the Government of that province to investigate its conditions in other parts of the country.

Among the five areas in which the shells are collected—Tinnevelly, usually known as the Tuticorin fishery, Ramnad, the Carnatic Coast, Travancore, and Kathiawar—the first is the only place where it is carried on systematically, and it has existed here for at least 1800 years. Early evidence of the use of the shell is found in the Foote collection of Indian prehistoric antiquities in the Madras Government Museum, and more recent excavations, conducted by Mr. A. Rea, have furnished additional examples. In Mysore the specimens have been supposed to date back to Neolithic times, but as the shells cannot be worked without a metal saw, they probably belong to a later age, that of iron.

In Tinnevelly, where the industry is carried on under official superintendence, about seventy divers are employed. In favourable circumstances, a diver may in each excursion to the beds make twenty-five descents, each yielding from nothing to eight shells. These on reaching the shore are classified in nine grades, ranging from 4 to 2¼ inches in diameter; the wormed shells, being of inferior value, are placed in a special category.

The chief economical value of the shell is for the production of bangles or bracelets, the object of wearing them being partly for purposes of ornament, partly as a protective against evil spirits and the evil eye. While the source of supply is mainly southern India, the manufacture of bangles is now practically confined to Bengal. Mr. Hornell suggests that this transference of the manufacture took place in the fourteenth century, which marks the downfall of Hindu supremacy in the south, when the rich cities of the Pandyan kingdom were sacked by the Mahomedans, and the coast trade passed into Arab hands. At the present day the shells are imported to Calcutta, and pass thence to Dacca and other centres in Bengal, where they are cut by the Sankhari caste, which holds a high place in the Hindu social system. The wearing of chank bangles is now virtually confined to Lower Bengal and the hill tribes north and east of the province, from the Santals to the tribes of Assam and Manipur, and from the Sunderbuns to the Himalayas and the Tibetan plateau. Some 2½ million shells appear to be worked up annually in Bengal. The columella is first extracted by sawing off a slice of the lip and smashing the apex. The sawyer sits on an earthen floor tightly wedged between two short wooden stakes driven into the ground, one supporting his back and his toes against the other. He presses with one foot a disc of hard wood against the mouth aperture and divides the shell into sections with a heavy saw, the blade of which is in the form of a crescent ending in a hook at each end. The use of any more elaborate machinery is unknown. He is paid about one rupee for every ten shells he cuts. The work is very fatiguing, owing to the constrained position of the artificer.

Besides being cut into bangles, the shell supplies other forms of ornament, rings, necklaces, coat or dress buttons being made from it. Up to quite recent times these shells were used as currency in the Naga Hills. Some of the fragments are burned into a fine lime, used for industrial purposes and as a cure for various diseases, such as rickets, asthma, and cough. This is justified by modern medical research, the lime being useful to strengthen the bones of rickety children or by the deposit of salts round tuberculous centres. A minor use of the shell is to supply the equivalent of our infants' feeding-bottles.

Besides these economical uses of the shell, it is employed in various ways connected with the religious and social life of the Hindus. It is the emblem of the god Vishnu, and when the convolutions take the sinistral or left-hand form it is highly valued, and deposited in temples of the god. The four daily services at a Hindu temple are announced by blowing the shell, which in ancient times was also used as a war trumpet. No one who has encamped near a Hindu temple will forget the weird muffled roar which calls the god to wake at early dawn and receive the service of his worshippers. Beggars blow the shell as an appeal for alms. It is specially valued as a protective against the evil eye, and hence water is poured from it on the foundation-stone of a temple or house, or it is hung round the necks of children or cattle. It is blown at harvest when a man undergoes a special purification and is sent to cut the first-fruits, and at marriages to scare the evil spirits which beset bride and bridegroom. With the same object it is sounded when a corpse is being carried to the funeral pyre or to the burial ground.

On the whole, this survey of one of the purely indigenous industries of the country, the products of which are all locally absorbed, is of sufficient interest to justify the labour which Mr. Hornell has undertaken in collecting the materials for his excellent monograph.

LUMINOUS INSECTS.[1]

THE power of emitting light at night is a property that has been developed to varying extent in many different branches of the animal kingdom. We find it, for instance, in the Protozoa, *e.g.* Noctiluca, an organism which, though microscopic in size, is sometimes present in such countless millions on the surface waters of the ocean as to make the whole sea appear to be ablaze with a pale, cold, "phosphorescent" light. Higher in the animal scale we find the property well developed in the Hydrozoa, *e.g.* Pyrosoma, a colonial oceanic form. We have it again in numerous molluscs, in the insects, and even in the vertebrates, a large number of the fish that inhabit the abysmal depths of ocean, where the sun's rays can never penetrate, carrying their own lamps disposed about their bodies in patterns that vary according to the species. Here, however, I propose to consider only the insects that exhibit this power.

There is, as might be expected considering the striking nature of the phenomena in question, a very extensive literature on the subject. This is for the most part scattered throughout numerous scientific periodicals, but the earliest part of it, up to 1887, has been collected together by Gadeau de Kerville in his "Insects Phosphorescents," published in that year.

It is rather remarkable that the beetles (Coleoptera) have almost a monopoly of light emission amongst insects, and even here the property is almost confined to two families. The first, and by far the most important of these, for our consideration, is the Lampyridæ, or, to give them their popular name, the glow-worms and fireflies. With them are associated one or two small closely allied families, the Phengodidæ, Rhagophthalmidæ, etc., some of which are as yet very imperfectly known and unsatisfactorily characterised. In the Lampyridæ proper the luminous organs, when present, are generally found in both sexes, though frequently more strongly developed in one than in the other, and are situated in the terminal or subterminal segments of the abdomen, the light being shown from the ventral surface.

All members of this society are familiar with the glow-worm of this country, *Lampyris noctiluca*. I

[1] From a paper read before the South London Entomological and Natural History Society by K. G. Blair.

will remind you that in this species, in the adult stage, the light-giving property is practically confined to the female. Destitute of wings, she is rather an unlovely object, doomed to crawl about amongst the grass and low herbage, while her prospective spouse enjoys the freedom of the air above her. Yet her light is emitted from the underside of her tail, a situation that would not at first sight appear to be particularly well chosen as a source of illumination. Her *modus operandi* in exhibiting her light is usually to climb a little way up some convenient stem and to sit there with her lamp suspended, her body twisted a little to one side so as to exhibit the light without obstruction. If she can find no stem stiff enough to bear her weight she will remain with her body on the ground, the abdomen twisted to one side to expose the light as freely as possible, turning it first to one side then to the other in her attempts to attract the attention of wandering males. At Lugano Mr. H. Main and I have observed that they were particularly partial to old walls, even sitting 10 or 12 ft. above the ground. Though we found the larvæ fairly plentiful in the grass the female beetles were always on the walls, and in such a situation their light was plainly visible from a long distance; the twisting motion of the abdomen was also clearly observed.

Luminous organs are present in the male glow-worm in a similar situation, but to a very minor degree. The extent to which they are functional possibly varies in different localities. It is probable that in this sex the light is emitted only for a comparatively short time after reaching maturity, and that it soon becomes exhausted.

Photogenic organs are also present in an advanced degree in both the larva and the pupa; even the eggs are luminous, though there is here no definite light organ, but the whole surface glows faintly.

To the same family belong the "fireflies" of southern Europe. Of these there is a considerable number of species, which possibly present slight differences in the details of their light emission. One of the best known is *Luciola italica* of northern Italy, a species the habits of which Mr. Main and I had the pleasure of studying at Lugano.

Luciola italica was observed on the evening of our arrival at Lugano, in the grounds of the school, near the lake. Though abundant after dark, they were scarcely to be observed during the day. The first flashes were seen about 8.30, while the lingering daylight was fairly strong, and they were most numerous about 9.30 or 10, after which time their numbers noticeably decreased, though they could still be seen from our bedroom windows well after 11 p.m.

As was to be expected, all the fireflies caught on the wing were males. They have a fairly steady, not very rapid, flight, and flash their light at almost regular intervals, but they do not obviously appear to be searching for the females. When they do perceive an answering flash—and the discovery seems to be a matter of accident rather than the result of deliberate search—they pause in their course, and then fly down to it, although they may be as much as 10 ft. away.

The females were never observed to use their wings, but were always found on the grass or the herbage. In these insects, unlike the American Photuris, etc., observed two years ago, the initiative in seeking a mate appears to be with the female, as in the case of Lampyris. At times they will be quite dark, while sometimes they will glow with an almost steady, though not very bright, light. When "calling" for a mate, however, they flash with rather long slow flashes, incompletely extinguished in the intervals. Such a period of flashing is usually of short duration, and is succeeded by a dark period. It is this succession of slow flashes that bears the appearance of definitely calling for a mate, and during which the males most readily approach her, though they are also attracted to some extent by a steady glow.

The males, both in captivity and in nature, *i.e.* when caught in a spider's web, were observed to glow with a constant though not very brilliant light, somewhat resembling the steady light of a female, but no case of flying males approaching these dead males was observed.

The mating habits of many American species of Lampyridæ, popularly known as lightning-bugs, have been investigated recently by McDermott.[2] In these insects, as in the European Luciola, both sexes are luminous, and the light is emitted as a series of coruscating flashes. Again, the male has the more brilliant light, but in these insects he seems to take the initiative in searching for a mate, hovering over the ground flashing his lamp, and apparently watching for an answering flash from the less active female concealed in the grass.

The lightning-bugs investigated by McDermott belong mainly to the genus Photinus, of which the species are numerous, two or more of them often being found on the same ground. The results of this investigator's observations, assisted by a series of ingenious experiments with small electric bulbs which could be operated to simulate the flash of the insect, conclusively show that each species has its characteristic method of exhibiting its light, and that an individual of any one species will in general only reply to, or evoke a reply from, a member of the opposite sex of that species. He found, however, that some species would respond much more readily to his artificial flashes than others, and that some would even answer the flash of a match.

A few details of his observations on certain species may perhaps be quoted:—

Photinus pyralis.—The flash of the female is given three or four seconds after that of the male, and is of the same colour, but of longer duration and less intense.

Females would answer in numbers to the flash of a match swung in an arc to simulate the flash of a male, though as a rule not more than one female would reply to a flashing male.

A particular female would not reply to the flash of a male of another species (*P. consanguineus*) though she would to that of a match.

The male could also be deceived by a bulb placed in the grass and flashed three to five seconds after his own flash; when the bulb was flashed without the pause it was not so effective.

No male was ever observed to reply to the flash of a creeping male.

P. consanguineus.—The male gives a double flash, two flashes in quick succession followed by a pause, then two more, and so on; the female replies within a second to the second flash of the male.

A particular female would not reply to the flash of a match, but would answer the double flash of a bulb when 20 or 30 ft. away; on a nearer approach she seemed to recognise something unusual and would no longer reply.

P. scintillans.—The male gives a short single flash and the female a longer single flash; the female in this species is apterous.

A female would reply to the first flash of a male of *P. consanguineus*, but the latter takes no notice.

P. marginellus.—The male gives a single short sharp

[2] *Canad. Entom.*, 1910, pp. 357-363; 1911, pp. 399-406; 1912, p. 73 and pp. 303-312.

flash, yellower than that of *P. scintillans*; the female replies with a double flash, the first sharper and brighter than the second, followed at once by the second. The reply is given very quickly after the flash of the male.

P. castus.—The male gives a single flash, not so short and sudden as that of *P. marginellus*; the female gives a single flash very much like that of *P. scintillans*, but delivered immediately after the flash of the male; there is no distinct pause as in *P. pyralis*, and no indication of doubling as in *P. marginellus*.

P. castus and *P. marginellus* are very similar, and, indeed, by some authorities, have been considered to be merely forms of one species. Mr. McDermott admits that he can find no points of structural difference between them, but considers them distinct species on account of the very different flashes emitted by them. They are frequently found flying together, but no case of interbreeding has been observed, though especially watched for.

Mr. E. E. Green[3] has published notes on the use of the light by certain species of luminous beetles in Ceylon. Of these, one, *Lamprophorus tenebrosus*, Walk., belongs to the Lampyridæ properly so called. The female of this species is apterous with a ventral subterminal light-organ which she exposes much in the manner of our glow-worm. The male, though normally brilliant, approaches a "calling" female with the light shut off, its advent being heralded only by the partial extinction of the light of the female.

The other species mentioned by Mr. Green present certain marked differences from normal Lampyridæ in the emission of their light as well as in structural points, and have been placed in a separate family, Rhagophthalmidæ. Concerning the light of *Dioptoma adamsi*, Pasc., Mr. Green notes the larviform female was observed to recurve the body over the back so as to expose the ventral subterminal light organ. On the approach of the male the light was partially eclipsed and the tail turned down. The male at the time was not known to be luminous, but under the stimulus of sexual excitement, it was observed to exhibit a row of luminous spots along each side of the abdomen, as well as dorsal spots on the abdomen and across the base of the thorax.

I have recently received from Mr. Gairdner, of Bangkok, some females of a glow-worm which, he reports, turn up their tails to exhibit the light in a similar way to Dioptoma. Like the female Dioptoma, too, they are of a more degenerative type than Lampyris females, the antennæ and legs being small and feeble with a reduced number of joints.

Allied to these and to the Lampyridæ is another small family, the Phengodidæ, many of the members of which possess very remarkable luminous properties. In Brazil and Argentina, for example, is an insect that on account of its peculiar scheme of luminosity has long been known as a "railway" larva. The head of this creature glows brightly with a red light, like a live coal, which is more or less intermittent in character, while along each side of the body is a row of more constant lights, green or yellow, or even changing at intervals from a bluish to a more yellow hue. For many years these "railway" larvæ were nothing more than a puzzle to entomologists. On account of their light-giving powers they were usually considered to be lampyrid larvæ, though nothing else like them was known. Still less were they like the larvæ of the only other known luminous coleopterus family, the Elateridæ. The astonishment was great when in 1885[4] it was announced that the botanist, Hieronymus, had found one of these so-called "larvæ" mated with a beetle belonging to the genus Phengodes. Eggs were obtained from it which in due course produced larvæ, thus proving that the supposed larva was in reality the sexually mature, though degenerate and completely larviform, female of a beetle.

We are now confronted with the very interesting question as to whether the apterous, more or less larviform, state of the females of many of these glow-worms is a primitive condition or the result of degeneration from an earlier, higher, winged type. Riley[5] states that the female larva of *Phengodes laticollis* and *Zarhipis riversii*, both North American species, goes through a pseudo-pupal state prior to the final moult. It appears, therefore, that this larviform female is a mature though degenerate female, and that we have not here to do with a case of pædogenesis; *i.e.* of the larva becoming sexually mature without the attainment of somatic and metamorphic maturity.

The same writer considered that we here "get a glimpse, so to speak, into the remote post, from which has been handed down to us, with but little alteration, an archetypal Hexapod form which prevailed before complete metamorphosis had originated." Were this really the case, it is difficult to account for the occurrence of a pupal state in the individual development of the female, though this might perhaps be interpreted as a partial transference from the metamorphosis of the male. Further, if the larviform condition is to be explained as a case of arrested development and the persistence of a primitive type, either one would expect to find it fairly constant in a group of closely related species, and genera evidently arising from a common ancestry, or it must be considered as a kind of throw-back or reversion to an ancestral type.

For my part I prefer to regard the theory of degradation from an earlier winged type as affording a better explanation of the facts as we find them. We have the successive stages in such degeneration all illustrated, from the fully winged though sluggish female of Luciola, through the brachypterous state found in the females of certain species of Photinus, down through the apterous but otherwise developmentally mature females of Lampyris, and the more degenerate type of female of Dioptoma to the completely larviform females of Phengodes. The steps in this series do not imply relationship or common ancestry, but merely indicate the points, successively further and further back in the phylogeny of the group, when the use of the wings in the course of any particular line of development was discarded and their consequent degeneration set in, or, to put it briefly, that the apterous condition is of polyphyletic origin. I know of no instance among the Lampyridæ, such as we have amongst the Lepidoptera with apterous females (*e.g. Anisopteryx aescularia*) where, though wings are wanting in the adult, there are well-developed wing rudiments in the pupa, but I have found one female of *Lampyris noctiluca* with the wing and wing-cover well developed, though shrivelled, on one side of the body.

With the question of the evolution of the apterous female is bound up the question of the evolution of the power of luminosity. Many members of the family Lampyridæ are probably not luminous at all. Pale yellowish abdominal spots are almost always to be detected in the region of the luminous organ, but whether the species possessing them are always luminous is open to doubt. Our knowledge of the habits of many of these insects is extremely defective, and it is frequently impossible to say from dried specimens whether a species is or is not luminous.

[3] Trans. Ent. Soc., 1912, p. 717.

[4] Haase, *Sitzung. Natur. Ges. Isis.*, p. 101 and *Deutsche Ent. Zeit.*, xxxii., p. 154; "Camb. Nat. Hist. Ins." part ii., p. 251.

[5] *Ent. Mo. Mag.*, xxiv., 1887, p. 148.

In most of the luminous species the eyes, particularly of the males, are extraordinarily large and well developed (*e.g.* Lampyris, Photinus, Luciola, etc.), but the antennæ are simple. In the non-luminous species, on the other hand, the eyes are of a more normal size, but the antennæ of the male are frequently strongly plumose (*e.g.* Cladodes, Lamprocera, etc.), a feature that in this order as in the Lepidoptera is usually regarded as indicative of a highly developed sense of sex-perception in this sex, correlated with the possession of sluggish and retiring habits on the part of the female. It is noteworthy that in the genus Phengodes both the plumose antennæ of the male and the powers of luminosity of the female are unusually well developed.

Undoubtedly the chief function of the light is in securing the mating of the sexes, but that this is a secondary function only is evidenced by the different degree to which the use of the light is developed. Its wide occurrence within the family proves that the power of emitting light must have arisen early in the evolution of the family, though exactly how it originated it is impossible to say. Possibly, it may have served at first as an indication of unpalatability, common to both sexes, and then, coming under the influence of sexual selection as an evolutionary force, have developed along the various lines we see indicated. In connection with their unpalatable qualities, it may be noted that the Lampyridæ is a family that has many mimics in other families of beetles, amongst the Telephoridæ, for example, and the longicorns. Species of the longicorn genera Amphionycha and Dadoychus even go so far as to have a ventral pseudo-luminous patch resembling the luminous patch of the fireflies, but in the allied genus Alampyris, where the dorsal mimicry is quite as close, this patch is lacking.

Apart from its principal function in securing the proper mating of the sexes, the light seems also to be largely used, at any rate by the males, for purposes of display. Where the powers of luminosity are largely developed in this sex the emission of the light is usually of an intermittent flashing type. It has been noticed in various parts of the world that these flashing males tend to congregate in large companies, and that all the individuals of one of these gatherings will flash in concert. All the fireflies around one tree or group of trees, for instance, will flash together, while those around a neighbouring tree will be pulsating to a different time. This feature has been observed of a European species of Luciola (though Mr. Main and myself were unable to detect anything of the sort with *L. italica* at Lugano), of an Indian lampyrid, genus not stated, and of the genus Aspidosoma in South America. The American species of Photinus and Photuris do not seem to possess the habit.

The exact reason of this flashing in concert, or the method by which it is brought about, have not been ascertained. It has been suggested that the light is not really intermittent in character, but merely appears so owing to its being alternately masked and exhibited by movements of the creature's body, and that a slight puff of wind might perhaps affect all the members of a company and cause them all to conceal their lights at once. Though this explanation of the intermittent character of the light applies well enough to Pyrophorus, an insect we shall shortly consider, it is certainly not applicable to these Lampyridæ. It is true the light is not absolutely extinguished between the flashes, but it is so diminished as to become practically dark; moreover, the flashing in unison is too regular to be caused by chance puffs of wind. A more probable explanation of the phenomenon is that each flash exhausts the battery, as it were, and a period of recuperation is required before another flash can be emitted. It is then conceivable that the flash of a leader might act as a stimulus to the discharge of their flashes by the other members of the group, and so bring about the flashing concert by the whole company.

The physical and chemical nature of the light of these insects have been the subject of numerous investigations. Though often spoken of as "phosphorescent," the light has nothing whatever to do with the oxidation of phosphorus.

The most recent conclusions are those of Dubois, and were summarised by him in a communication to the Zoological Congress at Monaco in 1913. He finds that the mechanism for the production of light is the same throughout for both plants and animals, and is the result of the action of an oxidising zymase upon an organic proteid product in the presence of water. In the case of luminous insects the proteid, which he calls *luciferine,* is contained in the form of granules in the photogenic organ, while the zymase, to which he applies the name *luciferase,* is dissolved in the blood. The light is given off by the action of the luciferase on the luciferine as the blood passes through the luminous organs. This zymase can be replaced experimentally by a chemical oxidising agent such as permanganate of potash, lead dioxide, hydrogen dioxide, etc.

The luminous organs in these insects are found on dissection to be abundantly supplied with tracheæ, which open by means of very large spiracles. It is probable that by opening or closing these spiracles the insect is able to regulate the supply of oxygen to the luminous organs, and so in some degree to control the emission of light.

Though in many species the flashing of the male is so regular as to suggest its being due to reflex rather than to voluntary action, yet in the female the light appears to be more under the control of the insect. In many species the light may be emitted after the death of the insect, but in the case of males of the flashing species the light is then constant instead of intermittent and less intense than in life. While searching for the females of *Luciola italica,* I was several times deceived by the constant faint light of a dead firefly caught in a spider's web near the ground.

Another group of beetles the light-giving properties of which have caused them to be very widely known—at any rate by name—are the "fireflies" of tropical America, Pyrophorus. These must not be confused with the "fireflies" of Italy and southern Europe, which, as I have said, are really winged glow-worms allied to the lightning-bugs of the United States. The fireflies of tropical America and the West Indies, the creatures that the local belles wear in their hair, and about their persons, as a kind of living jewelry, known locally as Cucujos, belong to a very different family, the Elateridæ, or skip-jacks. They are considerably larger than the glow-worms, and their light organs are differently situated. The most obvious are a pair of large yellowish spots on the thorax, one near each of the posterior angles. If the beetle is examined alive, these spots, the "eyes" as they are called, will at first be quite dull and opaque; but when the insect is handled they will soon be observed to kindle, the glow increasing gradually in intensity until it reaches its maximum. This light is only emitted by the firefly when stimulated by some excitement, such as that caused by handling, and glows steadily so long as the excitement continues; as this wanes the light gradually dies away.

When the insect is on the wing the light seen is

not that emitted from these eye-spots, but originates from another light organ at the base of the abdomen. This organ is usually concealed between the abdomen and thorax, and is only exposed when the elytra are open so that the abdomen can be bent back. The light is of a redder, or yellower, colour than that emitted from the thoracic spots; and is intermittent instead of continuous, the flashes being caused by slight movements of the abdomen, whereby the light is alternately concealed and exhibited. The bionomic value of the light in these insects is not at all understood, but it does not seem to have any sexual function in this case.

The larvæ of these fireflies are also luminous. They are of typical elaterid form and live in rotten wood. In the young larvæ the light is emitted from the junction of the head with the body, but in the older larvæ it is emitted also from the junctions of the segments all along the body. The eggs also are stated to be luminous.

Various beetles of other families have been recorded as luminous, but all these records want confirmation, and some of them were certainly only accidental.

To sum up, nearly all the cases of luminous insects, and *all* those that are in any way well known and common, belong to the order Coleoptera, and even here almost entirely to the family Lampyridæ. An exception to this statement is found in the elaterid genus Pyrophorus, but other records all require confirmation. In the Lampyridæ the light plays an important part in securing the mating of the sexes, but its functions in other luminous beetles have not been satisfactorily explained.

In other orders of insects luminosity is rarely met with, at any rate in the normal condition of health; little or nothing is known of the part that it plays in the life of the animal; indeed its very existence, apart from what we may call accidental causes, is usually more or less problematical.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Romanes lecture—subject, "Science and the Great War"—was delivered by Prof. E. B. Poulton on December 7 before a large audience, which followed with marked interest and frequent applause the scathing indictment brought by the lecturer against the ruling powers of this country for their neglect of the teachings of science with regard to the conduct of the war. Prof. Poulton showed how by their refusal to benefit by the expert knowledge which might have been at their command for the asking, the Government had actually played into the hands of the enemy. This was especially apparent in the case of the materials for the manufacture of high explosives and in that of the importation into Germany of foodstuffs. The evil had to some extent been stopped, thanks, in the matter of cotton, to agitation by the Press; but it was still far from being at an end. The most deadly kind of war was one waged by a ruthless enemy employing to the full all the resources of modern science. Such an enemy we were now being called on to face, and our only hope of success lay in using those means which were ready to our hands if the authorities could be induced to apply for information and assistance in the proper quarters.

SHEFFIELD.—At the annual meeting of the court of governors of the University, it was announced that one outcome of the war was the establishment of a department in the scientific teaching of glass-making. The industry, an important one for the rougher kinds of work in south Yorkshire, had previous to the war to cope with serious German competition. The time is suitable to encourage this industry when it is relieved from German rivalry, and it is hoped that the University's efforts will be directed towards the finer kinds of glass work in which this country did but little in the past. A lecturer and a demonstrator in glass manufacture have already been appointed.

The great demand for medical men and the undesirability of discouraging suitable students, especially women, has resulted in the University deciding that Latin is no longer required as a subject in the matriculation examination for the medical degree. The new regulation continues until the University shall otherwise determine.

THE list of past and present students and staff of the Imperial College of Science and Technology serving with H.M. Forces, issued in May last, has been corrected so far as possible up to May 27. An analysis of the roll gives the total in connection with each of the constituent colleges. The grand total of present and past students and members of the staff was, in the case of the Royal College of Science, 161, the Royal School of Mines, 305, and the City and Guilds (Engineering) College, 719, being 1185 in all. Of this total 376 were present students, 739 past students, and 70 members of the staff, 715 of the total being officers.

As has been already noted in these columns, Columbia University received by the will of the late Mr. A. F. Eno the residuary estate. It is now announced in *Science* that Columbia University also receives a reversionary interest in certain bequests, and bequests of 50,000*l.* each are made to New York University, the American Museum of Natural History, and the Metropolitan Museum of Art. Our contemporary also records that Mr. and Mrs. Norman W. Harris, of Chicago, have increased their gift of 5000*l.* to Mount Holyoke College made at the time of the seventy-fifth anniversary, to 10,000*l.*, for the endowment of the chair of zoology.

THE annual meeting of the Mathematical Association will be held on Wednesday, January 5, at the London Day Training College, Southampton Row, London, W.C. The following addresses will be given:—(1) The aims of education, a plea for reform, (2) The allowance for the earth's rotation in the theory of projectiles, Prof. A. N. Whitehead; The results of an investigation into the degree of accuracy that may be expected in simple arithmetical work in boys' schools, G. W. Palmer. There will be a discussion on (*a*) the use of mathematical tables in schools, and (*b*) desiderata in a book of such tables for school use, to be opened by Mr. A. Lodge.

IN a recent publication of the Department of Agriculture and Technical Instruction for Ireland (Dublin, 1915) Mr. E. P. Barrett deals with suggestions for the teaching of the first year's syllabus in experimental science in secondary schools. The proposals mainly refer to the use of graphs, with special application to the experimental determination of the relations between connected quantities. Unfortunately, however, the author overlooks the necessity of drawing graphs between quantities of the same kind in their proper proportions, and his figure makes the circumference of a circle appear to be about one and a half times its diameter, a mistake for which hundreds of marks are probably lost every year by examination candidates.

A COPY has reached us of the prospectus of the School of Tropical Agriculture, Peradeniya, Ceylon, of which the Director of Agriculture is the Principal. The school is situated close to the Botanic Gardens, and is intended for boys of seventeen years of age and over who have passed the eighth standard of the