That the elastic yielding of the ballast under the passing loads, and the slight rocking of the ties, absorb or resist the creeping force, would appear from the fact that the tendency to creep is most pronounced where the supports under the rails are held rigidly, as in bridges. On the Harrisburg bridge, over the Susquehanna, the Pennsylvania company encountered this difficulty, but arrested the movement by spikes through the angle-splices at joints. On the St. Louis arched bridge, and its east approach, there is found a most remarkable example of creeping rails. Prof. J. B. Johnson, in a paper read before the Engineers' club of St. Louis,[1] discusses this case at length, and offers an explanation.

The bridge proper is 1,600 feet long; the east approach, a series of short girders on iron columns, is 2,500 feet long, with a grade rising towards the bridge of eighty feet per mile; both are double-tracked. As it was thought by those in charge of the bridge that fastenings at frequent intervals, to resist the movement, would bring too great a strain upon the structure, the attempt was made to restrain the rails by holding them firmly at isolated points some distance apart, with the result that spikes, bolts, and splice-bars were sheared off or torn apart. After the failure of attempts to arrest the creeping, the track was cut at the two abutments and at the east end of the east approach. The time of eight men (five by day, and three by night) is stated to be largely occupied in changing rails at these points. Where the openings are enlarging, short pieces of rail are taken out, and longer ones put in their place: where the openings are closing up, the process is reversed. Each operation is performed many times a day, and a careful record is kept, from which the following facts were obtained: the north track, when carrying an annual westward traffic of about 5,283,000 tons, moved west on the approach and up-grade 401 feet in a year, and on the bridge moved 264 feet; the south track, under an eastward traffic of 4,807,000 tons, crept east 414 feet on the approach, and 240 feet on the bridge, in the same time. The movement each way on the bridge was proportional to the tonnage; and the difference on the approach was doubtless due to the grade, as the changes of temperature would produce a slipping down hill, as previously stated.

Professor Johnson cites some explanations of this case that have been given: viz., the stopping of trains on the bridge; the deflection of the bridge itself by the weight of the train; the distortion of the arch, as a train enters a span, by its curve becoming less convex on the loaded portion, and more convex on the unloaded side, with a reversal of the distortion as the train passes over and off the span, the arch thus slipping under the rails; and, finally, the elastic rolling-out and recovery of the rails under successive wheels, as we may imagine a strip of rubber to move as a roller is passed over it. He does not think, however, that these causes are sufficient to account for so great a movement, and, in explaining his theory, offers a preliminary illustration. Suppose a span of a bridge to have supports exactly alike, such as sliding surfaces, at the ends of the bottom chord, and a train to enter upon it. The bottom chord is stretched by the action of the load, and, as the end where the engine enters is held fast by the added weight, the other end must slip on its support in the direction of the train movement. As the cars pass off at this latter end, and hold it fast, the lower chord shortens, and recovers itself at the first bearing by slipping towards the train. Thus the bridge creeps in the direction of the moving train. If the points of support were under the upper chord, the direction of this creeping would be reversed. When rollers are placed under one end, and the other is anchored fast, the slip and recovery take place on the rollers, and no creeping results.

He notes that between the trucks of every car the rail springs up from the support an appreciable distance, by reason of the elasticity of its bearings, and that, when pressed down by the passage of the rear truck, any marked point on it has advanced a small distance. A wave-motion of the rail may be perceived in advance of every wheel, and an increment of forward movement every time a wheel passes. The more cars, the more movement for any train. The rail moves across the bridge by reason of the extension under flexure of the flange on which it rests. In proof of his position, he showed, by a model over which a loaded wheel was rolled, that a rail supported by the bottom flange will creep forwards, and that the same rail, when supported by its head, will creep backwards; and hence he argues that some point of support between the head and the bottom flange may be found, for which the tendency to creep shall be zero.

[1] Journal of the Association of engineering societies, November, 1884.

THE PATRIARCHAL THEORY.

IN 1861, Sir Henry Maine's work on 'Ancient law' was published. In that work he clearly set forth the importance of 'legal fictions' in the development of institutions. In this respect, his work will remain as a permanent contribution to the science of society. In the same treatise he made an exposition of the patriarchal theory of the origin of society, which had long been held by a class of writers in Europe. In his introduction he says, —

"This evidence establishes that view of the race which is known as the patriarchal theory. This theory is based on the scriptural history of the Hebrew patriarchs. All known societies were originally organized on this model. The eldest male parent is absolutely supreme in his household. His dominion extends to life and death, and is as unqualified over his children

The patriarchal theory. Based on the papers of the late John Ferguson McLennan. Edited and completed by DONALD MCLENNAN. London, *Macmillan*, 1885. 16+365 p. 8°.

as over his slaves. The flocks and herds of the children are the flocks and herds of the father. These he holds in a representative rather than in a proprietary character.''

Subsequently 'Village-communities in the east and west,' 'Lectures on the early history of institutions,' and 'Dissertations on early law and custom,' were published, in which Maine still advocated the patriarchal theory. Arguments for this supposed origin of society were derived from the history of the Romans, Greeks, Hindoos, Celts, Teutons, Slavonians, and Hebrews.

In 1868 the Smithsonian institution published Morgan's great work on 'Systems of consanguinity and affinity of the human family;' and in 1877 his work on 'Ancient society' appeared. In these, and in miscellaneous articles published in the reviews, Morgan clearly and fully established the existence of more primitive forms of social organization than those exhibited in the Scriptures and early Roman history. Thus the patriarchal theory fell to the ground. Morgan's investigations extended far and wide among the lower tribes of mankind, and his work altogether constituted a masterpiece of inductive research.

But we now know that Morgan's work had one blemish. Seeing that the growth of family institutions, which constitute a large part of primitive sociology, was in the main toward a higher state of society as measured by the standard of civilized ethics, he accredited savage peoples with modern opinions relating to physiology, and with a high degree of moral purity, and held that the growth of institutions was due to a conscious effort at reform. While, therefore, Morgan's theory of the structure of primitive society was established on abundant facts, his theory of the origin of this structure and the cause of its development was unsound. Thus it occurred that a theory of the structure of society resting upon an inductive basis was to some extent discredited because of *a priori* theories of social and moral reform. Inductive conclusions suffered by reason of their association with deductive errors. For these reasons certain scholars in Europe, and especially in England, have to some extent ignored Morgan, and have gone on to re-affirm and elaborate the patriarchal theory. Chief among these is Sir Henry Maine.

J. F. McLennan, the author of 'Primitive marriage,' and other works on tribal society, collected a great body of facts relating to marriage by capture, and the interesting formalities which supervene upon that institution, and from them deduced the theory of exogamy and endogamy, by which he classified the tribes of mankind into exogamous and endogamous, and thus failed to discover that exogamy and endogamy are correlative parts of the same institution. McLennan was evidently dealing with facts more primitive than those with which Maine was dealing, and, soon discovering the errors into which Sir Henry had fallen in his patriarchal theory, he finally commenced the preparation of a critical treatise on that subject, probably for the purpose of clearing the ground for the more elaborate treatment of his theory of marriage and concomitant theories of tribal kinship. He died before his work was completed. His brother, Donald McLennan, has taken up the subject, and edited the papers, adding new material. The book which we now have before us is the result, and is a very fine piece of destructive criticism. The entire field occupied by Sir Henry Maine is reviewed; and the facts from Aryan and Semitic history are carefully examined, and shown to be quite contradictory of Maine's theory. He shows, further, that the particular form of patriarchy discovered among the Romans, and which Maine claimed to have been the universal form, was exceptional, and that the Roman tribes presented the sole instance. To American anthropologists this work may seem one of supererogation; but it will serve a good purpose by clearing the ground of false theories which have had deep root, and have been continually springing up to choke the growth of sounder doctrines.

In this new book by the McLennan brothers, the destructive part is much more satisfactory than the constructive: in fact, the critical portion is somewhat marred by erroneous theories relating to primitive marriage, and by some strange blunders relating to kinship, — blunders common to many writers on sociology.

It seems probable that a form of social organization based upon communal marriage was primordial; but, be that as it may, it must here be neglected. It has been established that a very early form of society was based upon kinship, and that kinship was used to organize peoples into groups of different orders. In the very simplest form, there is always a larger group including two or more smaller groups. In this grouping, kinship of one kind is used to combine the individuals of a smaller group into a minor body politic, and kinship of another kind to combine the groups into the larger body politic. Thus the group in its various orders depends upon the recognition of different kinds of kinship. To make this plain, it becomes necessary to define

the kinds of kinship recognized in primitive society. First, then, kinship by consanguinity and kinship by affinity are clearly distinguished. Then kinship by consanguinity, or 'cognation,' as designated in Roman law, is divided into parts. The consanguineal kindred of any given person may constitute a large body. There may be selected from this body all of those persons whose kinship may be traced exclusively through males. Such kinship was called by the Romans 'agnation,' and the body of included kindred, 'agnates.' From the same body of cognates there may be selected all those who can trace their kinship exclusively through females. Let such kinship be termed 'enation,' and the body thus constituted, 'enates.' The agnates and enates together constitute but a part of the whole body of consanguinei or cognates. In all tribal society, either the agnates or the enates are clearly distinguished from the other cognates, and organized into a body politic, usually called the clan or gens.

Maine holds in that primitive society agnation was the only kinship recognized, and that enation is an accidental and infrequent derivative; that the true course of kinship development is from agnation to cognation. McLennan holds that in primitive society enation only was known; that agnation is an accidental and infrequent derivative; and that the true course of evolution is from enation to cognation. The fact is, that cognation, including enation and agnation, is primitive; that is, that no society has yet been discovered among the savage tribes still living on the globe, or in recorded history, that has not recognized cognation in its different branches; and in all cases different kinds of kinship have been used for different organizing purposes.

In the simplest form above mentioned, where the group constituting a tribal state is organized into sub-groups, sometimes the higher group is bound together by affinity and general cognation, while the smaller group has a kinship bond of enation. And, again, sometimes the higher group is bound together by affinity and general cognation, while the smaller group is organized on agnation. In either case, the tribal bond is affinity with cognation; and in like manner the clan bond is either agnation or enation. The evidence that cognation has been recognized in all tribal peoples, is complete. Not a single tribe has yet been found to ignore it in its social organization; and, in every language that has been investigated, kinship terms for it are discovered. The real question, therefore, is not whether agnation or enation is the more primitive, but whether agnatic kinship or enatic kinship was the tie which bound together the members of a clan or smaller group in the tribal organization. Sir Henry Maine and the McLennan brothers alike have failed to discover this, one of the most patent facts concerning primitive institutions; and this failure has led both parties into the most radical errors.

There is another institutional principle which seems to be primordial; at any rate, it is everywhere woven into primitive custom-law. This principle will here be called 'elder-rule.' It would seem that primitive men in the savage state, groping for some means to prevent controversy and secure peace, hit upon the very obvious expedient of giving authority to the elder; so that, in all the relations of life, superior age should confer authority.

There are thus two primordial principles in early law: the first is that kinship by affinity and consanguinity is the bond of society; and the second is that authority inheres in the elder. These two principles have been worked out in many and diverse ways, and about them have gathered many legal fictions; but they were primordial, and have been universal down the whole course of history, including the highest civilization; so that even now affinity and consanguinity, both agnatic and enatic, together with elder-rule, still continue, — the one as the bond of the civilized family, and the other as its rule of authority. But the history of the application of these principles is long and varied.

The Roman patriarchate was defined by agnation; and the group was a body whose kinship was reckoned only through males, and over whom the patriarch, who was the highest male ascendant, was the ruler. This ruler had despotic power. He owned his wife, and by legal fiction reckoned her as the elder sister of his daughters. He also owned his sons, and his sons' wives, and their children, and was the owner or custodian of all the property belonging to the group. This is *patria potestas*. The patriarchy, therefore, is a despotic form of elder-rule exercised by the eldest ascendant over a group of agnatic descendants. On the death of the patriarch, the group was dismembered into as many parts as there were sons with families. The patriarchal group, therefore, was dissolved and re-organized with every passing generation.

There is another form of elder-rule, which I shall denominate 'presbiarchy,' in which the ruler is the oldest man of the kinship group,

whether that group be agnatic, enatic, or cognatic. Such a group does not necessarily dissolve on the death of the ruler, for the next younger man who is the oldest of the group takes his place. The group, therefore, is comparatively permanent, and there is no inherent necessity for its dissolution. It may remain as long as there is a living man to act as ruler. Presbiarchy has widely prevailed: in fact, it seems to be primordial.

The patriarchy, with its *patria potestas*, as far as we now know, was confined to the Roman tribes: but the patriarchy without absolutism has been much more widely distributed, and it has probably been associated also to a greater or less extent with presbiarchy, real or fictitious; so that the latter has frequently been divided into patriarchies, they being subordinate groups.

Maine and the McLennan brothers seem not to recognize presbiarchy; and Maine, wherever he discovered evidences of it, and also where he discovered evidences of any other form of elder-rule, presented them as proof of the existence of the patriarchy. Had the McLennans recognized elder-rule, they could have made their criticism of Maine much more effective. As it is, they have successfully attacked Maine's theory by showing that *patria potestas* has not been widely spread; in fact, that there is no evidence of its existence, except among the Romans.

Maine also bases his theory of the primordial and universal patriarchy upon his theory of agnation; and, wherever he discovers a recognition of agnation, he holds that it is evidence of the patriarchy with *patria potestas*. The McLennans show that agnation is not the only kind of kinship recognized in tribal society, by arraying much evidence of the recognition of enation; but they themselves fall into the antipodal error of supposing that enation was the only kind of kinship recognized.

Altogether the patriarchal theory of Maine has been successfully overthrown in the work before us, by a re-examination of the very facts adduced in its support; and we owe a debt of gratitude to the authors for the thorough way in which they have accomplished their task. If, now, Sir Henry Maine will on his part as completely overthrow the McLennan theory of exogamy and endogamy, and its concomitant polyandry, the ground will be well cleared for the development of a sound system of sociology upon the inductive basis established by Morgan.

Connected with this theory of the patriarchy is Spencer's theory of ancestor-worship, by which he accounts for the genesis of theism, — a theory which ignores all the facts of savage philosophy, finds an origin for opinions midway in the history of culture, and accounts for later opinions as following in the course of normal development, and for early opinions as degeneracies. With the final overthrow of the patriarchal theory, the ancestral worship theory has its weak foundation entirely removed. A piece of good destructive criticism here would be opportune.

Spencer's ghost theory of the origin of a dual existence has long been overthrown by Tylor's grand induction denominated 'Animism.' A good piece of destructive criticism on this point also would be timely.

J. W. Powell.

LESQUEREUX'S CRETACEOUS AND TERTIARY FLORA.

This work is the third, and will undoubtedly be the last, of the series of final reports contributed by this author to the publications of the U. S. geological survey of the territories in charge of Dr. Hayden, and which together constitute a truly great and enduring monument to the fame of the now venerable paleobotanist. The first of these volumes appeared in 1874, and was devoted to the flora of the Dakota group, the only cretaceous flora then known in the west. The second, a larger work, came out in 1878, and was called the 'Tertiary flora;' but more than half of it was taken up with species of the Laramie group, by many regarded as cretaceous. The present volume is in the nature of a review of the whole field covered by the two preceding, bringing the matter down to date, and embraces some Pacific-slope miocene localities in addition.

The first hundred and twenty pages and eighteen plates are devoted to a revision of the flora of the Dakota group, and the description and illustration of thirty-five new species from that formation. At the close of this division of the work, the author introduces an exhaustive table of distribution, extending it to embrace the entire Cenomanian formation, to which he assigns the Dakota group, as well as the middle cretaceous of Greenland. He divides the Cenomanian of Europe into three groups of localities: viz., 1, Moletein, Quedlinburg; 2, Quadersandstone, Harz, Bohemia;

Contributions to the fossil flora of the western territories. Part iii. The cretaceous and tertiary floras. By Leo Lesquereux. Report of the U. S. geological survey of the territories. F. V. Hayden, U. S. geologist in charge. Vol. viii. Washington, *Government*, 1884. 12 +283 p., 59 pl. 4°.