
12 the honorary degree of Doctor of Science from Oxford in 1934, and from Princeton  
13 in 1936. In 1925 he received the \$1000 prize of the American Association for the  
14 Advancement of Science; in 1935 the Barnard Medal; and in 1938 the Bruce Gold Medal.

15 Professor Henry Norris Russell sums up his contributions to science  
16 as follows:- "These investigations have extended the spatial frontiers of human  
17 knowledge in a greater proportion than any others in the history of science."  
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21 ..... Philip C. Staples .....  
President.

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23 ..... May B. Allen .....  
Secretary.

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25 ..... Eder H. Forstall .....  
Chairman of the Committee on Science  
and the Arts.