The spectroscopic displacement law—the similarity of the spark spectrum of an element to the spectrum of its immediate predecessor in the periodic table—is studied in detail. A full account is given of the anomalous Zeeman effect and also of the Paschen-Back effect, by which the Zeeman resolution of the components of a doublet or triplet become normal for very strong fields. It is admitted that the theoretical account is "a curious mixture of the quantum theory and of a phenomenological theory of vibration," but the reader is given a fair impression of some of the hand-to-mouth methods which are at the present time so fruitful.

The chapter on band spectra, which has been written in collaboration with Kratzer, is admirable. That the Bohr theory, invented to account for atomic spectra, should lend itself without further assumptions to the general explanation of spectra apparently so different as molecular spectra is one of its greatest achievements. Band spectra may be expected in the future to disclose the structure of molecules in the same way that line spectra have disclosed the structure of atoms, and, judging from recent investigations, the quantum theory of band spectra will have important applications to the physics of stellar atmospheres.

The translation conveys remarkably well the vigour of the original and loses little of Sommerfeld's vivid and sometimes unconventional phrases. Two points might usefully be mentioned. "The angle of inclination of both components" (p. 412) is obscure and is hardly English: what is meant is "the angle between the two components." Secondly, the translator seems to have been beaten by the word "Knotenlinie": to an astronomer, at least, "lines of nodes" would be intelligible. E. A. M.

OBSERVATORIES.

Reports of Observatories for 1922

(continued from p. 256).

Royal Observatory, Greenwich.—The Astronomer Royal's report indicates the usual large amount of observational work accomplished. With the transit circle nearly ten thousand observations have been made, for the most part of stars brighter than magnitude 8·0 in the wide zone 32° to 64° N. declination. The usual Sun, Moon, and planetary programme was also carried out. Considerable progress has been made in the preparation of a catalogue of fundamental stars from the observations made in the years 1915–21. The mean places for 1925·0 have now been derived, and the precessions and secular variations for about three-quarters of the stars have been computed. For the first four lunations of 1923 the errors of Brown's new tables of the Moon seem to be very steady. The mean error in longitude is −7″·8

with a mean discordance of ±0″·81; the errors in latitude are small. The variation of latitude has been derived for 1922 from observations made with the Cookson floating telescope as in the previous ten years.

With the 28-inch equatorial 655 double-star observations have been made. The micrometer has been modified and a graduated strip fixed so as to make the setting of the instrument in declination easier. With the 26-inch refractor 1199 photographs have been taken for stellar parallax. During the year the parallaxes of 49 stars have been determined, making in all 195 determined with this telescope. It is proposed to determine the proper-motions of the parallax stars both in R.A. and Dec., and a few additional photographs are taken when necessary so as to give an interval of 6 or 7 years and the proper-motion with a probable error of ±″·002 or ±″·003. With the 30-inch reflector 23 photographs for effective wave-length have been taken. This completes the area from 85° to the Pole, while the work in zones 83° and 84° is well advanced. With the prismatic camera and grating 19 photographs have been taken. A photometer of the Hartmann type, with modifications suggested by M. Jules Baillaud, is being constructed in the workshop, and is to be used for the measurement of the spectra. The astrographic equatorial, which was re-erected in December after return from the eclipse expedition to Christmas Island, is being used to take new plates of the alternate zones of the Greenwich Astrographic Catalogue. The plates are inserted in the telescope, with the film away from the object-glass so that the new photographs can be measured relative to the old ones—film to film. Displacements of the order of 1″ are readily detected, and as the time-interval is 20 to 25 years or more, all proper-motions as large as 5″ a century should be found. Up to the time of the report, 31 fields have been photographed and 15 measured.

The heliographic, magnetic, and meteorological observations have been carried on as in previous years. With the approach of sun-spot minimum, rapid progress has been made in overtaking war arrears in the measurement which is now practically up to date. A large amount of attention is now given to the reception and comparison of time-signals.

Considerable progress has been made in overtaking arrears in printing. The volumes for 1917 and 1918 have been distributed, the printing of the volume for 1919 has been completed, and that for 1920 is making rapid progress.

Cape Observatory.—The reversible transit circle has been employed in observing a list of stars selected from Boss's catalogue, and over seven thousand observations have been made. Observations of all the outer major planets were made with the heliometer. With the Victoria telescope 300 spectra were photographed on 165 nights. The spectra have been measured for the

determination of radial velocities, and are mainly those of spectroscopic binaries. The 4-prism spectrograph and short camera were usually employed, but the long camera was used for a special series of plates of the spectrum of Procyon required for a determination of the orbit. The orbits of 6 spectrographic binaries have been computed. With the astrographic telescope 123 plates have been taken, the majority for proper-motion determination, the others for comets, minor planets, and standard stellar magnitudes. 119 variable stars have been under observation by two voluntary observers.

Great progress has been made in the reduction and publication of observations. A volume containing the ledgers of Meridian Observations 1912–1917 was issued. Of the Cape Astrographic Zones, vols. iv. and v. were issued, the whole of vol. vi. passed for press, and about half of vol. vii. A catalogue of 20,843 stars brighter than the 9th magnitude in the Cape Astrographic Zone ($-40°$ to $-52°$) was also passed for press. This catalogue gives R.A.'s and Dec.'s. A discussion of all the Cape photographic magnitudes is being carried out.

Durham Observatory.—Mr. Thomson, who has succeeded the late Col. E. H. Grove-Hills as honorary Director, has issued a report of the present state and prospects of the Observatory. The principal instruments are: (1) an almucantar, (2) Hills's suspended zenith telescope, (3) a 6·4-inch equatorial refractor, (4) a transit, and (5) meteorological instruments. There is one observer. It is not proposed to use (1) and (4), and a wireless receiving-set has been installed for the reception of time-signals. There are discrepancies in the results obtained from the zenith telescope, and alterations to the suspension springs are being made. The equatorial is being used for variable-star observations. Meteorological observations are regularly carried out.

Sidmouth Observatory.—Dr. Lockyer and his two assistants are to be congratulated on the successful prosecution of their spectroscopic work. With the 12-inch prismatic camera 720 photographs, with an average exposure of 30 minutes, were taken. The 9-inch telescope is being used for stars down to the fourth magnitude, and 107 plates were taken with an exposure of about an hour. 17 plates are of ζ Tauri, which has a very peculiar, possibly changing, spectrum. The $5\frac{1}{4}$-inch doublet is being employed for the photographs of meteors. Twelve plates have been exposed with the instrument pointed at the Pole. A bright Taurid fire-ball has been recorded on one of the plates. The discussion of the photographs secured is going on steadily. The spectroscopic parallaxes of 500 stars of types F–M have been published, and a list of another 500 is in preparation. The spectroscopic method has been extended to the hotter stars, and a list of the parallaxes of 260 B-type stars is being prepared.

THE LIVERPOOL OBSERVATORY (BIDSTON).—After a career of eighty years, during which the Liverpool Observatory has fulfilled the purpose for which it was designed, the Mersey Docks and Harbour Board, who are responsible for its support and management, have decided that the time has arrived when the usefulness of the institution might be increased by directing its energies into channels additional to those originally contemplated. It may be recalled that the chief objects sought in establishing an observatory in Liverpool were the communication of accurate time to the Port and the rating of chronometers. The action of the British Association at the Liverpool meeting in 1837 contributed largely to the adoption of the necessary measures; the meeting in 1923 might give similar encouraging support to the widened programme now under consideration.

The Mersey Docks and Harbour Board consider that the facilities which the Observatory affords for the advancement of knowledge and diffusion of science and learning might be increased, if a closer union could be established with the University. As a preliminary measure, it was suggested that the future administration and working of the Observatory might be advantageously entrusted to a joint Committee of the Board and University, each nominating five members. This joint Committee has now been appointed, the Board's representatives being Mr. C. Livingstone, Mr. H. F. Fernie, Col. H. Concanon, the Marine Surveyor and Water Bailiff, and the Director of the Observatory, the University nominees being Mr. C. Booth, Prof. Johnstone, Prof. Proudman, and Prof. Wilberforce.

The Dock Board and the University are actuated by a desire to effect an intimate connection between the recently constituted Tidal Institute, the Observatory, and the department of the Marine Surveyor, while the tidal measurements conducted by the Marine Surveyor afford the necessary means for testing the accuracy of prediction. This closer co-operation has the additional advantage of removing the inconvenience of overlapping.

By utilizing the existing establishment as the nucleus of a geophysical observatory, teaching could be combined with research, an extension which is not only feasible but eminently desirable. None of the past activities need be abandoned. The scientific centre would be maintained unimpaired, and its traditions continued. The greater activity exhibited and the execution of an enlarged programme arranged to meet modern requirements should appeal to the intelligence of a progressive community. Meteorology would be followed on extended and more original lines. Magnetic observations, which have never hitherto formed a part of the work, would be actively pursued, and the inconvenience occasioned by the want of accurate magnetic constants removed. The attention already given to seismology could be increased with advantage. Classes are now held in practical surveying and

geodesy, and these, at present hampered by want of room and convenience, could be more fittingly accommodated.

There is a difficulty in finding the necessary funds, especially at this juncture, but if a judicious programme is submitted to the attention of those capable of carrying it into execution, the past history of Liverpool leads one to anticipate that even this great obstacle will not be found insurmountable.

[To be continued.]

NOTES.

Removal of Greenwich Magnetic Observatory into Surrey.—The approaching removal from Greenwich of the magnetic branch of the Royal Observatory will break the continuity of a series of observations, which has extended over a period of 83 years. Magnetic observations were commenced at Greenwich in 1840. Photographic methods of registration of the magnetic elements were not then available, but the variations were determined by eye-observations made at first every two hours and later every hour. Continuous photographic registration was introduced in 1847. In 1913, recording instruments of modern design were substituted for the old instruments and housed in a new and specially-constructed building, maintained at a constant temperature.

With the gradual growth of electric traction, steps had to be taken to safeguard the magnetic traces from disturbance, due to leakage currents. Since 1903, the Observatory has been protected by a special clause inserted in all Parliamentary Bills for electric rail or tramways running within five miles of Greenwich, which required the return currents to be insulated, if the distance was within three miles. Although with this protection the records have not remained undisturbed, the disturbances have been kept within limits sufficiently small to be comparatively harmless.

Recently a large scheme was put forward for electrifying the local lines of the South-Eastern and Chatham Railway. The Greenwich Observatory is completely encircled by the lines through Greenwich and Blackheath, that through Greenwich passing within a few hundred yards of the Observatory. It was apparent that the magnetic work would be seriously affected by any leakage currents. The question of safeguarding the interests of the Observatory was, therefore, taken up by the Astronomer Royal with the Ministry of Transport. The maintenance of a satisfactory system of insulated returns within a certain distance from the Observatory would have involved the Railway Company in very heavy expense. A compromise was ultimately arrived at, by which the Railway Company agreed to defray the costs of the removal of the magnetic observatory to another site and the extra