Observatory, Prof. Perrine has found four principal condensations of the faint nebula surrounding Nova Persei, and that these have been displaced *one minute of arc* to the south-east in a period of six weeks.

MEAN PARALLAX OF STARS.—No. 8 of the *Publications* of the Astronomical Laboratory at Groningen contains an investigation, by Prof. J. C. Kapteyn, of the mean parallax of stars considered with reference to their determined proper motions, magnitude and spectral type.

PLANETARY INFLUENCE ON SUN-SPOT PERIOD.—In the Paris *Comptes rendus* (vol. cxxxiii. pp. 726–729), Prof. Birkeland gives the discussion of a further attempt to trace any possible connection between the 11-yearly sun-spot period and the gravitational disturbance of the planets Mercury, Venus and Jupiter, using observations made from 1892–1896. He comes to the same conclusion as formerly, that the variations cannot be traced to planetary influence.

DISTRIBUTION OF COSMIC VELOCITIES.—Profs. J. C. Kapteyn and W. Kapteyn have recently completed the elaborate treatment of two preliminary communications made by the former to the Academy of Sciences at Amsterdam, and the first part of the treatise is published as No. 5 of the *Publications of the Astronomical Laboratory of Groningen.*

In this an attempt is made to deduce, from the available observations of proper motion, the law defining the relation between the number of stars having linear velocities of determined values, or shorter, the law by which the frequency of a linear velocity is given as a function of its magnitude. The main assumption on which the derivation is based is "the real motions of the stars are equally frequent in all directions."

In the papers mentioned above it had been stated that certain inequalities existed in the distribution of velocities with respect to the apex of the solar motion, and that these had been traced to the influence of a systematic error of the proper motions in declination. It is now thought that many of the former difficulties will be removed by the introduction of a correction for this anomaly.

The formulæ given are developed to such terms as are likely to provide for any great future extension of the accuracy attainable in proper motion determinations, and although the time may come when spectroscopic investigations of velocity (the accuracy of which does not depend on the distances) will supersede the present observations, at present the possibility of having two independent determinations from different components of the real motion is a valuable and important consideration.

The second part of the work, dealing with the application of these formulæ to the observations, will be presented in a later publication.

THE INFLUENCE OF THE MEDITERRANEAN PEOPLES IN PREHISTORIC BRITAIN.[1]

THE progress of archæological discovery during the last twenty years has thrown a flood of light on the relation of the prehistoric period in Europe north of the Alps to the civilisation of the Mediterranean in the period embraced by history. We are now in a position to recognise the source from which the inhabitants of middle and northern Europe, and of the British Isles, obtained the art manifested in their articles of daily use, and we are able to trace them back to that wonderful Mediterranean civilisation, proved by the labours of Schliemann to be older than the Greeks and shown recently by Mr. Arthur Evans to have occupied a commanding position in the island of Crete. Schliemann discovered its range over the eastern Mediterranean from Troy to the Peloponnese, Evans extends it to almost within sight of Italy, where the Etruscan civilisation is the dominant factor at the dawn of history.

The picture presented to us of the Mediterranean region during the period extending from the establishment of the Greeks in the east and the Romans in the west, backwards to at least 2300 years B.C., as proved by the discoveries at Knôssos, may be outlined as follows. A civilisation of the very highest order existed in the region extending from Italy eastwards through the Ægean Sea to Asia Minor, equal in splendour to that of Egypt and Assyria. Although it borrowed many things from both, it was a development independent of both, and, so far as the evidence goes, it appears to have been indigenous in the Mediterranean region and Asia Minor. Whether or no it is as ancient as that of Egypt and Assyria is an open question.[1] It was common to the ancient Trojans and Mycenæans overthrown by the Greeks, to the Cretans, and to the Etruscans overthrown by the Romans. It is worthy of remark that in the eastern Mediterranean it formed the foundation of Greek art, while it survived in the west under the name of Roman, its possessors in each case being absorbed into the Greek and Roman peoples.

The establishment of the Phœnicians in the Eastern Mediterranean, at least as far back as the seventeenth century B.C., as proved in the records of Egypt, has also to be considered. They were the great merchants and carriers, distributing the wares of Egypt, and later of Assyria, to the various Mediterranean peoples, founding colonies here and there, among the greatest of which was Gades (Cadiz), about 1100 B.C., and Carthage, 814 B.C. Their fleets in penetrating westward had to contend with the Etruscan maritime power, dominant in the western Mediterranean. They and the Etruscans were the great distributors of metal, more particularly bronze, and their ships penetrated in later times far northwards along the Atlantic shore. It is not at all improbable that Phœnician ships coasted along the Atlantic as far north as the British Isles, bringing with them the wares of the Mediterranean and returning with tin from Cornwall and gold from Ireland. There is, however, no absolute proof of their presence in Britain, because, like the English of to-day, they had no art of their own and merely imitated the art of other peoples.

During the period under consideration, the various peoples inhabiting the Mediterranean were sufficiently organised to allow of a confederacy for the attack of Egypt. The first mention of a European people in the Egyptian annals is the attack of the Sardones and the Tyrrhenes (Etruscans) and their defeat by Ramses II. in the seventeenth century B.C. This was followed about seventy years afterwards by a more formidable combination, in which the two above-mentioned peoples were joined by the Sicels, Lycians, Achæans and Lybians. The allies advanced by sea and land, conquered part of the Delta, and were defeated after a desperate struggle by Meneptah I.

It remains now to trace the influence of the Mediterranean civilisation through middle and northern Europe. The two oldest routes of traffic are those starting from the head of the Adriatic, from the ancient Etruscan city of Hatria. The first runs by Trieste, Laibach, Gratz and Bruck, to Presburg, and thence past Breslau and along the Lower Vistula to the amber coast of Samland. The second, or western route, takes the line of the Adige, past Verona and Trient, over the Brenner Pass into the valley of the Inn, crossing the Danube either at Linz or Passau. Thence it ran through the Bohemian passes into the valley of the Elbe, and made for the amber coast of Schleswig and Holstein. These were the two principal routes taken by the caravans, which brought to the inhabitants of middle and northern Europe in the Bronze Age bronze swords, axes, daggers, bracelets, brooches and other articles from the south, carrying back, among other things, the amber so highly valued by the Mediterranean peoples. There were probably similar routes to these northwards and westwards over the plains of France, starting from the Alpine passes, and along the river valleys, along the lines afterwards followed by the Greeks of Marseilles (Massilia). It was probably by one or other of these routes that brooches, swords and other implements of southern derivation, arrived at the sea-board of the North Sea and Atlantic, and were brought by ship into Britain and Ireland. Ireland, it must be noted, at this time was the *El Dorado* of the west, attracting adventurers from the south both by sea and land.

These routes were also used in the prehistoric Iron Age north of the Alps, and along them metal work of most beautiful design, brooches and bracelets, mirrors and other articles, belonging to the so-called "late Celtic" art, were introduced into Britain—such, for example, as the mirror, brooch, and bronze bowl found at Glastonbury. In Ireland this art is amply represented in the numerous golden and bronze ornaments.

The Greeks, too, after their establishment at Massilia in the sixth century B.C., took up this trade, making clearly defined routes through France, to the Atlantic shore and to the Rhine valley, along which the tin of Cornwall was carried overland to

[1] Presidential Address by Prof. Boyd Dawkins, D.Sc., F.R.S., to the Vesey Club, on October 15, illustrated with slides.

[1] I feel unable to accept Prof. Flinders Petrie's conclusion, that some of the pottery found in the tombs of the first dynasty in Egypt belongs to the Mycenæan or Ægean pottery, and therefore goes back as far as 4750 B.C.

the south. They also probably carried on a trade by sea. In 325 B.C., Pythias, the first explorer of Britain known to fame, was sent at the head of an expedition from Massilia, working his way along the Atlantic coast and wintering somewhere near Dover. From this point he sailed to the Orkneys and Scandinavia, returning by way of the amber coast at the mouth of the Elbe. The Greek influence was also felt from the northern borders of Greece through Germany. In Britain a coinage which was copied from the Stater of Philip of Macedon marks the close of the prehistoric Iron Age, when the Greek influence was dominant. In Ireland, it is worthy of note, none of these coins have been met with, and it is likely, therefore, that the Greek influence was never felt in that island.

From this outline it is clear that the principal artistic development in Britain, in the Bronze and prehistoric Iron Ages, was due to the art of the south, and that it was derived mainly from the Mediterranean civilisation, including under that term Mycenæan, Ægean, Etruscan and Dalmatian art, and that in later times it was aided by intercourse with the Greeks.

W. BOYD DAWKINS.

THE MOVEMENTS OF PLANTS.[1]

IT is sometimes asserted that the power of movement is a character distinguishing animals from plants. This statement arises to some extent from an obvious confusion of thought. Trees are stationary, they are rooted to one spot; but they are not, therefore, motionless. We think them so because our eyes are dull—a fault curable with the help of a microscope. And when we get into the land of magnification, where the little looks big and the slow looks quick, we see such evidence of movement that we wonder we do not hear as well as see the stream of life that flows before our eyes.

In speaking of the cells of which plants are built, Mr. Huxley said that a plant is "an animal enclosed in a wooden box, and Nature, like Sycorax, holds thousands of delicate Ariels imprisoned in every oak." It is this delicate prisoner, the living protoplasm, that we may watch pacing round its prison walls. And we may see it stop as though frightened at our rough usage, and then, after a hesitating twitch or two, we see it recover and once more flow round the cell. Or we can see under the microscope minute free-swimming plants rushing across the field of view, all one way, like a flock of little green sheep that we can drive to and fro with a ray of light for a sheep dog.

But I am not going to speak to-night of microscopic matters, but rather of things on a bigger scale which can be seen with the naked eye. I will begin by trying to show that very obvious movements are to be seen in every kitchen garden or in every garret window where a scarlet runner is grown for its red flowers' sake.

If you will examine a scarlet runner, you see that the shoot is not completely vertical, but bends over to one side. To record the movements of the plant a series of photographs may be taken vertically from above the plant, so that the end of the shoot shows like the hand of a watch against a sort of clock-face on which the points of the compass are marked. These photographs will show how the shoot swings round in its instinctive search for another stick to climb up.

This well-known movement is performed by a co-ordinated series of curvatures the exact nature of which need not trouble us now. Let us rather consider the less obvious power of coordination which enables a plant to grow upwards in a straight line. Think of a forest of pine trees, hundreds of thousands of them, all growing vertically up towards the sky. Here is a clear case of movement, for the leading shoots were once but a few inches from the ground, and now they are crawling along vertical lines 100 feet up in the air. It may be said that this is mere increase in size, not movement in the ordinary sense. But I can show you that the trees could not grow in this way had they not a power of curvature to which the name of movement cannot be refused.

As it is not easy to experiment on pine trees, we will use a pot of mustard seedlings, which represents in miniature a forest of vertical stems. Now suppose the flower-pot upset and left lying on its side for a few hours: the seedlings will be found to have all recovered the vertical position, and they have done so by a bend which is just as much a case of movement as the flexure of a man's arm, though it is effected by a very different mechanism. Not everyone realises how rapid this movement is. Fig. 1 is from a diagram made in the ordinary course of class-work at Cambridge, and illustrates this point. A shoot of *Valerian* was placed horizontally at 2.17 and a black line painted like a silhouette on a vertical sheet of glass to record its position at 2.30; similar lines were painted at intervals, forming a record of fairly rapid movement. If greater delicacy of observation had been practised, it would have been easy to show that the plant begins to curve up within a few minutes of being placed horizontally.

It is a remarkable fact that the plant should be stimulated, or stirred up, to a definite curvature by merely placing it horizontally. The curvature tends to bring the plant into the upright position, and when the whole stem has reached the vertical, the stimulus ceases to exist. It is as though the plant were in a condition of content when vertical and of discontent in any other position, and as though the discontent expressed itself in curvature.

But the plant does not gain the vertical by a single continuous curvature; at first it overdoes the thing (see Fig. 1) and the end of the shoot may pass beyond the vertical by 20°–30°. But this new position, inasmuch as it is not vertical, originates a new stimulus, and the new curvature which follows brings the shoot back towards the upright position. It may again overshoot the mark, but by repeated corrections it finally attains the normal upright posture.

It is this power of correcting the line of growth whenever it deviates from the upright that enables the pine tree to grow

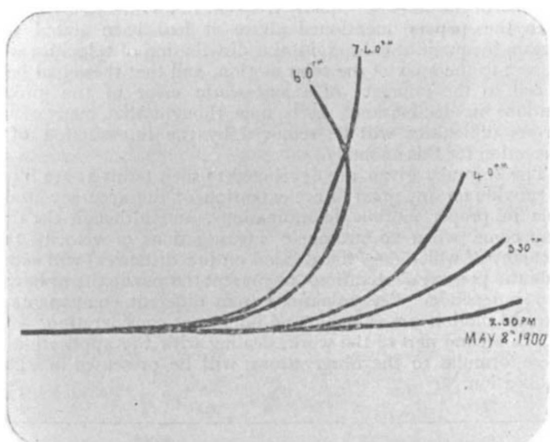

FIG. 1.—A *Valerian* stem curving geotropically.

straight upwards. And this is what I meant when I said that its habit of growth depends on regulated curvature to which no one can refuse the name of movement.

The pine and the seedling have, in fact, a wonderful kind of sensitiveness—a sensitiveness to the force of gravity. To those accustomed to think of Mimosa as the sensitive plant *par excellence* my words may sound strange. But the sensitiveness of Mimosa is crude by comparison with that of the seedling. A plant with a perception of the position of the centre of the earth and a power of growing along the line so perceived is a much greater miracle than a leaf that closes its leaflets when burnt or cut or shaken.

I hope I shall be able to prove to you that we can point to certain parts of the plant which have the special quality of the perception of gravitation, but we are at present ignorant of how the act of perception is effected. We know something of the machinery of hearing or vision in animals, but in plants we can only guess that when a cell is placed horizontally a resulting change of pressure on the protoplasm produces that loss of equilibrium which is translated into curvature.[1]

The use of this gravitational sensitiveness is clear enough. It is to the pine tree what a plumb-line is to the builder, for

[1] Evening lecture delivered at the Glasgow meeting of the British Association, September 16, by Francis Darwin, F.R.S.

[1] It is, however, probable that Nemec and Haberlandt are right, and that the stimulus depends on the pressure of solid particles, *e.g.* starch-grains, on the protoplasm. See their papers in the *Deutsch Bot. Ges.*, 1900.