tion of the moving body depends 'not at all on the direction of its motion.' But I may remark, that Routh (see Rigid dynamics, p. 192) has also given the subject a rigorous investigation by means of the equations of motion, and finds for the deviation to the right, in north latitude, two terms, — the one agreeing with the above, as found from the component about the vertical; and the other, a function of the cosine of the angle contained between the meridian and the line of projection of the moving body.

J. E. HENDRICKS.

Des Moines, Io., July 16, 1883.

ALNWICK CASTLE ANTIQUITIES.

A descriptive catalogue of antiquities, chiefly British, at Alnwick Castle. Printed for private distribution. Newcastle-upon-Tyne, 1880. 11+210 p., 43 pl. 4°.

By the generosity of the Duke of Northumberland, the Boston public library has recently been made the recipient of a copy of this truly magnificent work, and of the companion volume descriptive of the important collection of Egyptian antiquities, also preserved at Alnwick. In no more satisfactory manner could the liberality and public spirit of the noble proprietor have been manifested than in thus sharing his treasures with the antiquaries and art-lovers of other countries. Such sumptuous volumes as these constitute a monument *aere perennius*, like those which illustrate the literary and artistic treasures of Earl Spencer at Althorp, or the magnificent publications in which the Archduke Ludwig of Austria has recorded his travels.

In its artistic and mechanical execution, this catalogue is beyond praise: never have we seen more beautiful or more faithful delineations of the various kinds of antiquities. If we cannot speak in quite such high terms of commendation of the accompanying letterpress, the fault should not be laid to the charge of Dr. Collingwood Bruce, upon whom devolved the task of preparing the work for the press. His competency as an antiquary has been sufficiently manifested by his able and thorough study of 'The Roman wall,' whose 'stations' have yielded to the explorer many of the objects described in the volume. It is to the untimely death of Mr. Albert Way, by whose assistance and advice much of the collection was gathered, who knew its contents thoroughly, and to whom the preparation of the catalogue had been originally intrusted, that any shortcoming must be attributed. Although several distinguished English antiquaries have lent their aid to the editor in their respective departments of knowledge, we miss the influence of one guiding mind, familiar with the results of recent archeological research in all its various branches, and capable of 'speaking the latest word' upon the many interesting and important topics suggested. Still the reader cannot fail to receive instruction from the accounts given of numerous relics of various periods in the ages long since past, while the beauty of many of the objects delineated goes far to justify the claim that, —

> "Not rough nor barren are the winding ways
> Of hoar antiquity, but strewn with flowers."

The expression 'chiefly British' in the title must be understood to mean that the greater part of the antiquities described have been found in Great Britain. Those first represented belong to the prehistoric periods of stone, of bronze, and of iron, and consist mainly of weapons and implements, such as axes and celts of stone, and swords and celts of bronze, or of a great variety of those rude, hand-made, sepulchral vases found in grave-mounds, in which was stored a supply of food for the dead. To the same remote ages are to be ascribed those singular markings found upon stones, known to archeologists by the name of 'cup-cuttings,' of which two remarkable examples occurring in Northumberland are represented. They are found in countries widely separated, and everywhere they closely resemble one another, and they have greatly exercised the minds of antiquaries as to their origin and significance. They consist of a series of shallow pits or cups, incised upon ledges, or, more frequently, upon bowlders. Of these, a central one is often found surrounded by one or more concentric circles; and a characteristic feature of such groups is a longitudinal groove extending from the central cup to beyond the outermost of the circles that surround it. That they are religious emblems is generally conceded, as the same kind of markings is found upon the slabs of stone of which ancient graves have been constructed. It is highly probable that they are a conventional representation of a primitive system of nature-worship that prevailed among our Aryan ancestors, symbolizing the mysterious origin of life. The whole subject has recently been treated in the most able and exhaustive manner by the learned archeologist of the Smithsonian institution, Mr. Charles Rau, in the fifth volume of Major Powell's 'Contributions to American ethnology.' We cannot help feeling surprised that the editor, while quoting largely from Sir James Simpson's 'Archaic sculptures,' makes no reference whatever to the late Professor Edouard Desor of Neuchâtel, whose various writings

upon *Les pierres à écuelles* have shed much light upon this obscure subject.

Another strange problem bearing upon this vexed question of early religious symbols is but just touched upon in this volume. We refer to the use from a very remote period, either for emblematic or decorative purposes, of a peculiar form of cross, resembling the Greek letter gamma four times repeated. This has been called by various names,  — the 'digammated cross,' or 'gammadion;' in the middle ages the 'fylfot;' and recently, by Sanscrit scholars, the 'swastica.' M. Burnouf believes that this, also, is a primitive religious symbol of the Aryan races, and that it represents the two pieces of wood which in early times were laid crosswise before the sacrificial altar in order to produce the holy fire, having their ends bent at right angles and fastened in such a way as not to be moved. Where the pieces crossed there was a small hole, in which a third piece of wood was rotated by means of a cord until fire was generated by friction. This sign occurs upon two Roman altars figured in the volume, which have been transferred to the museum at Alnwick from neighboring stations upon the Roman wall, where they had been disinterred. Several references are given to authors who have treated of this emblem, — among them, to Dr. Schliemann, who found it at Hissarlik upon 'whorls' of baked clay; and the statement is made, that it eventually came to have a Christian signification, and is found in the catacombs at Rome in conjunction with the usual Christian symbols. The elaborate study, however, by De Mortillet, entitled *Le signe de la croix avant le christianisme*, is entirely overlooked, in which its occurrence is traced down from the 'terremares' of the age of bronze, in Emilia, in upper Italy.

A unique object represented is an example of the so-called 'chrisma,' the monogram formed by uniting the first two Greek characters of the name Christ, X and P. This combination had long been in use as an abbreviation of different words, and it is  found upon the coinage of various eastern nations. Constantine placed it upon the 'Labarum' as a Christian emblem; and it is often met with upon his coins and those of his immediate successors, and upon terra-cotta lamps found in the catacombs at Rome and elsewhere. Three, at least, of such ancient Christian lamps, have been discovered in England; but the rarity of the present example consists in the fact that it is embossed upon the outside of a little drinking-cup made of red clay. This is of the very uncommon kind of pottery occasionally brought to light in England, which was manufactured by the Romanized Britons at Caistor, in Northamptonshire, the Durobrivae of the Romans. It is used as an ornament in association with a very well executed representation of the coursing of a hare, and it is probably to be referred to about the middle of the fourth century.

Several fine specimens of ancient Roman fictile ware from Pompeii are delineated, as well as those found in Great Britain, among them handsome lamps and facsimiles of the potter's stamps, which are often found impressed upon their under side. Such stamps were also usually placed upon the bottom of the finest kind of table-ware that was manufactured by the Romans, — that called 'Samian ware' from the place of its origin, but of which the best quality was fabricated at Arezzo, and spread by commerce over the whole Roman world. It is of a lustrous coral color, and often has embossed upon the outside, figures of different deities, or of men and animals, especially of those gladiatorial scenes of which the Romans were so fond. These figures were fashioned in moulds, many of which have come down to our own times, and are of a high grade of artistic merit. Frequently, however, the ornamentation consists only of harmonious conventional patterns, or of a scroll-work of leaves and vines of much grace and beauty of design. The potter's stamp sometimes contains the whole name, sometimes only initials, and occasionally it consists merely of some symbol. One figured in the volume is a representation of 'a tiny human foot,' which the editor thinks is "probably a rebus upon the name of the potter, which may have been CRASSIPES." This is rather an unfortunate conjecture, as it was a special whim of some of the potters of Arezzo to have their stamps made in the shape of a human foot. They are found in this form containing a variety of names, as well as no name at all. The writer has in his possession at least twenty different inscriptions of this sort.

It is certainly remarkable that only in England have there been found, it would appear, any specimens of the actual shoes or sandals worn by the Roman soldiers. One such is represented from the ruins of one of the camps that mark the line of the Roman wall. Similar discoveries upon such sites are recorded, and a few of these objects have been found in the bed of the Thames at London. The writer saw several that came to light in London in 1873, in excavating the foundation for a large building in the heart of the 'city.' On that

occasion the ditch that surrounded the fortified Roman town was laid bare, formed out of the natural bed of a little brook, and in it these and many other curious relics were found. These ancient Roman shoes are singularly like modern ones in pattern and mode of fabrication; and, in consideration of their wonderful state of preservation, they would seem to justify the cobbler's proverb, 'There's nothing like leather.'

Among the 'medieval remains,' we find figured and described 'a bronze eagle with uplifted head and open mouth.' The bird, however, strongly resembles one represented in *Archaeologia*, vol. 46, pl. 17, that was discovered in the recent excavations at Silchester in 1870. This, the late John Richard Green, in his Making of England, calls "a legionary eagle, hidden away, as it would seem, in some secret recess, and there buried for ages to tell the pathetic tale of the fall of Silchester." In Horsley's Britannia romana, there is also figured a similar bronze eagle discovered in England. It is true, that the Roman eagles that are delineated upon Trajan's Column and upon the Arch of Constantine are represented with expanded wings, and that Montfaucon and recent writers upon classical antiquity, copying him, have stated that they were *invariably* made in this manner. All three of these birds, however, have their wings folded, from which we may infer that the other fashion of representing them may have arisen in part from the exigencies of pictorial art.

We have an example given of one of those singular seals, in the shape of a monkey perched upon a cube, made of a peculiar kind of porcelain, and bearing an inscription in ancient Chinese characters, such as are occasionally found in the bogs in various parts of Ireland. At first they were believed to be of remote antiquity; and it was even supposed that they had been brought into the country by the Phoenicians, since it was asserted that they are not to be found in China at the present time. But this is not the case, as they can now occasionally be procured of the dealers in curiosities in that country. The inscriptions are engraved in an antique character, now only employed for seals, and known as the 'seal character.' Frequently they consist of some poetic quotation like the one given: 'When the water falls, the rocks appear.' Their presence is undoubtedly due to modern commerce, though not of a very recent period. In this particular they resemble the little Chinese bottles used for holding snuff, which are found in ancient Egyptian tombs, one of which is preserved in the museum at Alnwick. They are about two inches in height, and have on one side a flower, and on the other an inscription, which on several specimens reads, 'The flower opens; lo! another year!' This is known to be a quotation from a poet who lived in the eighth century P.C., and the object evidently was intended for a New-Year's gift. Instead of proving, as Rosellini supposed, the existence of a commerce between the two countries in Pharaonic, or at all events in Ptolemaic times, it is now known that they were brought to Egypt in the middle ages by caravans from western China. They are not of exceeding rarity, as Sir Gardner Wilkinson states that he has seen more than twenty of them, found in the tombs at Thebes and other places, and the writer has half a dozen obtained in Cairo.

Unquestionably the most pleasing object delineated in the volume, and one of the glories of the collection, is the well-known 'Rudge cup.' This is a little bronze vessel, about four inches in diameter and three in height, of a simple bowl shape, and adorned in the most tasteful manner with different colored enamels, in the style called *champlevé*. In this, the metallic field is cut away so as to produce cavities, in which is inserted the paste that becomes vitrified upon being subjected to heat. The ornamentation consists of a series of panels made up of four squares of various colors, alternating with compartments containing four crescents of different hues, set back to back. The colors are turquoise and dark blue, beautifully contrasted with a narrow border of pale red, which outlines and separates the several compartments. Around the top runs an inscription which is supposed to contain the names of several localities lying along the line of the Roman wall, but which has thus far proved a puzzle to the interpreters. It was found in the year 1725, at a place called Rudge Coppice, near Froxfield, in Wiltshire, in a well near the site of some Roman ruins. The well was filled with rubbish; and in it were also found four or five human skeletons, some animal bones, and several coins of the lower empire. It is described as merely 'a remarkable relic of the Roman times;' but this would appear to be a very unmeaning designation, when we call to mind the fact that 'relics' of this description are never discovered in Italy. It may be worth the while to give a brief account of the more important specimens of ancient *champlevé* enamelling that have come to light in Europe, and to state what is known or surmised in regard to their probable origin and place of fabrication.

For purposes of comparison, the editor has given an engraving of an enamelled bronze cup, of similar shape and method of manufacture, which was found at Harwood, in Northumberland, and is now in the British museum. He also describes a facsimile cast of a beautiful vessel, known as the 'Bartlow vase,' the original of which was nearly ruined in a fire which took place in the mansion of Lord Maynard, by whom it was discovered in 1832, during excavations made in a series of remarkable flat-topped tumuli situated at Bartlow, in Essex. A plate showing it in all its pristine beauty may be found in *Archaeologia*, vol. 26, pl. 35. It is now in the British museum, where can also be seen a similar vase, discovered at Ambleteuse, near Boulogne. Still another of the same character, found in the western part of France, is preserved at Angoulême. Finally in the *Mémoires de la société des antiquaires du nord*, n.s., 1868, there is represented an exceedingly beautiful specimen of an enamelled bronze cup of the same pattern, discovered in 1867 in a peat-moss at Maltboeck, in the southern part of the peninsula of Jutland, in Denmark.

Beside these vases, enamelled fibulae and horse-trappings have frequently been found in ancient graves, especially in England. Professor Boyd Dawkins, in his Cave-hunting, also gives a plate representing several brooches of this kind, which were discovered during the explorations of the Victoria cave, in Settle, Yorkshire. This was so named on account of its discovery upon the coronation day of Queen Victoria, in 1839; and it is especially interesting as having been a place of refuge of the miserable British fugitives who fled before the sword of the 'conquering Engle.'

The art of enamelling was known to the ancient Egyptians, the Etruscans, and the Greeks; but the last had ceased to make use of it at least two hundred years B.C. By the Romans it was never practised at all; and it is not alluded to by Pliny in his encyclopedic 'Natural history.' The only reference to it to be found in any ancient author occurs in the *Imagines* of Philostratus the elder (lib. i., im. 27). In a description of a picture of a boar-hunt, after enumerating the different colors of the horses ridden by the youthful huntsmen, and saying that the bits were of silver and the housings enriched with gold and various colors, he adds, "They say that the barbarians, who dwell near the ocean, pour these colors upon heated brass, and that they adhere, and become like stone, and preserve the designs made by them." Now, Philostratus was a Greek rhetorician, called from Athens, in the beginning of the third century, to the court of Julia Domna, wife of the emperor Septimius Severus. As this emperor passed considerable time in Britain, where he built, or at any rate repaired, the wall that goes by his name, and died at York, it is by no means improbable that Philostratus gained his knowledge of the processes of enamelling from accounts brought to the court from that region. To the English antiquaries it seems to be established, by the number and the beauty of such objects that have been discovered in their own country, that this was the principal seat of its manufacture; and Mr. John R. Green does not hesitate to call the 'party-colored enamel the peculiar workmanship of Celtic Britain.' But from the fact that the late Abbé Cochet has found precisely similar enamelled objects in his explorations of ancient cemeteries in Normandy, and from the discovery of cups of the same kind upon the soil of France, the antiquaries of that nation maintain that their own countrymen were 'the barbarians that dwelt near the ocean.' *Non nostrum tantas componere lites;* but certainly objects of this character ought never to be styled 'Roman.'

We wish that we had more space at our disposal to direct attention to the many other beautiful objects of antiquity to be found in this fine collection. HENRY W. HAYNES.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

Linear differential equations. — M. G. Floquet, in a paper entitled "*Sur les équations différentielles linéaires à coefficients périodique*," has made an interesting and seemingly important addition to the literature of periodic functions. He considers a homogeneous linear differential equation of the form

$$P(y), = \frac{d^m y}{dx^m} + p_1 \frac{d^{m-1} y}{dx^{m-1}} + p_2 \frac{d^{m-2} y}{dx^{m-2}} + \ldots + p_m y = 0,$$

the coefficients being uniform functions having all the same period, ω, and the general integral being supposed uniform. If the variable be changed by the substitution

$$e^{\frac{2\pi i x}{\omega}} = \xi,$$

the result is a linear transformation of P, in which the coefficients are uniform functions of ξ. From the known expression for its integrals in the region of a