This pdf does not recreate the booklet exactly, as I have removed some of the landscape format images to the end for easier viewing.

In some cases the originals are still opposite the written page as well to give the idea of how the booklet looked.

Portrait format images have been left in place.

THE NORMAN LOCKYER OBSERVATORY

SALCOMBE HILL
SIDMOUTH

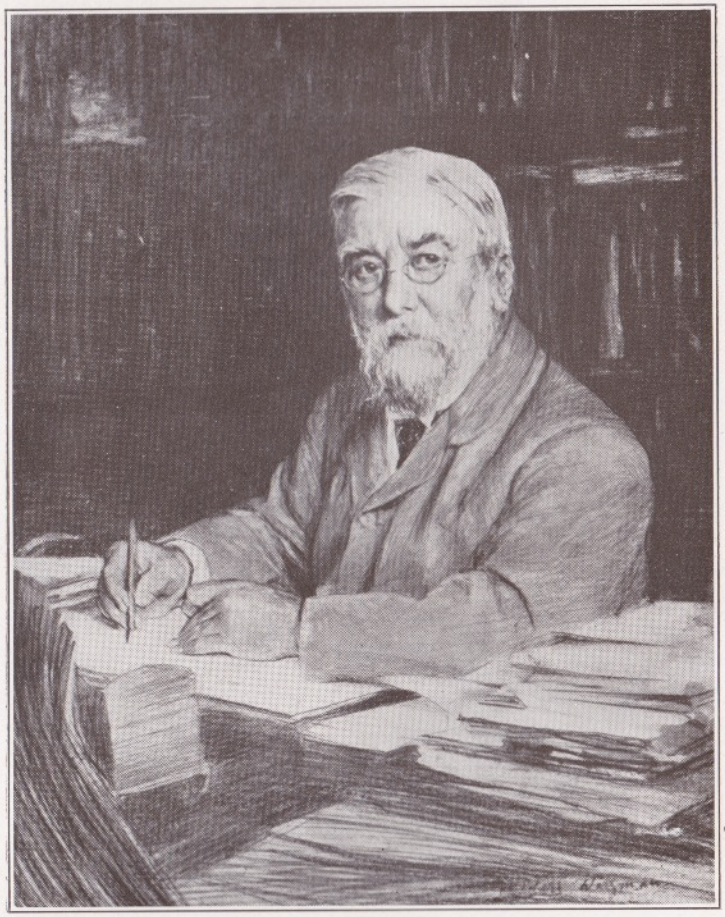
HANDBOOK

Second Edition

1935

Compiled by
WILLIAM J. S. LOCKYER, M.A., Ph.D., F.R.A.S.,
Major (late R.A.F.),
DIRECTOR.

PRICE - SIXPENCE



SIR NORMAN LOCKYER, K.C.B., F.R.S.

From a Crayon Drawing by
BLAKE WIRGMAN.

HANDBOOK
TO THE
NORMAN LOCKYER OBSERVATORY

Compiled by

WILLIAM J. S. LOCKYER, M.A., Ph.D.,
F.R.A.S., Major (late R.A.F.),
DIRECTOR,

Honorary Lecturer in Astronomy at University College of the S.W. of England (Exeter).

Dedicated to

The late WINIFRED LUCAS LOCKYER,
Assistant Honorary Secretary and Librarian.

First Edition - 1921
Second Edition - 1935

Norman Lockyer Observatory Corporation
Hon. Sec., Capt. W. N. McCLEAN, A.M.Inst.C.E.,
1, Onslow Gardens, London, S.W.7.

1935

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(1) NORMAN LOCKYER (1836-1920).

SIR NORMAN LOCKYER, the originator and part founder of the Norman Lockyer Observatory, was born at Rugby on May 17th, 1836. He was the son of Mr. Joseph Hooley Lockyer, a lecturer on scientific subjects at Rugby School, and also one of the early workers on the electric telegraph. His mother, before her marriage, was Miss Anne Norman, of Cosford.

He was educated at private schools and on the Continent, and in 1857 received an appointment at the War Office, where he was later made Editor of Army Regulations. In 1870 he was appointed Secretary of the Duke of Devonshire's Royal Commission on Scientific Instruction and the Advancement of Science. When the work of the Commission was completed, and as a result of his discoveries in connection with the sun and his private astronomical work, he was offered an appointment in the Science and Art Department, South Kensington, by Mr. Disraeli, the Prime Minister, which he accepted, and was transferred there in 1875.

Scientific pursuits, however, had long supplied the real interest of his life. While at the War Office his leisure was devoted to the study of astronomy, and while there he erected an observatory at his home in Hampstead.

His first observations were on the planet Mars, and he communicated them in 1863 to the Royal Astronomical Society, having been elected a Fellow of that Society two years previously.

In 1860 Kirchhoff first demonstrated the possibility

of determining what substances the sun and stars were made of by the light which came from them. Lockyer soon realised the significance of these revelations in physical astronomy, and turned his attention at once to the application of the spectroscope to the celestial bodies. From that time onward his observations were brilliant and epoch making, and he was soon (1869) made a Fellow of the Royal Society and afterwards (1875) a Corresponding Member of the Paris Academy of Sciences. The discovery in 1868 of the gaseous nature of solar prominences, simultaneously with the great French astronomer Janssen, on which occasion the French Government struck a special medal, and the further discovery in the same year of the gas helium in the sun, found on the earth by Sir William Ramsay twenty-seven years later, are only two of the many striking advances which he made.

On his appointment as Professor of Astronomical Physics in the Royal College of Science, and later, in 1885, as Director of the Solar Physics Observatory, South Kensington, he was in a position to carry on, unhampered by other official work, his investigations in solar and celestial physics. The results of these researches have been embodied in his numerous books, which include " Contributions to Solar Physics," " The Spectroscope and its Application," " Studies in Spectrum Analysis," " Stargazing: Past and Present," " Chemistry of the Sun," " Meteoritic Hypothesis," " The Sun's Place in Nature " and " Inorganic Evolution."

He was chief of no less than eight British Government Solar Eclipse Expeditions, and organised the programmes of several others while Director of the Solar Physics Observatory.

On the transference of the Solar Physics Observatory

to Cambridge in 1913, when his official connection with the Observatory ceased, he felt the abrupt break in his life's work very deeply. Being as keen as ever on the progress of astrophysics he devoted himself to erecting this hill Observatory at Sidmouth, where he spent his declining years. The progress made in the buildings, equipment and organisation under his care will be found described in the body of this Handbook.

In addition to his astronomical work he originated and edited the now well-known scientific journal called *Nature* from the year of its foundation in 1869 up to 1919.

His public activities made contact with national life at many points, and he set himself the task of establishing an organisation which would bring home to all classes of the community the necessity of making the scientific spirit a national characteristic to inspire progress and to determine policy in affairs of all kinds ; as a result the British Science Guild was founded in 1905.

During his career he received many distinctions. As early as 1871 he was appointed Rede Lecturer to Cambridge. The Royal Society awarded him the Rumford Medal in 1874, and appointed him Bakerian Lecturer for the same year, and again in 1888. Glasgow, Edinburgh and Aberdeen gave him the honorary degree of LL.D. ; Cambridge and Sheffield the Hon. Sc.D. ; Oxford the Hon. D.Sc. The British Association elected him as President for 1903-4. In the year 1894 he was given the C.B., and in 1897 he was promoted to K.C.B. He was also a member of many learned societies both in this country and in France, Germany, Italy and the United States.

He was twice married. His first wife, who died in 1879, was the younger daughter of Mr. William James,

the well-known engineer, of Trebenshon, near Abergavenny, by whom he leaves four sons and two daughters. In 1903 he married the younger daughter of the late Mr. Samuel W. Browne, of Bridgwater and Clifton, and the widow of Bernard E. Brodhurst, F.R.C.S.

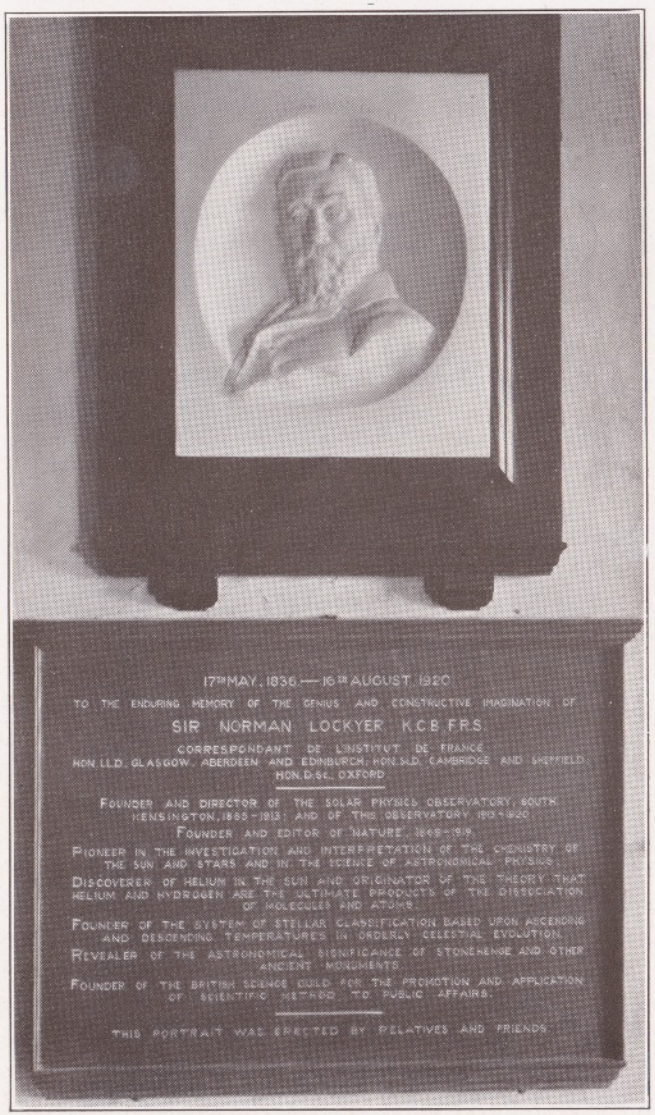
In concluding this brief sketch of a most active life it is fitting to quote the following extract from the address of the President of the French Academy of Sciences, Monsieur Henri Deslandres, the distinguished astronomer, one of the Foreign Members of the Norman Lockyer Observatory, delivered at the opening meeting of the Session of the Academy on October 4th, 1920:—

Monsieur Deslandres said:—

> "During the holidays the Academy has had the grief of losing one of its most illustrious correspondents, the great English astronomer, Sir Norman Lockyer . . . ."
>
> "Sir Norman Lockyer is one of the founders of Physical Astronomy, which has developed so greatly during the last 50 years. He approached Science by untrodden paths, and great discoveries are associated with his name . . . ."
>
> "Sir Norman Lockyer is certainly one of the greatest scientific men of England, and one of the greatest astronomers of all time. The Academy is honoured by his inclusion as one of its members."

Sir Norman died at Sidmouth on August 16th, 1920, and was buried at Salcombe Regis.

In 1922, July 22nd, a portrait medallion of Sir Norman Lockyer was unveiled by the recent Astronomer Royal, Sir Frank Dyson, at the Observatory in the presence of a large and distinguished company. The



Marble Plaque by the late Sir Hamo Thornycroft of Sir Norman Lockyer, which, with the oak tablet below, was erected by relatives and friends.

FIG. 1.

medallion, which is situated on the South Wall of the Director's room, executed by the late Sir Hamo Thornycroft, R.A., was erected in his honour by his relatives and friends. The inscription engraved on the oak tablet and the portrait are reproduced in an accompanying illustration (fig. 1).

(1A) WINIFRED LUCAS LOCKYER.

The death, on July 9th, 1934, of the honorary assistant secretary, Miss W. L. Lockyer, the younger daughter of Sir Norman Lockyer, has been a great loss to the Observatory. Miss Lockyer had the interests of the Observatory at heart in many varied ways. In addition to her duties as assistant secretary and to much general outside work she also voluntarily undertook a great deal of work at the Observatory itself, such as the arrangement of the library, bookbinding, the making of a card catalogue, distribution and acknowledgment of publications, ordering supplies, etc. At any special observatory function her willing and cheerful assistance was always a factor of importance in contributing to the success of the occasion. She frequently added to the Observatory's equipment by gifts of various kinds, and also undertook at her own expense many minor repairs. In addition to a sum of £600 which she left to the Observatory funds, and a field of 4·349 acres in close proximity to the Observatory grounds, she bequeathed numerous pieces of furniture and books. As she took such a great interest in the decision to bring out a new edition of the Handbook, the Council unanimously decided to dedicate this edition to her memory. Her grave is at Salcombe Regis close to that of her father.

Miss Winifred L. Lockyer.
FIG. 2.

(2) THE OBJECT OF AN ASTRONOMICAL OBSERVATORY.

THE object of an Astronomical Observatory is to make a study of the appearances, compositions, distances and movements of the heavenly bodies in order to further our knowledge of what exists and is happening in the realm of space surrounding the little earth on which we dwell.

To accomplish this instruments of various kinds are used, and the more powerful these are the greater is our knowledge advanced.

Thus, transit instruments fix for us the positions of the stars around us, and tell us something of their movements in space, and the latter can only be accomplished after many years of continuous observations. Telescopes, whether of the refracting or reflecting kind, show us what the celestial bodies look like, and small adjuncts to these instruments reveal to us the internal movements of systems or stars which abound in space.

The attachment of glass or quartz prisms to telescopes helps us to extend our knowledge in two other directions, for not only is it possible to determine those motions of stars which cannot be detected by the telescope alone, but a means is afforded us of finding out exactly what the celestial bodies are made of, and ideas can be gathered as to their temperature, density, and distance.

The advent of the photographic plate has revolutionised the whole of observational astronomy, for where formerly hours were required to make a few observations the photographic plate is capable of recording in a few minutes a vastly greater host of facts than was possible formerly.

Further, it is possible to photograph objects in the heavens which the eye of man will never be able to see, and it is for this reason that photography has given us a far grander idea of the extent of the universe than we should have otherwise secured.

(3) FAVOURABLE CONDITIONS FOR AN OBSERVATORY.

IT is obvious that an astronomical observatory should be located in a region where the heavens can be viewed to the very best advantage, and it is as well to consider in the first instance what the most favourable conditions should be.

First of all, it must not be forgotten that the light of the heavenly bodies, before it reaches the object glass of the telescope, has to pass through our atmosphere, and this atmosphere is always in a state of movement, and absorbs some of this light during its passage. It is advisable therefore to get rid of as much of this atmosphere as possible, and this is accomplished by placing the observatory as high above sea level as possible.

The ideal position is that situated on a very elevated plateau, and mountains if possible should be avoided, as they facilitate the formation of local air currents unless they are heavily wooded or covered with verdure. Again the fewer clouds there are the greater is the opportunity for observations, so climatic considerations are very important.

Other detriments to good observation or " seeing," as it is termed, are mists, smoke, traffic tremors, town night-glare, etc., and good sites should be as free as possible from these.

It will be seen therefore that when it is desired to erect a new observatory such conditions as enumerated above ought to be adhered to as far as possible. Further, the site should be so chosen that the required conditions would be permanent, *i.e.*, that towns, railways, trams, etc., are not likely in the future to be placed near the locality.

In order to find out whether a site is favourable for an observatory, observations of the sun by day and stars by night should be undertaken.

Should the enlarged image of the sun formed by a telescope be found to be " steady " and the definition of a sun-spot be good and maintain this quality, then the day " seeing " is said to be satisfactory. In the case of night observations a star's image in the telescope is put out of focus and a series of rings are formed round the central point. If these rings rapidly change their shape or merge into one another, the " seeing " is bad, but if on the other hand they maintain their figure steadily, then the night " seeing " is considered good.

It has been the habit at this Observatory on nearly every night of observation to record the appearance of those diffraction rings, as they are called, and the result shows that the " seeing " is as a rule very good.

There seems little doubt that the gorse, bracken, grass and other vegetation with which the Observatory site and neighbourhood are covered prevent the sun from overheating the ground to any extent, and thus detract from the formation of local convection currents which are usually associated with elevated bare sites and are undoubtedly the cause of bad definition.

Again, the close proximity of the sea to the south of the Observatory plays a great part in rendering the air more steady and in improving definition.

The records of the Observatory show that the average number of fine nights throughout a year is 128 for the period 1920 to 1934. It is interesting to note that August, September and October have the highest average monthly numbers.

It is instructive to glance back a moment to the locations of some of the old-established observatories of the world and to note that while their observing conditions may have been satisfactory when they were founded they are not considered so now. Thus the following list shows how some of these institutions have either migrated or have added a new outstation to their establishment:—

	Height of Old Site. ft.	Height of New Site. ft.
Paris (Meudon)	194	534
Sicily (Mount Etna)	155	9,735
Berlin (Potsdam)	122	318
Madras (Kodaikanal)	23	7,745
Washington (Mount Weather) ...	200	1,725
Oxford (Radcliffe Observatory) ...	213	4,850

More recently erected Astrophysical and Solar Observatories equipped with large instruments have been placed at high stations, as will be seen from the following list:—

Observatory.		Elevation, Feet.
Toulouse University ...	Pic du Midi, France	9,384
Lowell	Flagstaff, Arizona, U.S.A. ...	7,293
Union	Johannesburg, S. Africa ...	5,858
Mount Wilson... ...	Mount Wilson, Cal., U.S.A....	5,712
Yale University ...	Johannesburg, S. Africa ...	5,700
Lamont Hussey ...	Bloemfontein, S. Africa ...	4,887
Bayden Station ...	Bloemfontein, S. Africa ...	4,523
Lick	Mount Hamilton, Cal., U.S.A.	4,209
Commonwealth Solar	Canberra, Australia	2,650
Montgros	Nice, France	1,240
Yerkes	Williams Bay, Wis., U.S.A....	1,105
Dominion Astrophysical	Victoria, Canada	730

(4) THE BEGINNING AND LATER DEVELOPMENT OF THE NORMAN LOCKYER OBSERVATORY.

In the year 1909 the Solar Physics Observatory at South Kensington had become so surrounded by large buildings that it was decided to remove it to another site. That Observatory, where astrophysical and astrochemical work had been carried on continuously since 1875 under its distinguished originator and director, Sir Norman Lockyer, and the work at which had been a model for so many other observatories, was eventually transferred to Cambridge.

On his retirement Sir Norman Lockyer felt that if England was to retain the position she had won for herself in this branch of astronomy, it was essential that a hill observatory should be established where this work could be carried on under the best available observational conditions.

Having recently built a house on Salcombe Hill, and procured land which extended up to and along the top of this hill, he was led to consider the last-mentioned site as an excellent one for an observatory. The position seemed admirably suited for the purpose, although it was not originally chosen with this object.

With his undaunted energy he set about constructing the Observatory in 1912, and with the help of sympathetic friends formed an advisory and organising committee on the various technical subjects which had

necessarily to be studied while the building and equipment were proceeding.

Details concerning the original organising and advisory committees, gifts of land and equipment, were given in the first handbook, so that reference to them need not be made here.

Figure 14 (see page 46) embodies the portraits of the following, who have taken an active part in the establishment and work of the Observatory:—

Sir Francis McClean	Joint Founder.
Lady Lockyer	Assistant Honorary Treasurer.
Dr. W. J. S. Lockyer ...	Director of the Observatory.
Sir Robert Mond	Chairman of the Corporation.
Sir Richard Gregory, Bart.	Chairman of the Council.
Captain W. N. McClean	Honorary Secretary.

In the year 1916 the Observatory was formed into a Corporation, to promote its development. All the lands, buildings and equipment were conveyed to this body, to which further reference will be made later (page 44).

(5) THE PRESENT SITE.

The site of the Observatory (latitude 50° 41′ 13·3″ N., longitude 3° 13′ 7″ W.), which was presented by Sir Norman and Lady Lockyer, is excellently situated on the top of Salcombe Hill, overlooking Sidmouth, at a height of 565 feet, and possesses an unbroken horizon in every direction (see fig. 3). It is well away from traffic tremors and night glare, and the contour of the hill near the top is unsuitable for the erection of many dwelling-houses. It is thus eminently suited to the

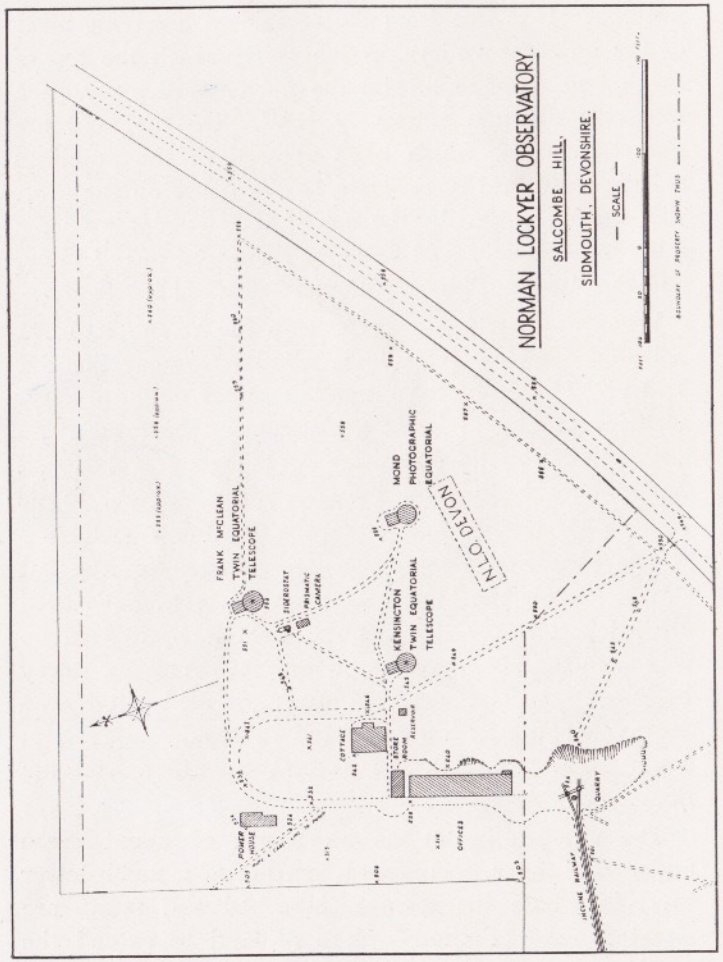
The region round the Observatory. The black cross is the site of the Observatory.
FIG. 3.

objects in view, and the results which have been obtained up to the present have fully justified the choice of the position. It is free from the occasional low-lying mists of the adjacent valleys, which rarely reach the top of the hill at night-time, and the purity of the sky on a cloudless night is extremely good. On the land are gravel quarries, which have allowed of the buildings being constructed of concrete blocks made on the spot. The site is shielded by the massif of Dartmoor from the full south-westerly and westerly gales and heavy rains, and the " seeing," as mentioned before, is excellent.

When approaching Sidmouth on the Exeter Road, a splendid view of the site is obtained across the Sid Valley. The lie of the ground is rather extraordinary, as the high ground forms a plateau or table-land at an elevation of about 600 feet, the top being a gravel deposit horizontally bedded on the green-sand, which, in its turn, is horizontally bedded on the new red sandstone.

The observing instruments are situated on the flat summit, while the offices, laboratories, etc., have been erected just below the summit, thus interfering in no way with the horizon of the telescopes. The one-storey buildings on the gorse and heather-topped hill by no means disfigure it: their dull red ruberoid and asbestos roofs harmonise with the general colouring, and the domes alone break the sky-line.

The site (see fig. 4) has an extent of about seven and a half acres, including a portion at a much lower level in which the springs, filter-bed and pump are situated. An additional piece of land to extend the northern boundary was very kindly presented by Miss Leigh Browne.



Plan of Site.
FIG. 4.

(6) THE BUILDINGS AND EQUIPMENT.

(*A*) *The Offices.*

The offices (fig. 5) face the terrace along the side of the hill overlooking Sidmouth, and with a splendid view of the coast as far as Scabbacombe Head a few miles further than Berry Head. This terrace faces west, and at its southern end is the quarry and top of the incline railway. On the roadway have been mounted natural blocks of conglomerite which have been moved from other parts of the site.

This building is constructed of cemented flints with roof of corrugated asbestos sheeting. It covers an area of 104 ft. by 21 ft. It is divided into five rooms each 20 ft. by 20 ft., and used as director's room, spectroscopic laboratory, library and wireless, photographic room, and workshop. The whole is heated by hot water from a furnace in a sunken lean-to chamber.

The rooms in the offices are generally known by numbers, one to five, number one being that at the southern end of the building. Number one room is the registered office of the Corporation and the director's room (fig. 6).

Room number two is devoted to experimental work, and contains electrical and spectroscopic apparatus for research work. The chief instrument is a large Littrow spectroscope presented by Lady Lockyer.

Number three room at present chiefly contains books, but it is hoped that in the near future a new and separate building will be constructed as a library and storage for

glass negatives. A valuable research library is in rapid progress of formation. Sir Norman Lockyer presented the whole of his astronomical library, and Sir Francis McClean a great number of valuable books and pamphlets.

An exchange of publications between this and other observatories and institutions has been in continuous operation, and this not only keeps the library up to date, but necessitates preserving considerable room for expansion of book space. In the year 1929 an inventory was made, and this showed that there were 5,370 volumes and 7,500 pamphlets.

A Sidereal and Mean Time clock and wireless receiving apparatus are also installed in this room, the aerials for the latter being outside on the higher ground to the eastward. The apparatus is used for the receipt of weather and time signals.

Number four room is devoted nearly exclusively to photography, and contains a dark room, an enlarging room, and also a copying camera mounted on a wooden base. Brackets are placed outside the windows for supporting a large glass mirror to supply sky light to the enlarging and copying cameras. The wedge micrometer is placed in this room also, and is in nearly continuous use.

Room number five is fitted up with a carpenter's and fitter's bench together with a foot lathe.

(*B*) *Store Room.*

Just to the north of the Offices, but unattached, is a lean-to shed, which is used for the storage of packing

cases, ground tools, etc., and has a lavatory attached. It covers an area of 30 ft. by 20 ft.

(*C*) *The Power House.*

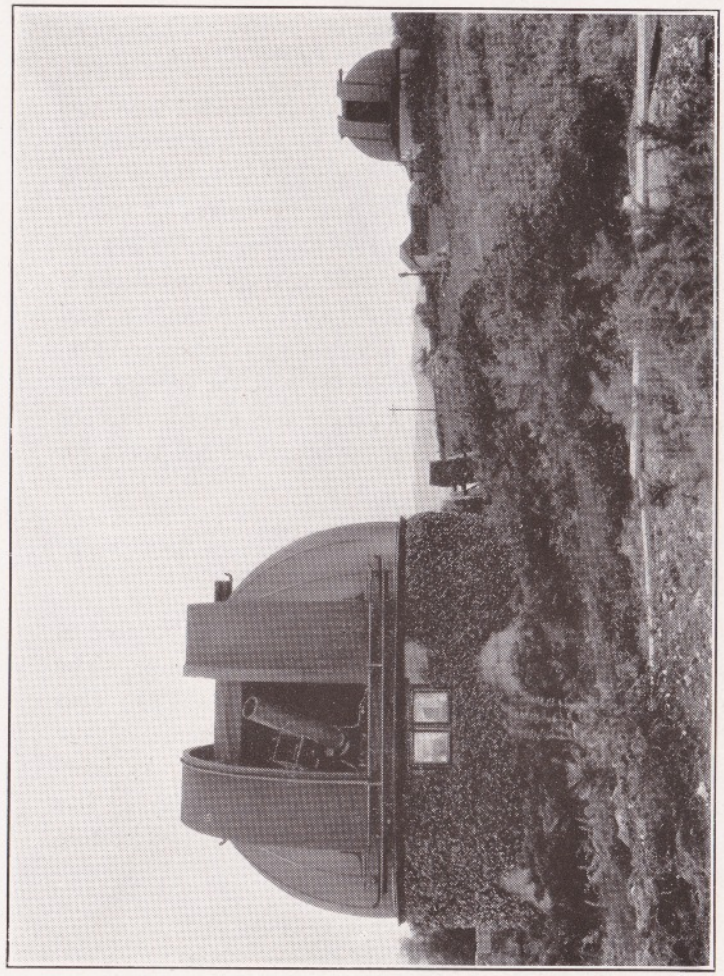
This building (40 ft. by 15 ft.) is divided into two rooms, the engine being situated in one and the set of accumulators in the other. The engine consists of a 12 horse-power Crossley oil engine. It drives by means of a belt a Siemens' dynamo for charging the 60 cells in the adjoining room. The current that is transmitted is 110 volts, and is used for lighting, pumping and laboratory purposes. The dynamo and belt were presented by Mr. Alexander Siemens, and the former was so constructed that it can operate the electric furnace which is available for use in the spectroscopic room for research work.

(*D*) *The Cottage.*

This bungalow is a single-storey house with its roof of asbestos sheets on the level of the top plateau. The rooms consist of a kitchen, scullery and four rooms. This building was originally erected for the home of the attendant, with rooms for a research student. As, however, the attendant prefers to live in the valley, it has now been converted into a temporary library, and heating apparatus has been installed.

(*E*) *The Frank McClean Dome.*

The Frank McClean Dome (fig. 7) consists of a circular building 20 feet in diameter, the walls of two



A view from the South of the "Kensington" Dome (nearest the camera) and the "McClean" Dome.

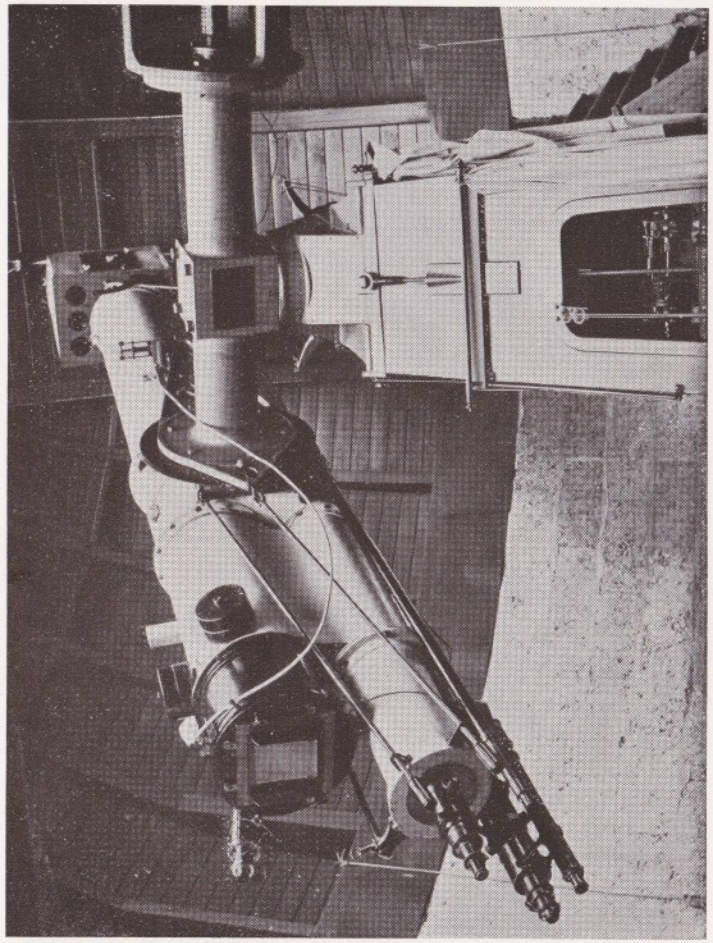
FIG. 7.

shells of 4·5-in. blocks with an air space of 2 inches between them. The roof, designed by Captain W. N. McClean, is hemispherical in shape and is made of wood covered with ruberoid with movable shutters, the whole being mounted on wheels running on rails. Adjoining is the annexe and photographic room. The dome contains a twin telescope presented by Sir Francis McClean (fig. 8). They are both refractors, having object glasses of 12 inches and 10 inches. The former is fitted with a 12-inch prism of 20° angle, and another prism of 12 inches and 15° angle is available when required. This telescope has a camera attachment, and is used for photographing the spectra of the fainter stars. The 10-inch telescope is for visual observations only. The instrument is fitted with a Grubb electric control and pendulum and electric illumination for the declination circle.

This instrument was originally built for the late Frank McClean, F.R.S., and erected at his house at Rusthall, Tunbridge Wells. Since its erection at Sidmouth it has been employed in the work of the classification of stellar spectra. More recently it has been chiefly used for the determination of stellar parallaxes, or the distances of stars, by the spectroscopic method.

(F) The Kensington Dome.

The Kensington Dome (fig. 7) consists of a circular building 20 feet in diameter, the walls being formed of concrete blocks made hollow so as to act as a double wall. The roof, also designed by Captain W. N. McClean, is hemispherical in shape and is made of



Interior view, showing eye-end and mounting of the "McClean" Telescopes.
FIG. 8.

wood covered with ruberoid with movable shutters, the whole being mounted on wheels running on rails. The annexe adjoining contains a dark-room and also a sidereal clock, presented by Sir Francis McClean. The dome contains another twin telescope consisting of a 10-inch refractor for visual purposes only and a 9-inch refractor with a prism of 9 inches aperture and 45° angle (fig. 9). The latter instrument is fitted with a camera attachment, and is used for photographing the spectra of the brighter stars. The instrument is fitted with electric illumination to the Declination circle, and its motion is regulated by Russell's electric control. It was presented to the Observatory by Sir Norman Lockyer.

(*G*) *The Mond Photographic Equatorial.*

This instrument (fig. 10), including the complete building, was presented to the Observatory by Sir Robert Mond, LL.D., D.Sc. Its erection was completed in October, 1931, and all adjustments were satisfactorily made by April of the following year. Its inauguration by the then Astronomer Royal, Sir Frank Dyson, K.B.E., F.R.S., etc., took place on May 28th in the presence of a distinguished company. The instrument was constructed by Messrs. Cooke, Troughton & Simms, of York, and the building erected by Messrs. G. E. Wallis & Sons, of London, after designs by the Honorary Architect to the Observatory, Mr. A. J. Healey.

The form of the mounting was so designed as to allow a complete and uninterrupted circumpolar motion at all declinations. A large (27·5 inches diameter) and accurately cut driving circle combined with an electric

control ensures very precise motion. Details of the lenses mounted in the four cameras are shown in the accompanying table.

DETAILS CONCERNING THE ZEISS LENSES MOUNTED ON THE MOND EQUATORIAL.

	Lens.	No.	Focal length. cm.	Aperture. c.m.	Size of plate. inches.	Area covered in degrees.	Scale of plate per inch.	Donors of lenses.
1	Zeiss Triplet	300,624	120	17·1	10 × 12	14 × 12	1·1°	Capt. W. N. McClean.
2	Zeiss Triplet	304,001	70	14·0	8½ × 6½	17 × 13	2·1°	Miss Leigh Browne.
3	Zeiss Triplet	311,652	50	10·4	6½ × 4¾	18 × 13	2·9°	The Air Ministry.
4	Zeiss Anastigmat	99,345	25	7·0	5 × 4	30 × 24	6·4°	Miss Leigh Browne.

This is a purely photographic instrument designed for the photography of relatively large regions of the sky on small or moderate scales. It is very serviceable for the photography of large nebulosities, comets, variable stars, novæ, minor planets, meteors, etc. Its behaviour is very satisfactory, and continuous exposures of more than eight hours have been made with it.

(*H*) *Other Instruments not erected.*

A 30-inch Reflecting Telescope presented by Sir Norman Lockyer.

The mounting of this 30-inch mirror and 7-inch flat is complete, but it is so very much out of date that before it can be erected again an entirely modern mounting is required to render it serviceable in the future.

A 21-inch Siderostat, on loan from Sir Francis McClean.

This instrument, constructed by Messrs. Cooke, Troughton & Simms, of York, is for throwing a beam of sunlight horizontally due south and maintaining it there. The 21-inch mirror is mounted in a fork and operated by a weight-driven clock controlled by an electric pendulum. It is generally used for total solar eclipse work, and has been employed at the eclipses in Flint Island (1908), Tasmania (1910), the Tonga Islands (1911), and Canada (1932).

Two 12-inch Siderostats presented by Sir Norman Lockyer.

These two instruments are similar in principle and use to that above described, but carry mirrors of smaller dimensions, namely, 12 inches in diameter.

(*J*) *Water Supply.*

The pump house consists of a small corrugated iron building, and is situated at the springs about 200 feet below the site of the Observatory. It contains a three-throw pump worked by hand or by an electric motor, the source of power being at the power house on the Observatory site. It is situated at the foot of the greensand where many springs issue, giving a good supply of water during summer and winter alike. One of these springs is led into a reservoir through a filter bed, and this is pumped up into a concrete tank sunk into the ground on the summit. Thence the water is supplied by

gravity to the offices and other buildings. This supply is ample for all requirements, but, in addition, rain-water is collected from the roofs in separate tanks. Sir Robert Mond generously provided the funds for the electric motor and the necessary connections from the pump to the power house.

(7) PROGRAMME OF WORK OF THE OBSERVATORY.

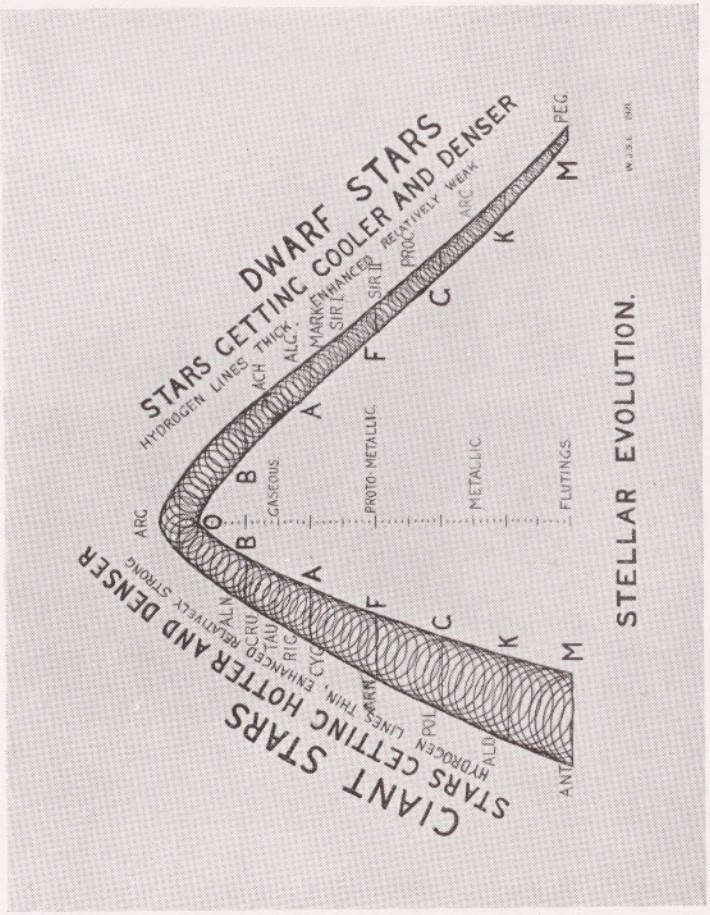
THE routine work carried on in the Observatory is in the main spectroscopic. As the word " spectroscopic " may not be generally understood, a few words as to its meaning may not be here out of place.

If white light, such as sunlight for instance, be made to pass through a prism of glass or quartz, or be allowed to fall on the surface of a diffraction grating, it is broken up into its component parts, giving what is known as a spectrum. This spectrum appears as a coloured band of light, the order of the colours being violet, indigo, blue, green, yellow, orange, red, violet having the shortest waves and red the longest. This band of light is crossed by dark lines scattered here and there in the spectrum. From the lines in this spectrum it is possible to identify the substances which are being burnt up or vaporised at the source of the white light. Thus it is quite an easy matter to say what materials the stars are made of, for one has only to place a prism in front of the object glass of a telescope and replace the eyepiece by a camera, and thus photograph the spectrum of a star. The main work of the Observatory consists in photographing the spectra of the stars and classifying them according to their

chemical composition and temperature, for it is found that there are large differences between the spectra from star to star. It was after a considerable study of stellar spectra that Sir Norman Lockyer was the first to point out that stars could be divided into two main groups, one set increasing their temperature and the other decreasing or cooling, and on this basis he placed the stars in consecutive stages of evolution (fig. 11). This system of classifying the stars was later corroborated by Professor H. N. Russell, Director of the Princeton Observatory, one of our honorary overseas members, who studied the subject from quite a different standpoint, and it is now almost universally accepted. The accompanying figure (fig. 11) gives one a general survey of the process.

At the beginning of the sequence the stars are of great size, of little density and of a red colour, and called " Giant " stars. As they get hotter they gradually contract, become more dense and take on a yellow colour. At the top of the curve they have reached their maximum temperature and are bluish green, and then commence to cool. As they cool they continue to become more dense and therefore smaller in volume and finally reach a very dense stage at the bottom of the curve (on the right-hand side) and become red again. They have now developed into " dwarfs." It will thus be gathered that stars on the same horizontal level have the same temperature and show nearly the same spectrum, but on the left side they are getting hotter and are giants, while on the right-hand side they are cooling and are dwarfs.

Some part of the work of the Observatory is to continue this scheme of classification and apply it to the faintest stars that can be photographed with the available instrumental equipment. The Frank McClean telescope is



A curve to illustrate the life histories of stars from their birth (left-hand side) to their death (right-hand side).

FIG. 11.

engaged on this work and has been in continuous use since its erection except for the break of over two years during the war, when no assistant was available to work the instrument.

The appearance of new stars in 1920 and 1934 presented opportunities of studying the changes of spectrum which took place, and valuable series of photographs were secured extending over several months in each case.

Another line of research taken up was one suggested by the American astronomer, Prof. W. S. Adams, of the Mount Wilson Observatory, one of the honorary overseas members of the Observatory Corporation. This consisted in deducing the distances of certain classes of stars from an examination of their spectra. The work was suggested as the Observatory had already accumulated a large number of spectra of stars, and they could be utilised for this research. Up to the present time (1935) 2,146 stellar distances have been determined.

In addition to the above the spectra of stars which show unusual or peculiar characteristics, comets, nebulæ and other interesting objects are photographed and discussed as occasions arise.

To illustrate the kind of photographs which are obtained with a telescope having a prism in front of the object glass, an instrument generally termed a "prismatic camera," the accompanying plates (figs. 12 and 13) are here reproduced. The first illustration (fig. 12) represents four of a large number of spectra taken with the Frank McClean telescope. The spectra are those of the new star which was discovered on August 20th, 1920, by the late Mr. W. F. Denning, of Bristol. No less than 70 photographs were secured, making a valuable series for studying the changes which the "nova" underwent during the few months of its visibility. At the top

is a spectrum of a star called Alpha Cygni, and this shows how closely the " new star " or " nova " resembled it. The great changes which the spectra underwent as the star waned are well shown in the sequence of spectra. It will be seen that the spectrum in the early stages was composed of dark absorption lines, while later these lines were accompanied by bright lines on their right-hand sides, and eventually the dark lines nearly disappeared. In the figure the photographs are given in the following order:—

No. 1, Alpha Cygni, August 12th, 1923 ;
No. 2, Nova, August 22nd, 1920, mag. 2·8 ;
No. 3, Nova, August 26th, mag. 2·7 ;
No. 4, Nova, September 10th, mag. 5·4.

Another series of photographs secured was that of the well-known variable star Mira (*o* Ceti). The two photographs here shown (fig. 13) were taken when the star was near maximum stages of brilliance in 1914, December, and 1924, February. The spectra show the hydrogen lines as bright, and also the fine series of flutings due to titanium oxide. The comparison stars are α Canis Minoris at the top, and α Herculis at the bottom.

Another distinct line of research has been pursued with the Kensington 9-inch prismatic camera, and that is the study of the spectra of certain Be-type stars which exhibit bright lines in their spectra. A selected list of these stars has been systematically photographed since the year 1923, and several of these stars have been found to have spectra which change from time to time and in some cases periods have been assigned to them. In three cases stars have been found to have bright lines where no record of such bright lines has been previously detected.

It may be mentioned here that a great number of observers have photographed the spectrum of the bright star γ Cassiopeiæ, which has a magnitude of 2·25, and does not change. The spectrum of this star has always been considered to be of a constant character, but photographs taken at this Observatory have proved that it changes considerably and in a very peculiar manner.

The Observatory is now in the possession of a very large and valuable set of negatives among which may be mentioned 2,414 negatives taken with the Kensington prismatic camera, 4,965 taken with the McClean prismatic camera, 92 with the Mond equatorial, and 885 taken, with the second-named instrument, by the late Dr. Frank McClean before the instrument was presented to Sidmouth.

Two new pieces of apparatus have been designed by the Director. The first is a clepsydra machine for broadening spectra. It is based on the homogeneous flow of oil through a small aperture, allowing a photographic plate to fall vertically at any desired speed in an enlarging camera. The photographs shown in figures 12 and 13 have all been widened in this manner. The apparatus was constructed by Messrs. Cooke, Troughton & Simms, of York.

The second is a wedge micrometer. Two graduated wedges were made by Messrs. Adam Hilger, to be placed one or other as desired in a measuring micrometer nearly in contact with a stellar spectrum. By passing the wedge over any line in the spectrum this line can be made to disappear, and the point at which disappearance takes place can be read off on an attached scale.

Both these new pieces of apparatus have proved very valuable, the first for preparing stellar spectra for plate illustration purposes for publication, and the second for

determining line intensity differences in spectra for both the researches on spectroscopic parallaxes and on bright hydrogen line stars.

(8) THE STAFF.

When the Observatory first commenced work in April, 1913, the staff consisted of Sir Norman Lockyer, Director ; Dr. W. J. S. Lockyer, Chief Assistant ; and Mr. H. E. Goodson as Assistant, and an observatory attendant, E. C. Lake. In August, 1914, Mr. N. K. Johnson was appointed as an additional assistant. In April, 1915, Mr. N. K. Johnson resigned, having received a commission in the Royal Flying Corps, and in July of the same year Dr. Lockyer left the Observatory, having also received a commission in the Royal Naval Volunteer Reserve, being attached to the Royal Naval Air Service. Mr. H. E. Goodson remained at the Observatory until September, 1916, when he left for munition work. The Observatory was then automatically closed, Mr. Lake, the attendant, looking after the instruments and buildings.

It was not until May, 1919, that work was recommenced, Mr. D. L. Edwards having been appointed as assistant after demobilisation from the Royal Engineers. Major Lockyer, after demobilisation from the Royal Air Force, took up his duties again in August of the same year.

Owing to the lamented death of the Director on August 16th, 1920, Major Lockyer acted as Director, and in February, 1921, he was appointed Director, with Mr. Edwards as Chief Assistant.

The attendant, Mr. E. C. Lake, died in 1924, and Mr. J. Boot was appointed in his place.

(9) RESEARCH STUDENTS

It was hoped that the presence of this Observatory in the South-west of England would attract from time to time astronomical students from some of the Universities. An opportunity is thus afforded for those students who are desirous of carrying out some research at an observatory to take advantage of the instrumental equipment that can be placed at their disposal.

The records of the research students who have worked at the Observatory, with the dates of their stay, are as follows:—

W. B. Rimmer ...	...	July, 1921—Sept., 1924
H. C. Woods ...	...	Feb., 1926—Feb., 1927
H. W. P. Richards	...	Feb., 1927—April, 1928
E. G. Williams ...	...	May, 1928—Oct., 1928

(10) PUBLICATIONS

The publication of the research work was originally printed in the form of Bulletins, and six of these were issued. These relate chiefly to discussions in relation to the classification of stars and catalogues of stars which have been photographed and classified at the Observatory.

Since the year 1919 all the research work has been communicated to the Royal Astronomical Society, London, and published either in the "Monthly Notices" of that Society or in their "Memoirs." A list of such publications up to the end of June, 1935, is given at the end of this Handbook as an appendix (page 50).

(11) VISITORS

WHILE the staff is so small it has been possible to open the Observatory to visitors one afternoon only in the week, namely, Wednesday. In spite of this, a great number of people have visited the Observatory, the average yearly attendance being about 300. It is hoped at a later date, when more assistance is available, to devote one instrument for one night a week regularly to show the more interesting objects in the night sky.

(12) THE NORMAN LOCKYER OBSERVATORY CORPORATION

IN a previous paragraph (page 17) it was stated that the Hill Observatory was formed into a Corporation. It is proposed here to refer to the Corporation more fully.

The licence was granted on July 25th, 1916, by the Board of Trade to the Corporation under the Companies (Consolidation) Act, 1908, and the Memorandum and Articles of Association were distributed to the members. Under the Memorandum of Association every member is liable to an amount not exceeding £1 to meet the debts and liabilities in the event of winding up. The incorporation has been on democratic lines, and no special powers of management attach to the donors. The membership is fixed at 300, and entails a subscription of £1 1*s*. a year or a £10 donation. Every member before election must sign a consent form, and has one vote, and only one. General meetings are held annually at which the Officers and Council are elected. The registered office of the

Corporation is fixed at the Norman Lockyer Observatory, Salcombe Hill, Sidmouth, Devonshire. The following is the composition of the present Council (1935), in which are vested the management and control of the Observatory. (See fig. 14.)

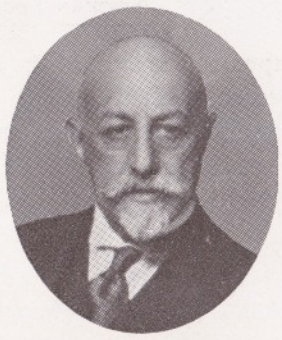
COUNCIL AND OFFICERS.

SIR RICHARD GREGORY, BART., LL.D., D.SC., F.R.S., *Chairman of Council.*
PROF. T. ARNOLD BROWN, M.A.
PROF. A. FOWLER, C.B.E., D.SC., F.R.S.
LADY LOCKYER, *Assist. Hon. Treasurer.*
LT.-COL. SIR FRANCIS MCCLEAN, A.F.C.
W. E. F. MACMILLAN.
SIR ROBERT MOND, LL.D., D.SC., *Chairman of Corporation.*
SIR NAPIER SHAW, F.R.S.
H. KNOX-SHAW, M.A., D.SC.
W. M. SMART, M.A., D.SC.
PROF. F. J. M. STRATTON, D.S.O., O.B.E.
PROF. A. M. TYNDALL, D.SC., F.R.S.
H. SPENCER JONES, M.A., SC.D., F.R.S.
Hon. Legal Adviser : S. H. HARGROVE.
Hon. Architect : A. J. HEALEY.
Hon. Secretary : CAPT. W. N. MCCLEAN.
1, *Onslow Gardens, London, S.W.7.*
(Tel.: Ken. 6045.)
Hon. Auditor : SIR NICHOLAS WATERHOUSE, K.B.E.

Bankers : BARCLAYS BANK, Earl's Court Branch.

In order to obtain advice on the present and future work of the Observatory it was considered advisable to form, if possible, a committee of representative British astronomers to act in this capacity. The result has been

Sir Francis McClean.



Sir Robert Mond.

Lady Lockyer.

Sir Richard Gregory, Bart.

Dr. W. J. S. Lockyer.

Captain W. N. McClean.

FIG. 14.

the formation of a Research Committee of the following eminent astronomers:—

RESEARCH COMMITTEE.

SIR FRANK W. DYSON, K.B.E., LL.D., D.Sc., F.R.S.,
Formerly Astronomer Royal,
Royal Observatory, Greenwich.

SIR ARTHUR EDDINGTON, D.Sc., LL.D., F.R.S.,
Plumian Professor of Astronomy,
University of Cambridge.

PROF. A. FOWLER, C.B.E., D.Sc., F.R.S.,
Yarrow Research Professor of the Royal Society,
Imperial College, South Kensington, London.

PROF. R. A. SAMPSON, M.A., D.Sc., F.R.S.,
Astronomer Royal for Scotland,
Professor of Astronomy, University of Edinburgh.

The ordinary members of the Corporation are 69 in number, and many distinguished foreign astronomers have been asked and have accepted the invitation to become honorary overseas members.

(13) THE FUTURE OF THE OBSERVATORY

THERE is no doubt that the founders of the Observatory, including many eminent men of science and generous donors, have succeeded in laying out and equipping the Observatory to a very considerable value, and have endowed it with funds of some magnitude, though insufficient for the future. But the good work must not stop here, because further endowment is necessary

to place the Observatory on a permanent basis. At the present time the staff is too small, but it is hoped to increase it as the endowment permits, so that it will consist of at least a Director, three assistants, with an attendant and an assistant attendant.

It is much to be regretted that Sir Norman Lockyer, the originator and part founder, passed away just when the Observatory had recommenced work after the war, but it is the earnest desire of the Council of the Corporation to secure funds to endow the Observatory in such a manner that it will be a lasting memorial to him who did so much to promote British Astronomical Science.

The name of the Observatory was originally "The Hill Observatory," but the Corporation Council in 1921 changed it to "The Norman Lockyer Observatory" as a fitting reminder of the great work which he accomplished in the realm of Astrophysics, and his great desire that such work should be continued at the Observatory which he had so much at heart.

The wide and intelligent public interest now shown in astronomical subjects encourages the hope that it will lead to increased support for this Observatory, in which for nearly twenty years valuable work in astronomy has been carried on with instruments and funds provided by private donors, and without the aid or control of State or other official institutions. Private benefactions have provided the United States with the finest observatories in the world, with the result that we owe to American astronomers some of the most important observations made in recent years in solar and stellar astronomy, particularly in the field of astronomical physics. It is perhaps too much to expect similar munificent support for astronomical research in this country, but it ought not

to be too much to hope that an observatory like this on Salcombe Hill, in which many notable contributions to progressive knowledge have been made, should be placed in such a financial position that the maintenance of its activities will be ensured.

(14) HOW TO HELP THE OBSERVATORY

THOSE who have read this Handbook will, it is hoped, desire in some way to further the interests of the Observatory. Anyone can do so by making a donation, or by joining the Corporation either by subscribing a guinea a year and thus becoming an annual member, or by paying ten pounds and becoming a Life Member. Cheques should be made payable to "The Norman Lockyer Observatory," and sent to the Honorary Secretary, Captain W. N. McClean, 1, Onslow Gardens, London, S.W.7.

It is also very desirable that readers should make the place known to their friends, for possibly some may be interested in Astronomy, and wish also to assist a research institution of this kind by increasing the endowment either by subscriptions or donations. A visit to the Observatory to see the present equipment, the programme of work, and the requirements of the future will be the best method of forming some opinion how the interests of the Observatory can be furthered to the greatest advantage.

The main point to remember is that private enterprise of this kind is the backbone of British success, and this applies just as much to Astronomy as to any commercial undertaking.

(15) APPENDIX.

LIST OF RESEARCH PAPERS PUBLISHED SINCE 1919.

W.J.S.L = William J. S. Lockyer (Director). W.B.R. = W. B. Rimmer (Research Student).
D.L.E. = D. L. Edwards (Chief Assistant). H.C.W. = H. C. Woods (Research Student).

					Vol.	p.		
(1)	1920	Nov.	M.N.	R.A.S.	81	38	"Spectroscopic and Magnitude Observations of Nova Cygni III., 1920."	W.J.S.L. & D.L.E.
(2)	1921	Jan.	,,	,,	81	173	"Further Observations of the Spectrum of Nova Cygni III., 1920."	W.J.S.L. & D.L.E.
(3)	1921	June	,,	,,	81	495	"The Spectrum of ϕ Cassiopeiæ in relation to those of α Cygni and γ Cygni."	W.J.S.L. & D.L.E.
(4)	1922	Jan.	,,	,,	82	226	"The Use of a Graduated Wedge in Stellar Classification and Parallax Work" ...	W.J.S.L.
(5)	1922	April	,,	,,	82	323	"On the Relationship between Solar Prominences and the Corona"	W.J.S.L.
(6)	1922	Nov.	,,	,,	83	47	"Spectroscopic Parallaxes of the Hotter Stars." (Preliminary Paper)	D.L.E.
(7)	1922	Dec.	,,	,,	83	92	"Photograph of a Bright Meteor"	W.J.S.L.
(8)	1923	Mar.	,,	,,	83	326	"The Spectrum of ζ Tauri"	W.J.S.L.
(9)	1923	Feb.	Mem.	,,	62	113	"The Luminosities and Parallaxes of 500 Stars, Types Fo to Mb"...	W.B.R.
(10)	1924	Mar.	M.N.	,,	84	366	"Spectroscopic Parallaxes of 100 B-type Stars"	D.L.E.
(11)	1924	April	,,	,,	84	409	"Recent Observations of some Bright-Hydrogen-Line Stars"	W.J.S.L.
(12)	1924	June	,,	,,	84	558	"Spectroscopic and Magnitude Observations of o (Mira) Ceti, 1924"	W.J.S.L.

APPENDIX—(*continued*).

					Vol.	p.		
(13)	1924	Nov.	M.N.	R.A.S.	85	47	"Apparatus for Broadening Spectra" ...	W.J.S.L.
(14)	1924	Dec.	Mem.	,,	64	1	"The Luminosities and Parallaxes of 525 Stars, Types Fo to Mb"	W.B.R.
(15)	1925	Mar.	M.N.	,,	85	439	"Spectroscopic Parallaxes of B-type Stars, (Third Paper). Second List of 100 Parallaxes"	D.L.E.
(16)	1925	May	,,	,,	85	580	"The Spectrum of ϕ Persei (Type Bope)" ...	W.J.S.L.
(17)	1926	May	,,	,,	86	474	"The Spectrum of ϕ Persei (Sp. Type Bope) throughout a complete Cycle (1925-26")	W.J.S.L.
(18)	1926	June	,,	,,	86	607	"The Spectrum of the Bright-Hydrogen-Line Star, H.D.C. 20336 in Camelopardalis (Sp. Type B3pe)"...	W.J.S.L.
(19)	1927	Mar.	,,	,,	87	364	"Spectroscopic Parallaxes of B-type Stars." (Fourth Paper)	D.L.E.
(20)	1927	Mar.	,,	,,	87	387	"Spectroscopic Parallaxes of 300 Stars of Spectral Class A0-A5"	H.C.W.
(21)	1927	Oct.	,,	,,	87	668	"The Total Solar Eclipse of 1927, June 29. Report of the Norman Lockyer Observatory Expedition"	W.J.S.L.
(22)	1927	Nov.	,,	,,	88	97	"The Degree of Darkness during the total Solar Eclipse of 1927, June 29" ...	W.J.S.L.
(23)	1928	Jan.	,,	,,	88	175	"Spectroscopic Parallaxes of B-type Stars (Fifth Paper): The Parallaxes of 125 Stars"	D.L.E.
(24)	1928	June	,,	,,	88	683	"Further Observations of some Bright-Hydrogen-Line Stars (1924-1927)" ..	W.J.S.L.
(25)	1928	June	,,	,,	88	695	"Note on a Correction to Spectroscopic Parallaxes"	D.L.E.

APPENDIX—(*continued*).

				Vol.	p.		
(26)	1928	Nov.	M.N. R.A.S.	89	127	"A wide absorption band in some B-type Stars"	W.J.S.L.
(27)	1930	Mar.	,, ,,	90	523	"Spectroscopic Parallaxes of B-type Stars." (Sixth Paper) ...	D.L.E.
(28)	1930	April	,, ,,	90	580	"Monochromatic Images of the Orion Nebula"	W.J.S.L.
(29)	1930	Nov.	,, ,,	91	187	"Two new Bright-Hydrogen-Line B5-type Stars"	W.J.S.L.
(30)	1930	Dec.	,, ,,	91	215	"The Spectrum of H.D. 20336 in Camelopardalis (Sp. Type B3 nek) throughout a complete Cycle (1925-1930)"	W.J.S.L.
(31)	1931	Jan.	,, ,,	91	259	"A new Bright-Hydrogen-Line Star of Spectral Type B8 in Lacerta" ...	W.J.S.L.
(32)	1931	Jan.	(Astro-Phys. Jour.)	73	55	"Note on the Variable Lines of Hydrogen in the Spectrum of 52 π Aquarii" ...	W.J.S.L.
(33)	1931	May	M.N. R.A.S.	91	797	"On the Relationship between Solar Prominences and the Forms of the Corona"	W.J.S.L.
(34)	1932	Mar.	,, ,,	92	449	"A bright Meteor passing the Pleiades" ...	W.J.S.L.
(35)	1932	Mar.	,, ,,	92	389	"Note on some Peculiarities in Stellar Spectra of Type B"	D.L.E.
(36)	1933	Mar.	,, ,,	93	362	"The Variable Spectrum of γ Cassiopeiæ" ...	W.J.S.L.
(37)	1933	June	,, ,,	93	619	"The Variable Spectrum of γ Cassiopeiæ." (Second Paper)	W.J.S.L.
(38)	1933	Oct.	,, ,,	93	729	"Variations in the Spectrum of 42 Camelopardalis"	D.L.E.
(39)	1935	Apr.	,, ,,	95	520	"The Variable Spectrum of γ Cassiopeiæ." (Third Paper) ...	W.J.S.L.
(40)	1935	June	,, ,,	95	—	"The Variable Spectrum of ζ Tauri"	W.J.S.L.

Norman Lockyer Observatory.

ENDOWMENT FUND.

[*Wording of Legacy for the Endowment Fund.*]

I bequeath, free of duty, to the "Norman Lockyer Observatory Corporation" the sum of £ upon trust to invest, and keep invested, the same in manner provided in the Trust Deed of the 16th day of April, 1926, relating to the Endowment Fund of the Corporation, And upon further trust to apply the annual income thereof for the purposes of the Corporation as expressed in that Deed, And I declare that the receipt of the Treasurer, or other proper officer for the time being of the said Corporation, shall be a sufficient discharge to my Executors for this sum.

NORMAN LOCKYER OBSERVATORY—ENDOWMENT FUND

Form of Declaration to be signed by Donors to the above Fund

I (*name in full*) .....

of ..... in the County of .....

DO HEREBY DECLARE that the sum of

.....

Stock is about to be transferred by me or by my procurement into the name of " The Official Trustees of Charitable Funds " under the authority of an Order of the Charity Commissioners to the intent that the same shall form an addition to the Trust Funds comprised in an Indenture dated the sixteenth day of April One thousand nine hundred and twenty-six and expressed to be made between Lady Thomazine Mary Lockyer and William Newsam McClean of the one part and Norman Lockyer Observatory Corporation of the other part and shall thenceforth be held upon the Trusts which would have been applicable thereto if the same had formed part of the investments originally comprised therein.

AS WITNESS my hand this ..... day of ..... One thousand

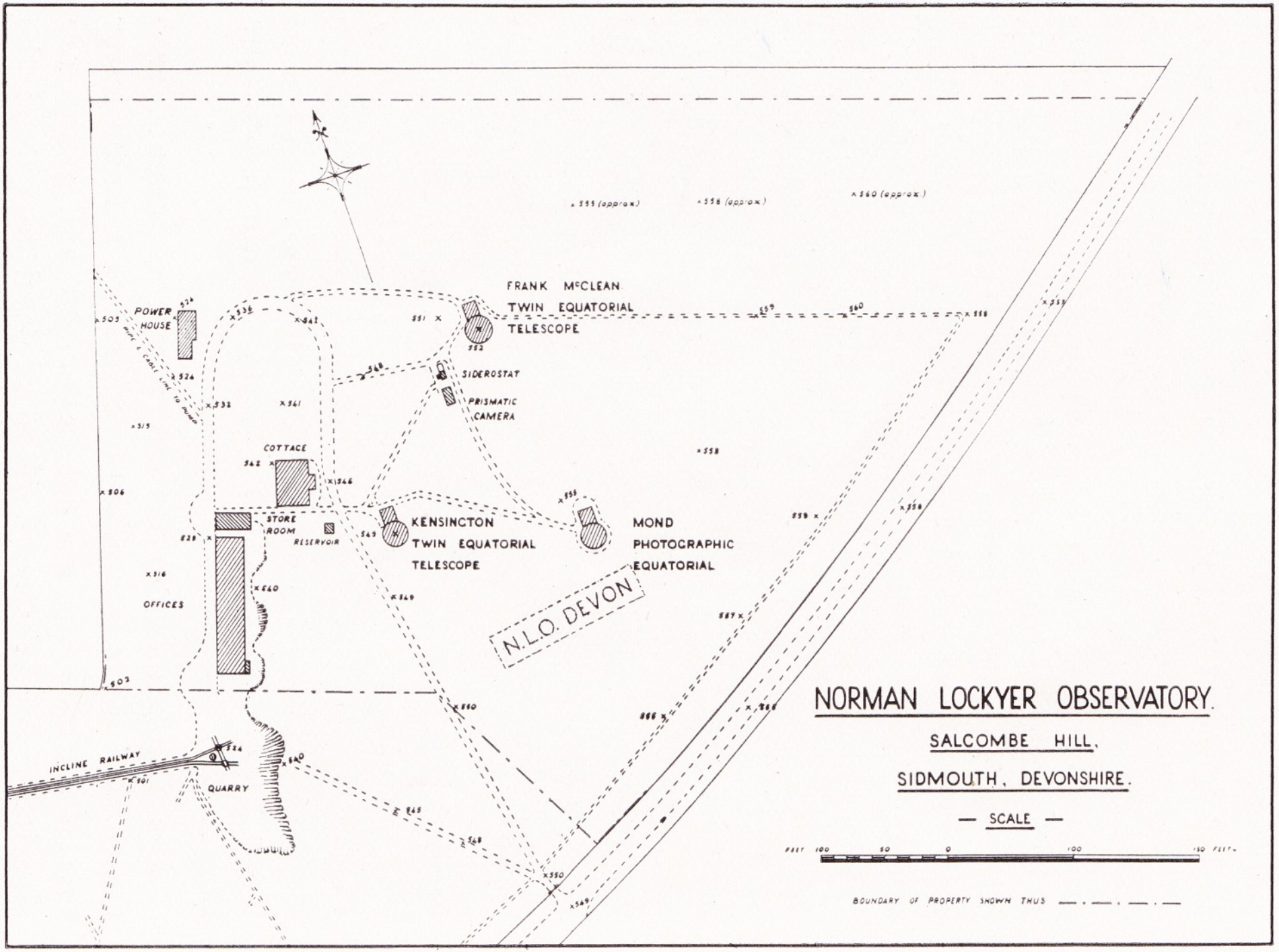
nine hundred and .....

(*Signature*) .....

In the presence of .....

The region round the Observatory. The black cross is the site of the Observatory.

FIG. 3.



Plan of Site.

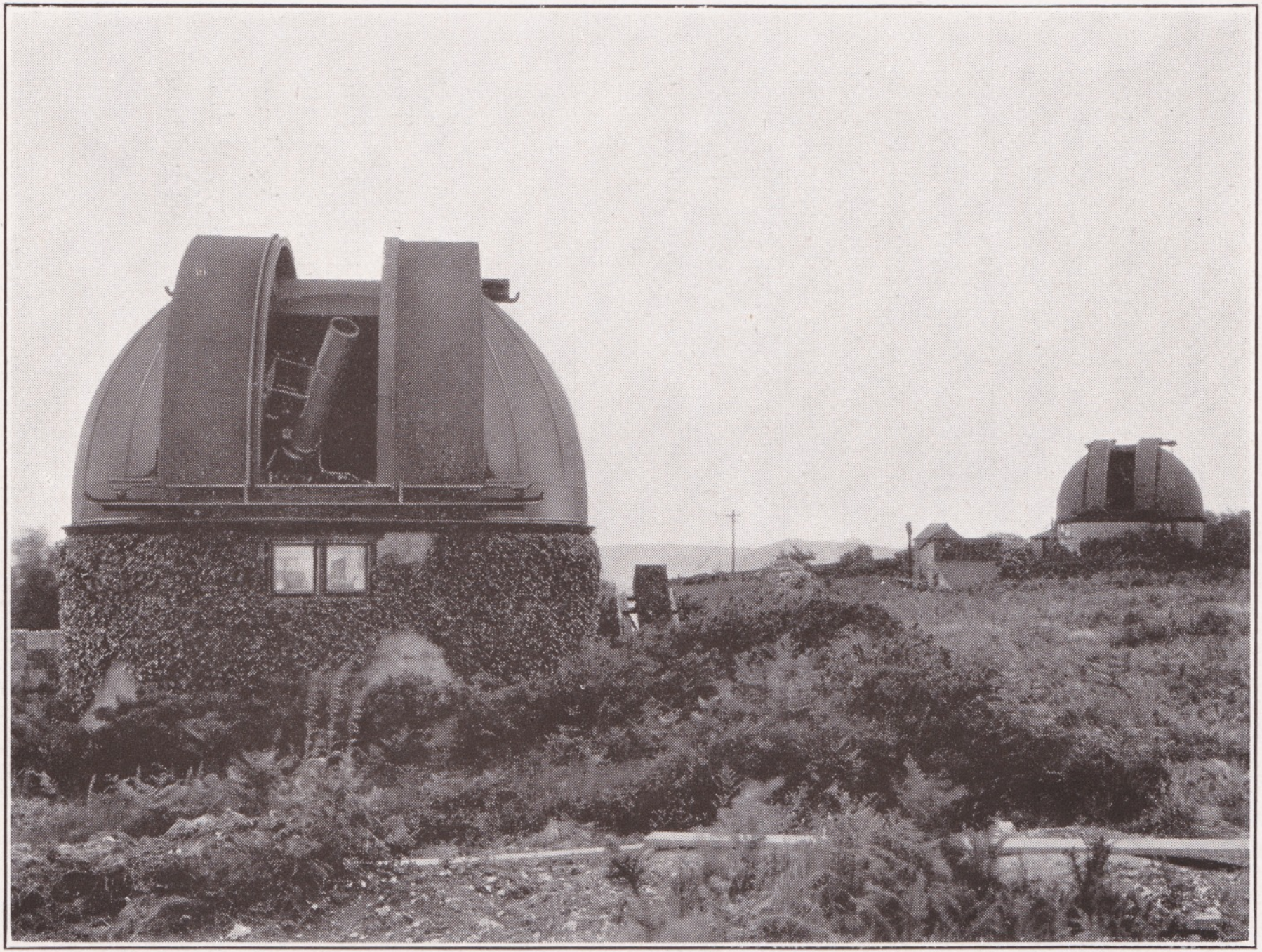
FIG. 4.

The Offices on the Terrace.

FIG. 5.

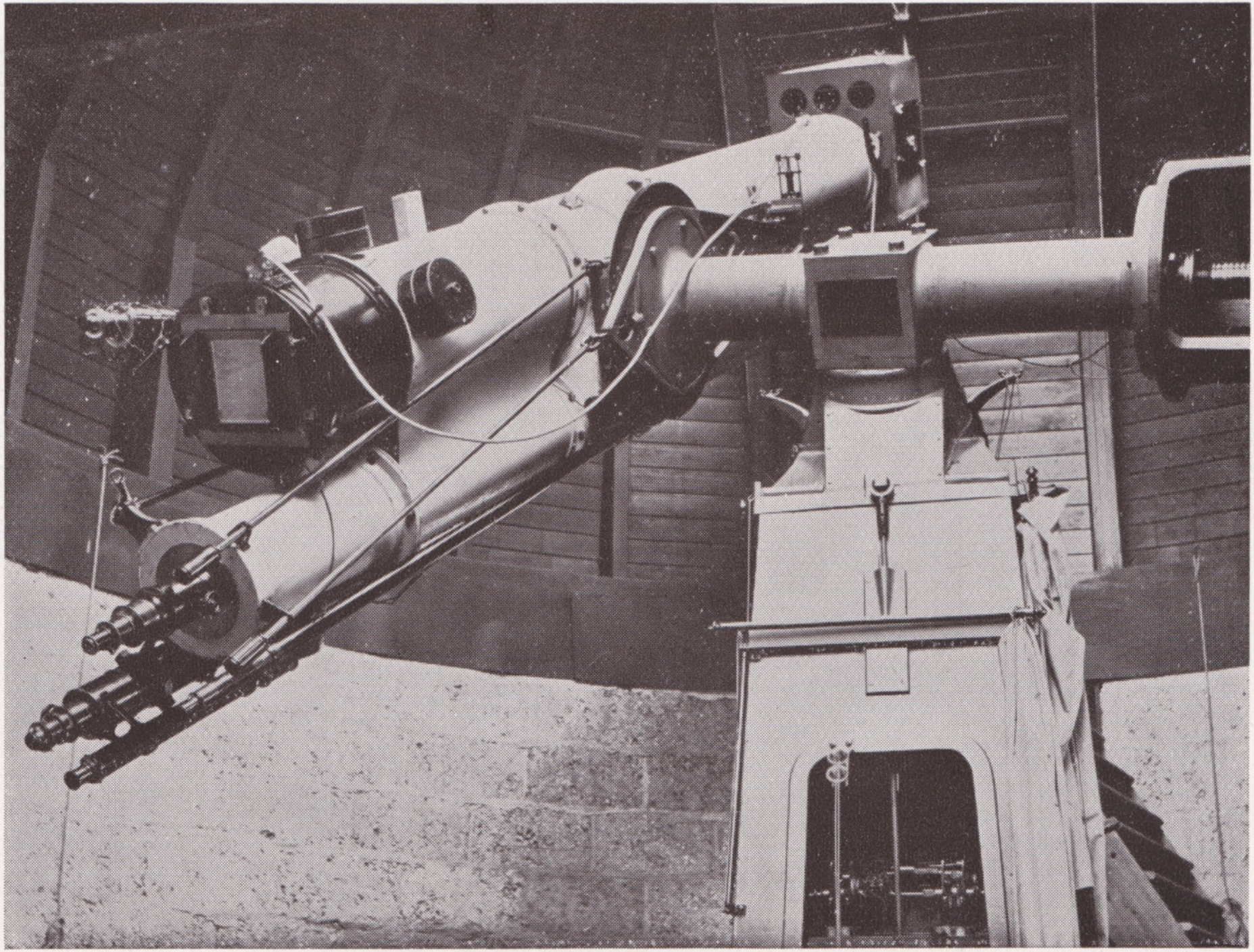
The Director's Room, showing the Library of Reference Books most commonly used.

FIG. 6.



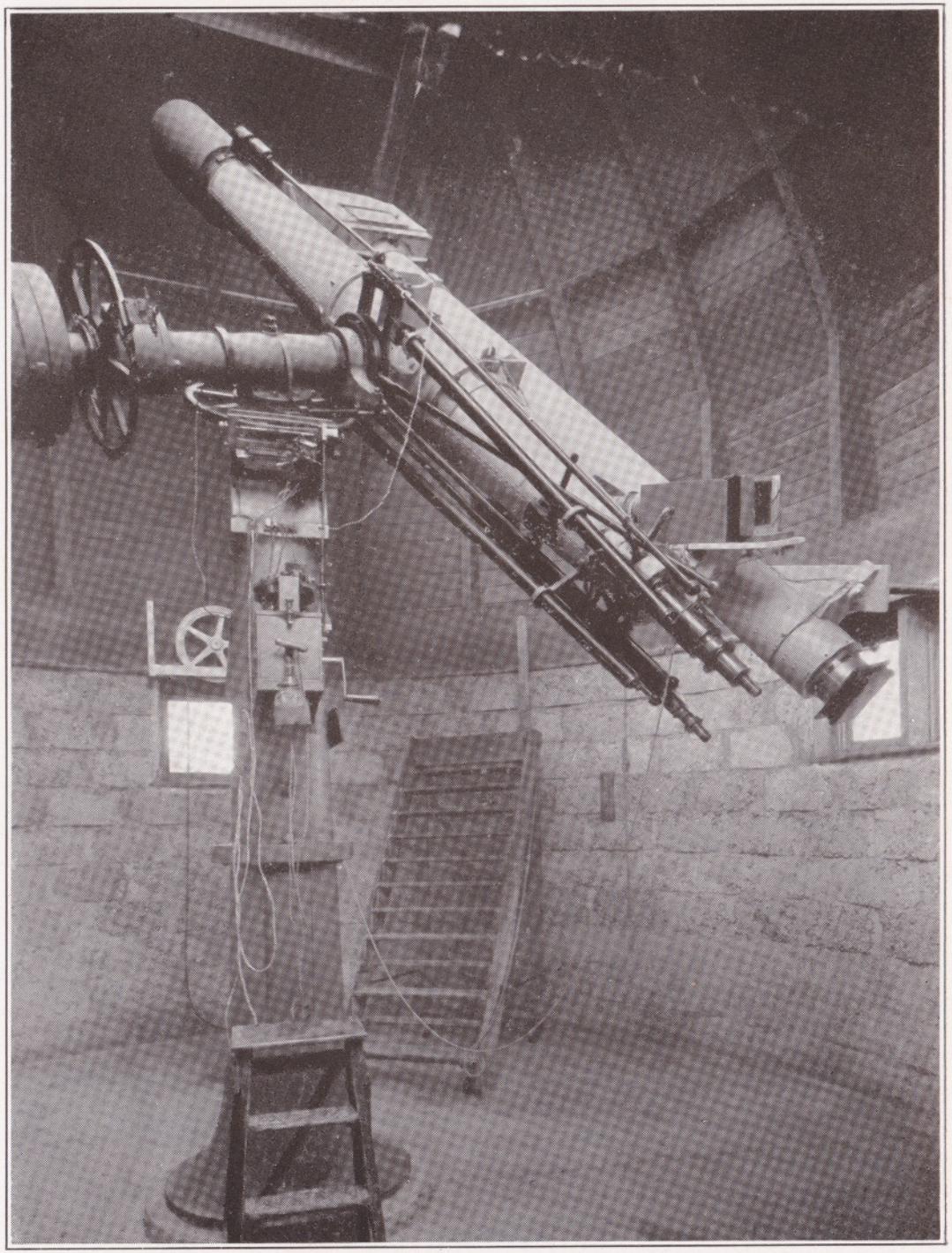
A view from the South of the " Kensington " Dome (nearest the camera) and the " McClean " Dome.

FIG. 7.



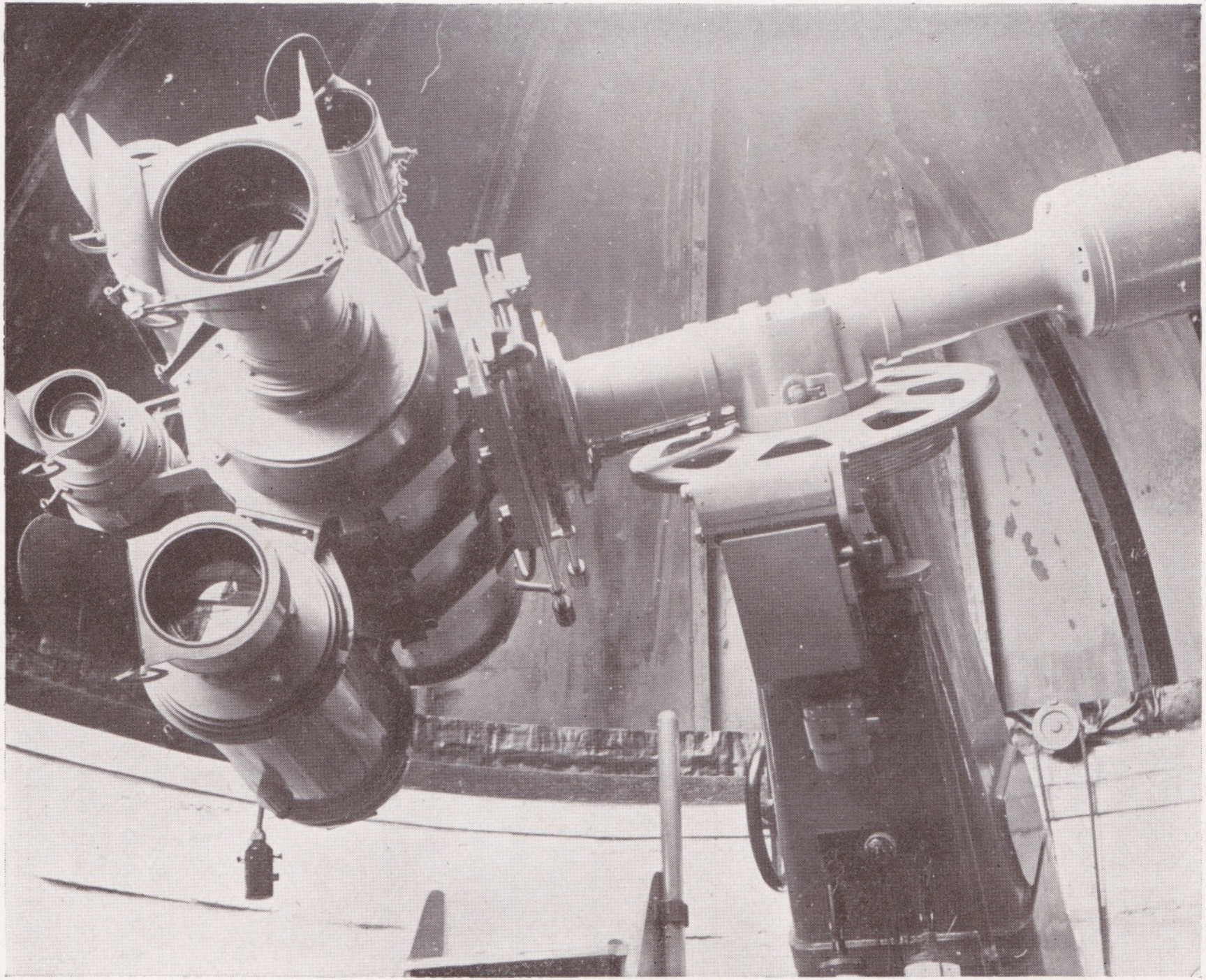
Interior view, showing eye-end and mounting of the "McClean" Telescopes.

FIG. 8.



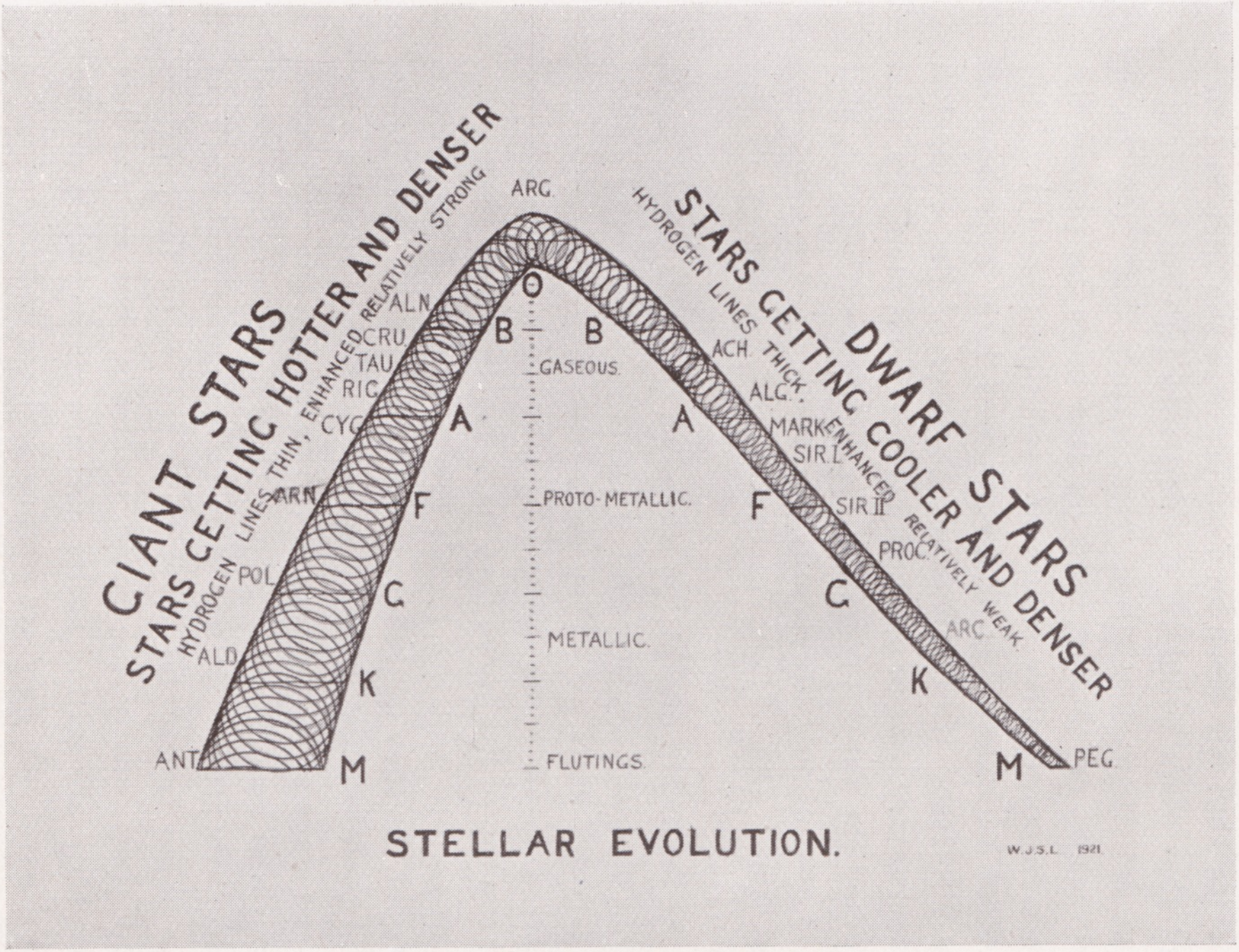
Interior view of the "Kensington," showing the mounting and the two Telescopes.

FIG. 9.



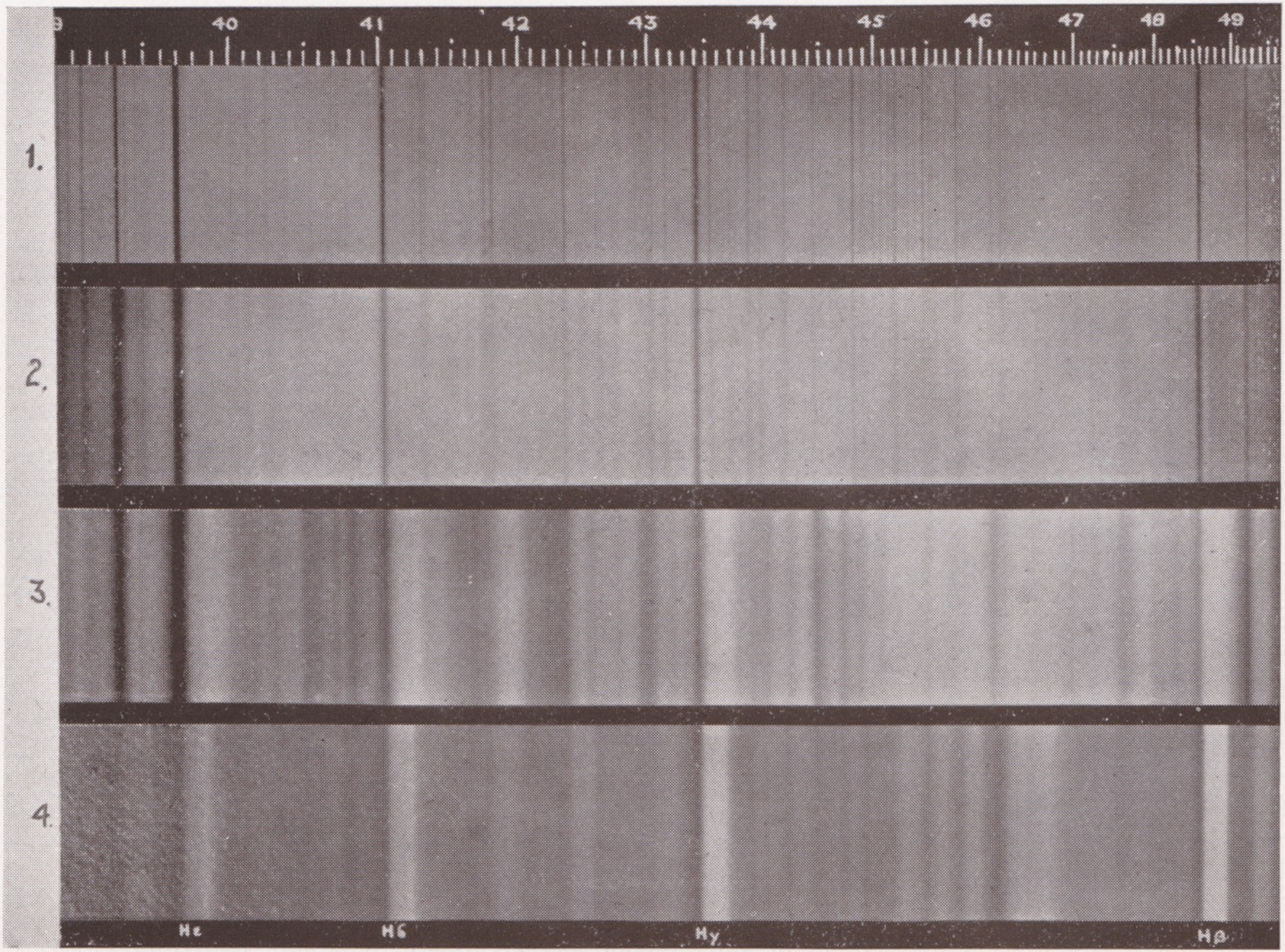
The " Mond " Photographic Equatorial, showing the Polar Axis and the Cameras.

FIG. 10.



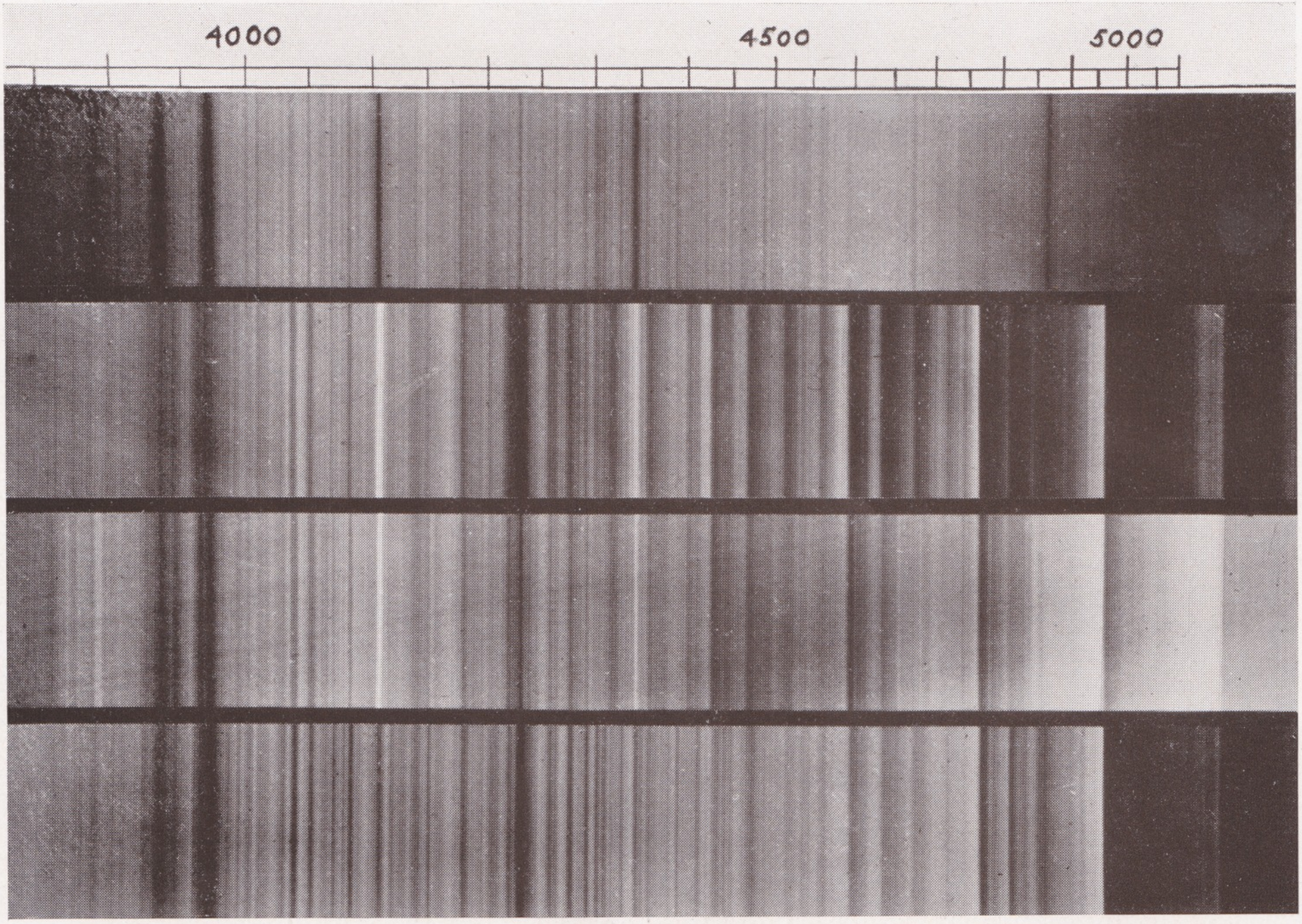
A curve to illustrate the life histories of stars from their birth (left-hand side) to their death (right-hand side).

FIG. 11.



Spectra of Nova Cygni III. (1920) on different dates—(2) Aug. 22nd, (3) Aug. 26th, (4) Sept. 10th, compared with (1) α Cygni.

FIG. 12.



The Spectra of o Ceti—(2) 1914, Dec. 21st, (3) 1924, Feb. 1st, compared with (1) α Canis Minoris and (4) α Herculis.

FIG. 13.