authorities are advised that they can ruin all the gas interests without the distribution of any compensation whatever. Surely the enormous capital sunk by the public in gas enterprise deserves some consideration from its representatives in Parliament assembled. Are our vestries and corporations so immaculate that they are to have entire control of our supplies of water and of light? Why not give them the supply of food and of heat? The line must be drawn somewhere, and it is well that Parliament should hesitate in the complacency with which it now thrusts on irresponsible communities the distribution of vital necessaries.

The only sphere in which electricity has made itself useful and practical as an illuminant is in our lighthouses, and though it is eminently adapted for nautical purposes, as ordinary ships' lights, or to illuminate the sails of a ship, the Report is silent on the point and on the absurd restrictions which have been placed by the Board of Trade on its use at sea.

The statement that the energy of one-horse power when converted into gas-light only gives 12-candle power, and into electric light 1,600 candle power is startling if true. Without the evidence before us on which this statement is made we cannot well contravene it, but it seems based on some fallacy. We remember seeing somewhere, but cannot recall where, a somewhat similar estimate, but it was based on the assumption that the whole of the coal was consumed in producing gas, and no allowance whatever was made for the coke, tar, and other products of distillation. Is it so in this instance? Though 3 lbs. of coal consumed in one way may give one horse-power, and in another way 12-candle light, it by no means follows that one-horse power is equivalent to 12-candle gas-light—for in the case of gas we do not know the remanent energy.

The report fully confirms the opinion we have frequently expressed that the electric light sensation was due to a scare and not to any real progress or new discovery made. The transmission of power for mechanical purposes is foreign to the inquiry, and the suggestion that currents used by day for mechanical purposes can be used at night for illuminating purposes assumes what we only wish were true, that there is no mechanical work done in England in hours of darkness.

The general conclusion arrived at is that we can do no more with the electric light at present, but that we must do nothing to restrict its development. We did not require a Parliamentary Committee to tell us that.

INDIAN GEOLOGY

A Manual of the Geology of India. By H. B. Medlicott, M.A., and W. T. Blanford, F.R.S. Published by Order of the Government of India. (Calcutta, 1879.)

THE appearance of this long-promised work marks an epoch in the history of Indian science. In two moderate octavo volumes (paged as one) and the map which accompanies them, we have placed before us, in an attractive and convenient form, the matured conclusions of upwards of thirty years' systematic survey of the geology of our Indian possessions; and now, for the first time, the geological structure of India, or, at least, its leading facts, may be mastered by the student at no greater cost of labour than is involved in a few days' study of a well-arranged and thoroughly trustworthy manual.

We are reminded almost in the opening words of the preface, how many of those who have contributed to the researches on which this work is based, have now passed from among us. Stoliczka, J. G. Medlicott, the two Oldhams, Williams, and Loftus are only a few of the better known names among the many that for a longer or shorter time have been borne on the rolls of the Indian "Geological Survey," whose bearers lie in Indian graveyards, or beneath some modest tomb on the out-skirts of an Indian village, or who finally have returned with shattered health to the land of their birth, only to bring to a close among their friends the last few enfeebled months of their career. Of the earlier labourers in the field, of those who witnessed the birth of the "Geological Survey of India," and who three-and-twenty years ago wielded their hammers in breaking open the secrets of Indian rocks, but three still remain members of the Survey Staff, and to two of these surviving members whose names stand at the head of our article, we are indebted for the present masterly summary of the common labours of all.

The contributions of the two authors to the joint work are distinct, and in point of magnitude unequal. To Mr. W. T. Blanford has fallen the lion's share of the labour. Of the thirty chapters which (including the introduction) make up the work, Mr. Medlicott contributes ten, viz., those on the metamorphic and azoic rocks of the peninsula, and those on the geology of the Himálaya east of the Jhelum, and on Assam. The remaining twenty chapters, including the introduction, which deal with all the fossiliferous and neozoic rocks of the peninsula, the geology of Sind, the Punjab and Burma, and the Sivalik fauna generally, are the work of Mr. W. T. Blanford. The map,[1] which is printed in colours and is on the scale of sixty-four miles to the inch, has been compiled in the office of the Geological Survey, from materials in part unpublished. It professes to be only a preliminary sketch map, and three small tracts in the peninsula, the greater part of the Bikanir Desert and Guzerat, the Nepalese Himálaya, and Arakan and the adjoining hill tracts are left uncoloured. But with these exceptions it exhibits in as detailed a form as the scale admits of, and with unquestionable accuracy, the extent and boundaries of the several formations, classed as Alluvium, Upper and Lower Tertiary, Cretaceous, Jurassic, Triassic, Carboniferous, Silurian, Submetamorphic, Metamorphic, Granitic, Volcanic; and in the peninsular area, Upper and Lower Gondwána, and Vindhyan, the meaning of which unfamiliar and special classification we shall presently have occasion to notice.

The subdivision of the whole region into a peninsular and an extra-peninsular area is one of fundamental importance, and, as such, is treated in the arrangement of the manual. Geographically, the two areas are separated by the broad unbroken alluvial plain which stretches along the foot of the mountain zone from the mouths of the Indus to those of the Ganges; and geologically both in

[1] A copy of this map was sent for exhibition to the Great Paris Exhibition last year, but was probably seen by few. In fact, it was suspended in the office room of the Indian department, avowedly for want of room. Meanwhile a conspicuous case in the centre of the transept was devoted to the exhibition of Indian pickles.

history and structure, they present many strongly-contrasted features. In the words of one of the writers, "This [the extra-peninsular area] is geologically an intrinsic portion of the Asiatic continent, whilst peninsular India is not." For many years, indeed, it seemed that there was scarcely any stratigraphical link between the richly fossiliferous formations of Sind, the Salt Range, and the Kumaon Himálaya on the one hand, and on the other, the plant-bearing or azoic shales, and thick-bedded sandstones, described by Newbold, Williams, Voysey, Hislop, and others, which, with volcanic and metamorphic rocks, make up the greater part of the peninsula. While, with the exception of the later Himalayan and Sind tertiaries, the former are in the main of marine origin, a large portion of the latter are the characteristic deposits of fresh water; and, as regards the less ancient and fossiliferous formations, the apparently conflicting indications of age afforded by their fossil remains left it long impossible not merely to correlate them with any recognised members of the extra-peninsular formations, but even to assign to them with any confidence an approximate place in the general scale of geological sequence. Nor can this problem even now be considered as fully solved. But the scraps of evidence which, one by one, have been brought to light in the continued progress of the Survey have greatly simplified it, and this evidence is ably analysed and summed up in the first volume of the manual. The plant-bearing formations of the Peninsula are now regarded as one great system, to which the name Gondwána has been given, subdivided into an upper and lower series, and it represents the deposits of an ancient system of river valleys, dating from Permian and lasting to Tithonian times. The lesson in geological reasoning, inculcated by the geology of these rocks, is one that deserves to be carefully pondered, and in illustration of the difficulties which it presents, we will quote one or two passages from the fifth chapter of the Manual. To render the description more clear to the general reader we preface them with an excerpt from the tabular synopsis of the Gondwána formations at p. 108, exhibiting the accepted stratigraphical relations of the different groups referred to. It includes four only of the eight regions summarised in the original table.

	General Sequence.	Satpúra Region.	Godaveri Valley.	East Coast Region.	Cutch.
Upper Gondwána.	Cutch and Jabalpur	—	Chikiála	Tripetty	Umia
		Jabalpur		Sattavedu (?) ...	Katrol
	Rajmahal and Mahadeva	Bagra ...	Kota-Maléri ...	Ragavapuram and Sripermatur	—
		Denwa...		Golapilli	—
		Pachmari	—	—	—
Lower Gondwána.	Panchet ...	Almod(?)	Kámthi (including Mangli)	—	—
	Damúda ...	Bijori ...		—	—
		Motur ...		—	—
		Barákar.	Barákar	—	—
	Talchir ...	—	—	—	—
		Talchir..	Talchir	—	—

"[Dr. Feistmantel] ascribes to the whole series an age ranging from Lower Trias or Bunter (Talchír and Damúda) to Middle Jurassic or Bathonian (Jabalpúr and Umia). His determinations, however, being founded exclusively on a comparison of the Gondwána fossil plants with those of European formations, are very frequently opposed by other fossil evidence. The Umia beds of Cutch, for instance, the flora of which is considered by Dr. Feistmantel of the same age as that of the Jabalpúr group, which is the highest Gondwána subdivision, contains several plants found also in the Lower Oolites of Yorkshire, but the Cephalopoda of the marine beds, which immediately underlie the Umia plant beds, and are, to some extent, interstratified, have been shown by Dr. Waagen to be uppermost Oolitic (Portland and Tithonian) forms; and to be separated by two distinct groups of beds, each with a well-marked fauna, from the underlying strata, in which lower Oolitic Cephalopoda occur. In the Damúdas and their representatives, on the other hand, although a few fossil plants are allied to Triassic species, several of the most abundant and characteristic forms are unknown in the Trias of Europe, but are represented by the same or nearly allied plants in the coal measures of Australia, the lower portion of which is certainly of Carboniferous age." Again, "As an example of the difficulties presented in the present state of our knowledge by the contradictory evidence afforded by the fossils of one group, the case of the Kota-Maléri beds may be cited. The Kota beds consist of limestone, and contain remains of fish which have a liassic facies. The Maléri (or Malédi) beds have yielded two reptiles, *Hyperodapedon* and *Parasuchus*, and a fish, *Ceratodus*, all of which are closely allied to European triassic forms. In these Maléri beds some plants have been obtained common to the Jabalpúr and Sripermatur groups, the flora of the former of which has been shown to be in part identical with that of the Umia group of Cutch. The singularly contradictory evidence of age afforded by this Umia flora has already been mentioned. The Kota beds with their liassic fish have now been shown to be so closely connected with the Maléri clays and sandstones, containing triassic reptiles and fish and jurassic plants, that both are classed in the same group."

The conclusion which Mr. Blanford draws from this apparently conflicting evidence is the following:—

"Assuming that the association of similar marine forms in the rocks of distant countries—for instance in the Carboniferous limestone of Europe, the Punjab in India, and Australia,—implies that the rocks are of contemporaneous or nearly contemporaneous origin, the remarkable combination of fossils in the Kota-Maléri beds seems to show that, in mesozoic times, there was a wider diversity in the forms of terrestial life inhabiting distant regions at any given period than there was in the faunas of the surrounding seas. This view is in accordance with the very similar conditions now found prevailing upon the earth's surface, there being a much greater difference between the terrestrial faunas and floras of Africa, Australia, and America, for instance, than there is between the animals inhabiting the Atlantic, Indian, and Pacific Oceans. . . . . There appear, in short, good reasons for believing that the terrestrial area of the world was divided into zoological and botanical regions in past times as it is at present, and the fauna and flora of India may have differed at times, more from those then existing in distant countries, than from the animals or plants which prevailed in the same distant regions at a different geological epoch."

At the very base of the Gondwána system occurs that remarkable bed of silt containing transported boulders which is held by the authors, and we believe we may now say by all members of the Geological Survey of India, to afford evidence of the action of ice, probably ground ice; and it is not a little striking that the most conclusive evidence of this agency, viz., polished and grooved boulders resting on a surface of limestone equally polished and scored, was met with in latitude 20°, at an elevation of about 700 feet above the sea. The resemblance of this bed to that at the base of the Karoo formation of South

Africa, and indeed the palæontological and physical parallelism of the Karoo and Gondwána formations generally is now well known.

The peninsular area affords no instance of any fossiliferous rock of older date than the Gondwána system. But a large area to the north of Madras, another in Chhatisgarh, east of Nagpur, a third very extensive tract in Bundelkhand and Malwa, partly covered by trap, but still exposed over a surface of 40,000 square miles, and some smaller tracts in the valleys of the Kishna and Bhima rivers are occupied by a massive and quite unaltered series of sandstones, limestones, and shales of great thickness which have received the name of the Vindhyan System. From the fact that both in Bundelkhand and Hyderabad diamonds are found imbedded in these rocks, the name "diamond sandstone" was given by Capt. Newbold to a portion of these rocks, but the name was erroneously extended to the much later sandstones of the Gondwána formation, an error only cleared up by the labours of the Geological Survey. Beyond the fact that the Vindhyan system cannot be newer than Lower Palæozoic, nothing whatever is known of its age. Repeated search in the limestones and shales, however promising in appearance, has revealed no trace of any fossil organism, and it is impossible to correlate them with any group of rocks in the extra-Peninsular area, or, indeed, elsewhere. Below and older than these again, are two, or perhaps more, series of submetamorphic rocks, which, under various local names, have been mapped and described in many parts of the Peninsula, and all rest on the fundamental gneiss, which, whether of one or many ages, is everywhere the oldest rock, and is still exposed over nearly half the area.

The only remaining extensive formation of the Peninsula is the great Deccan trap-flow, the most extensive volcanic formation in the world. The age of this formation is now definitely fixed as Upper Cretaceous. Except in the neighbourhood of Bombay, where it dips with a gentle inclination beneath the sea, the successive flows are perfectly horizontal, occasionally interbedded with thin deposits of freshwater origin, and at one place, near Rajahmahendri, with an estuarine deposit. The area still covered by this formation is estimated at little less than 200,000 miles, and there are proofs of its former existence throughout nearly ten degrees of latitude and sixteen of longitude. For the discussion of the many interesting problems presented by this great manifestation of volcanic energy, we must refer the reader to the original work.

In passing from peninsular India to the encircling mountains we pass from an old continent to a new one, from a relic of a mesozoic land area, to the Asia of tertiary and post-tertiary times, and from a region where prolonged denudation has long since obliterated all but the merest traces of original mountain structure, leaving water-worn bosses of hard crystalline rock-cores or scarped slopes and sculptured platforms of horizontal trap or sandstone, to one where the latest deposits of tertiary times are so contorted and faulted as to render the task of disentangling the geological relations of the formations sometimes one of extreme difficulty.

The history of the Himálayan system, which, in addition to the Himálaya proper, includes the Indus ranges and those of the Burmese peninsula, begins in eocene times. It is considered by Mr. Medlicott that the very ancient slaty rocks which now form the greater part of the mountain mass south of the snowy range, and which he designates as the "Lower Himálaya," had undergone no contortion prior to the nummulitic period; and that immediately before its partial depression beneath the nummulitic sea, this area had been long exposed to denudation as "part of a land of doubtful configuration." It is still somewhat doubtful to what age are to be assigned the slaty formations here spoken of. As yet they have yielded no recognisable fossil remains, and they present no such similarity of character to the formations north of the main axis in Zanskar and Hundes, where rocks rich in fossil organisms have been described by Gérard, Strachey, Stoliczka, and others, as to allow of more than a speculative correlation. A recent observation of Mr. Lydekker's in the Pir Panjál range of Kashmir, throws however some little light on the question. The rocks of the slaty series extend in a north-west direction to the Pir Panjál range, and a limestone which there occurs at the top of the series, and appears to be identical with the Krol limestone (also the highest member) of the series near Simla, has been identified by Mr. Lydekker as Carboniferous. From this it would appear that rocks of mesozoic age are completely absent from the Lower Himálaya, and are restricted to certain areas north of the snowy range, and in the extreme north-west to certain parts of Kashmir, and we may add, the western extremity of the Salt Range.

Only in the Eastern Himálaya, viz., at the base of the Sikkim hills, have we any *indubitable* representative of the characteristic fresh water formations of the peninsula. In 1849, Dr. (now Sir Joseph) Hooker, detected some of the well-known fossil plants of the Bengal coal-bearing (Damúda) formation in certain shaley beds exposed at the foot of the hills near Pankabári, on the road to Darjiling, and this observation, subsequently followed up by Mr. W. T. Blanford, and more recently by Mr. Mallet, has led to the recognition of a band of Lower Gondwána rocks, occupying a narrow zone between the tertiary sandstones of the Terai and the talcose slates of the outer hills. The connection between the Eastern and Western Himálaya remains, however, to be traced out, the intervening kingdom of Nipál being unfortunately closed by the suspicious jealousy of its Hindu rulers, equally to the general traveller, the trader, and the man of science. It is however pointed out by the authors of the Manual, that the probably palæozoic slates, sandstones, and limestones of the Lower Himálaya were originally deposited on a highly eroded surface of ancient gneiss, and probably in hollows, and it is suggested by Mr. Blanford, that like the ancient unfossiliferous formations of the peninsula, they may be of freshwater origin, and that the Lower Himálaya may, after all, have formed a portion of the same palæozoic and mesozoic continent, around the shores of which were deposited the fossiliferous shales and limestones of Zanskár, Hundes, and the Western Salt Range, in which case the chain of the Himálayas must have originated along a portion of the ancient coast-line. And we may observe that the junction of the north and south ranges of the lower Indus valley with the north-west and south-east ridges of the Himálaya coincides in a general way with

the region where the palæozoic and mesozoic marine formations appear to the south of the Himálayan axis, the former in the Punjab and Afghanistan, the latter both there and further south, in Cutch, Sind, and Bálúchistán.

The geography of India in the early eocene period may be represented as something like the following:—The whole of the peninsular area was then, as it now is, land, with the exception of some portions of the present coast tract north of Bombay. In like manner the coast of Kaliwár and the greater part of Cutch were submerged, and a deep sea extended up the present Indus valley, and over Bálúchistán, also over the Punjab and parts of Káshmir, sending an arm up the present Ganges valley, which was in part estuarine, and bounded on the north by a tract of land composed of the then uncontorted rocks of the lower Himálaya. To the east of Bengal the present plain of Silhet and a part of the Khasi Hills were probably covered by a shallow sea, and this extended to the southward over Arakan and at least a large portion of Burmah.

It was in this state of things that the first great disturbance took place, which, repeated again and again during middle and later tertiary times, resulted in the present chain of the Himálaya. The river valleys which, after the first great upheaval, were carved out in the then youthful chain, discharged their stream-borne *débris* as now on the Gangetic plain; and the accumulated conglomerates, sands and clays, which formed around the mouths of the valleys, again and again suffered crushing and upheaval during the subsequent compression of the mountain mass, were added to the hills, and in their turn underwent erosion. But the valleys originally marked out have preserved their general course and function; and the Sutlej, the Bias, the Tous, the Jumna, and the Ganges, still flow out from the mountains along essentially the same lines of drainage which their then nameless representatives followed in miocene times. Such, at least, briefly stated, is the history which Mr. Medlicott and his colleagues have evolved during many years' study of these interesting rocks, first made famous through the classic labours of Cantley and Falconer, and by them named "Siwalik."

Not the least interesting chapter of the Manual before us is that in which Mr. Blanford deals with the rich and varied vertebrate fauna of these tertiary rocks. The original collections of Cantley and Falconer have been largely added to in later years by various members of the Survey; and a comparison of the forms obtained from different horizons in the Sub-Himálaya, the Punjab, Sind, Perim Island, and certain river valleys in the Indian peninsula and Burmah, has led to some modification of the opinions originally held of the geological age of the Siwalik rocks and their contained fauna.

As Mr. Medlicott has shown, the Siwalik rocks are an ancient alluvial formation, like the river fans described by Mr. Drew in Kashmir, and like the *Bhábar* deposits still forming along the foot of the Himálaya at the present day. In what may be termed the typical area, between the Sutlej and the Ganges, disturbances of some magnitude which took place after a portion of these deposits had been laid down, necessitate a subdivision of the series into three groups, upper, middle, and lower, the last of which is termed the Náhun group. It is from the two upper groups that (with perhaps some doubtful exceptions) all the fossils of this special region have been obtained, the Náhun group having remained unproductive to repeated search. An elaborate analysis of the homotaxis of the 45 mammalian genera (consisting of 84 species) which compose this fauna shows that the proportion of living to extinct genera is greater than in most miocene deposits. The presence of four extinct genera not known to range above the miocene period is contrasted with the occurrence of sixteen genera, not found elsewhere at a lower horizon than pliocene or post-tertiary; and there is a close approximation between some of the mammals and the living species of the same genera, the most remarkable of all being the connection of the fossil buffalo, *Bos palæindicus*, of the uppermost Siwalik strata, that of the post-pliocene Jumna and Nerbudda beds, and the Common Indian arnee still existing. Of six species of reptiles sufficiently well known to be comparable, three are common forms now inhabiting the same area, and the fresh-water mollusca also all apparently belong to common existing species. Putting the whole palæontological evidence together Mr. Blanford concludes that a balance is in favour of a pliocene age. This conclusion is strengthened by stratigraphical evidence. At the top of the enormous succession of tertiary deposits of Sind, which have a total maximum thickness of some 30,000 feet, occurs a group termed the Manchar group, about 10,000 feet thick, which is of fresh-water origin and represents the Siwaliks of Northern India. The lower beds of this group pass downwards into the Gaj group (1,000 to 1,500 feet thick), which is of marine origin, and contains a characteristic miocene fauna, "more probably upper than lower miocene." The Lower Manchar beds have yielded a considerable number of mammals, and this fauna, although containing several species in common with the Siwaliks, is altogether older in aspect; the majority of the forms hitherto recognised, belonging to the peculiar types of even-toed ungulates allied to *Nierycopotamus* and *Anthracotherium* intermediate in character between pigs and ruminants, and peculiarly characteristic of the miocene epoch. In these lower Manchar beds is also found a form of *Dinotherium*, a type unknown in the Siwaliks. Remarking that "there can be no reasonable doubt that the Manchar beds of Sind, as a whole, correspond with the Siwalik formation of Northern India, the two being portions of a continuous band of tertiary rocks," it is concluded that the fossiliferous lower beds of the Manchar group correspond to the unfossiliferous Náhuns, and the almost unfossiliferous Upper Manchar beds to the ossiferous strata of the Siwaliks. Mr. Blanford then remarks on the probable climatic causes which have preserved in the Indian pliocene an unusually large number of forms elsewhere characteristically miocene; and compares the case with that of the Pikermi beds in Attica, which are of unquestionable pliocene age. He considers that the general cooling of the north temperate zone at the end of the miocene period caused a migration of many of the characteristic mammals into Southern Asia, the Himálayan chain at that epoch not presenting so impassable a barrier as at the present day, and that such was the case seems to be confirmed by the occurrence of rhinoceros and elephant remains in the tertiary deposits of Hundes

at elevations now occupied only by the yak and similar mountain forms.

In reference to the greater richness of the Siwalik fauna, as contrasted with the Indian fauna of the present day, he quotes with approval the suggestion of Mr. Wallace, that a sweeping reduction was brought about by the cold of the glacial period. Of the influence of this cold in India, there are abundant proofs in the great extension of the Himálayan glaciers, for instance, in Sikkim and Kashmir, down to 6,000 feet and 8,000 feet above sea-level; and in the Naya hills of Assam, whose greatest elevation does not exceed 10,000 feet, in the large moraines at 4,500 feet, described by Col. Godwin Austen.

The oldest proofs of man's occupation hitherto met with in India, are a chipped axe or scraper, in the alluvial (post-pliocene) deposits of the Narbada, associated with remains of *Ursus*, *Elephas*, *Rhinoceros*, *Hippopotamus*, *Tetraprotodon*, and *Bos*, all of extinct species; and a flake, apparently of human manufacture, in the Godavari gravels of similar age. Quartzite implements of the palæolithic type are abundant in the laterite gravels of Madras, but these are probably of later date. Axes of neolithic type have as yet been met with only on the surface, most abundantly in the Banda district of the North-West Provinces.

The Manual is illustrated by twenty-one admirably executed lithographed plates of characteristic fossil forms, and a few woodcuts of sketches and sections. Its utility for purposes of reference is rendered all that can be desired by a copious and well-arranged index. We confidently hope that the publication of the work will give an impulse to the advancement of Indian geology by adding largely to the number of non-professional workers, a class which has hitherto been singularly wanting in India, despite the examples of such men as Carter, Forbes, Newbold, Strachey, and Hislop. H. F. B.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

Prof. Clifford's Mathematical Papers

HAVING, at the request of Mrs. Clifford and Dr. Spottiswoode, undertaken the editing of the late Prof. Clifford's mathematical papers, I am anxious to secure the co-operation of all mathematicians who are interested in the matter. Prof. Clifford does not appear to have been in the habit of widely distributing copies of his writings, so I have found of many of them a great number of copies, whilst of others I have not come across a single one. I will first state what I have:—

All papers in the *Phil Trans.*, in the *Proceedings of the London Mathematical Society*, in the *Messenger of Mathematics*, in the *Manchester Transactions*, in the *Cambridge Philosophical Society's Journals*, in the South Kensington Handbook, in the *Mathematical Reprint* from the *Educational Times*.

Of the papers in the *Quarterly Journal of Mathematics* I have only §§ 1–11, 17–23, of the *Analytical Metrics*. I should be glad also to have a copy of the *Academy* for August 15, 1873, and information about "Lecture Notes" on Geometry. These last are lithographed and are comprised in twenty-six articles (? all), of which I lack one page, containing § 19–21. I need hardly add I shall be glad to receive any other papers (mathematical) which are not contained in the above-named journals. The NATURE article (translation of Riemann) I have. I have Mrs. Clifford's permission to distribute the author's copies of her late husband's papers to mathematicians who may wish to have them. R. TUCKER

27, Cantlowes Road, Camden Square, N.W.

Pine-Pollen mistaken for Flowers of Sulphur

THE following paragraph appeared in the *Times* of June 16:—

"During the past week, after heavy rain, a thin film of sulphur has been observed at Windsor, Slough, and in the neighbourhood generally, to settle upon the surface of rain-water caught in butts and cisterns. The phenomenon at first did not attract much attention, but being observed on different occasions it has given rise to much speculation as to the cause of it, there being no manufactures in the neighbourhood at all likely to have produced it. It has been suggested that a sulphureous vapour may have been wafted to this country by the recent south-east winds, and arrested and deposited in the rain."

The supposed "sulphur rain," a fine yellow dust, was the cause of great excitement among the country people in this neighbourhood. It was first observed on the afternoon of Sunday, June 8, after a remarkably heavy shower, and much disturbed the inhabitants of some of the villages round Eton, who fancied that it smelt "awful like brimstone," of which its yellow colour was somewhat suggestive. In some places it gave rise to such a feeling of fright that the people were afraid to go to bed, thinking that the judgment day was at hand! Two or three days afterwards there was another "sulphur" shower, and I collected a quantity of the dust with my pupils, who were at work with me in my laboratory at the time. One of them, H. Bury, immediately recognised its resemblance to the pollen of *Pinus pinaster*, with which he is familiar from its abundance in the neighbourhood of his home at Bournemouth; and we have none of us any doubt but that this so-called sulphur is the pollen of this tree or of the Scotch fir, *Pinus sylvestris*, both of which are common in Windsor Forest. Two of the Windsor doctors, both practised microscopists, at once came to the same conclusion; but a local chemist and druggist is said (on good authority) to have supported the sulphur theory. This, perhaps, accounts for the rather positive statement by the Windsor correspondent of the *Times* as to the nature of the deposit, and also for the suggestion he refers to respecting its origin, which explains the phenomenon in a manner that is certainly more curious than probable, from a chemical point of view. I hear that the "sulphureous vapour" is supposed to have been "wafted to this country," after escaping from Etna during the recent eruptions, which fortunately occurred at just the right time to give apparent probability to the sulphur theory.

Thinking that such a remarkable phenomenon should not be allowed to pass unnoticed, I sent a short note to the *Times* of the 17th inst., stating the real (pollen) nature of the yellow dust, hoping that this would set the matter at rest and dispel the superstitious fears of the rustics. I was therefore greatly surprised, a few days afterwards, at receiving a letter from an F.R.G.S. residing near Carlow, in Ireland, who had seen my note in the *Times*, but nevertheless spoke of an "extensive fall of sulphur" in his neighbourhood. He was good enough to inclose me a "specimen of its incrustations" on a dead leaf, and said that "till yesterday's heavy rains any quantity of leaves like that I send you might have been gathered, and the edges of the pools of water were heavily incrusted with pure sulphur." He added that he thought I should not find the deposit to be "the produce of *Pinus pinaster*." This, of course, was rather startling, for I naturally supposed that no one would write so confidently who had not satisfied himself by chemical tests and by microscopical examination as to the truth of his statements, especially after hearing of the mistake which had been made in England. A glance at the deposit under the microscope, however, revealed its true nature—pine-pollen again!

I wrote accordingly to my informant, telling him this and sending him some pollen taken directly from the tree, so that he might recognise its similarity to the "pure sulphur" he so kindly sent me. I hope that by this time he has done so.

The above facts are of interest, partly as affording an excellent illustration of the transportation of pollen by the wind, and partly because they show how ready some people are to attribute an almost miraculous origin to anything a trifle out of the com-