deviation from the normal, which, taken over a 3-inch range in the first-order spectrum, only amounts to 0·2 Ångström unit.

The important part played in solar and stellar spectroscopy by the H and K lines of calcium renders it essential that the absolute wave-lengths of these lines should be known with the greatest possible accuracy. For this reason Mr. C. St. John, working at the Mount Wilson Solar Observatory, has recently made a series of wave-length determinations for these lines in the arc, spark, and electric furnace, and in No. 2, vol. xxxi., of the *Astrophysical Journal* he gives his results in terms of the secondary standards of Fabry and Buisson adopted at the Meudon meeting of the International Solar Union. The mean results are 3968·476 and 3933·667 for H and K respectively, and are estimated to be certain within 0·001 Angström. Mr. St. John also discusses the behaviour of these lines under the various conditions employed, and, from his results, concludes that the wave-lengths are identical for the absorption and the fine emission lines, and are the same in arc, spark, and furnace. The mean ratio of the width of K to H is 1·28, and the mean ratio of the respective intensities is 1·47. The experiments described were preliminary to an exhaustive comparative study of the corresponding solar lines.

PLANT DISTRIBUTION.

TWO recent papers furnish a supplement to the magnificent phytogeographical memoir on South Africa by Dr. R. Marloth. The one is an article, by Dr. L. Diels, on formations and flora-elements in the north-west of Cape Colony, published in Engler's *Botanische Jahrbucher* (vol. xliv., part i.). This is a detailed and localised account of botanical observations made in the country lying between the mouth of the Olifant River, Clanwilliam, and Calvinia. Near Clanwilliam lie sandy stretches where Compositæ and Scrophulariaceæ provide the bulk of the conspicuous vegetation. As the land rises, succulents, notably species of Euphorbia and Crassulaceæ, become predominant. At a height of 500 metres the vegetation begins to show elements natural to the true Cape flora, culminating in a "proteaceous-macchi" association on the Bokkeveld ridge. A special object of the trip was the exploration of the Hantam-berg flora, which is classed by the author with the botanical formations associated with Namaqualand.

The second paper is a contribution by Dr. H. H. W. Pearson to the Royal Geographical Society, published in the *Geographical Journal* (May), giving a general sketch of a botanical expedition through the dry western districts of Cape Colony and the adjoining German territory to Luderitzbuch, and thence from Mossamedes in Angola to Ft. Rosadas on the Kunene River. The regions of vegetation through which Dr. Pearson travelled are very clearly set out in the accompanying map. The succulent Karroo vegetation was first traversed until this gave place to a composite flora near Calvinia. Further north, floras known as the Namaqualand montane and Bushmanland were met with. The former is characterised by the presence of *Aloe dichotoma, Vogelia africana,* and other plants, while species of Aristida and *Parkinsonia africana* are typical of the latter type. The district lying immediately south of Mossamedes is the historic locality in which Welwitschia was discovered, and here the author found it more at home than in Damaraland, which suggests that it is a tropical species, and therefore more closely related to the genus Gnetum than to Ephedra.

Attention is frequently directed to weeds produced in new countries by exotic plants. There is, however, more interest attaching to the spread of indigenous plants caused by a disturbance of natural conditions, of which a striking instance in the case of *Celmisia spectabilis* is described by Dr. L. Cockayne in the Canterbury Agriculturists and Planters Association's Journal (April). This plant is a composite and endemic, growing naturally with other species of the genus at elevations above 3000 feet. It has a woody, creeping stem furnished with numerous cord-like roots. The end of the stem bears a rosette of thick tomentose leaves with long sheathing bases; the rosettes are crowded together, forming a circular mat or cushion. Within the shelter of the leaves lies the bud, which throws out daisy-like flowers above the leaves, and subsequently develops downy fruits. As a result of burning and over-grazing, the tussock formations at a lower level, which consist of useful grasses, are being replaced by the Celmisia. The remedy suggested is to reinstate natural conditions, when the grasses should win back the lost ground.

Captain A. A. Dorrien-Smith contributes to a recent number of the *Kew Bulletin* (No. 4) an account of his botanical excursions in Chatham Island with the primary object of collecting specimens of *Olearia semidentata, Acrphylla Dieffenbachii,* and other local plants for introduction into the Scilly Isles. In the south and boggiest part of the island *Olearia semidentata* covers acres of ground, and here the author discovered a pure white form of this normally purple daisy-like flower, and his companion found a pink variety. The article provides an interesting sketch of the vegetation, and is illustrated with several photographs, two of which represent bushes of the normal type and white variety of the Olearia respectively.

THE MAINTENANCE AND ADMINISTRATION OF ROADS.

AUTHORITIES having control of highways have now to consider the problem of road construction and maintenance from a new point of view in consequence of the conditions of modern traffic. The problem is an acute one everywhere, and various solutions of it have been put forward by highway engineers. Evidence of experts as to the causes of the increased wear and tear of roads and their opinions as to remedies will be found in the report of the important conference on roads, held last year at the Institution of Civil Engineers, and also in various publications of the Roads Improvement Association and the Royal Automobile Club. The subjoined extracts from these publications, and summaries of papers, provide the essence of a large amount of evidence given by road engineers before several conferences and associations upon important questions relating to roads.

A very large number of our roads, except those of recent construction, may be said to have grown, or developed, rather than to have been made. Many of them were originally mere tracks, and have arrived at their present state through the accretion of coats of ground-up stone, often of poor character, possibly faced with a thin crust of granite or some inferior material. The fact that many roads have been built up by the use of metalling, without foundations, other than the subsoil upon which the metalling is placed, accounts for the difficulties, troubles, and expensive maintenance now experienced in connection with most existing rural main roads, for where the foundation of a road is weak, the surface is always difficult and costly to maintain.

The greatest practicable improvement in the construction of macadamised roads is to be found in the use of the very hardest and toughest coating materials well consolidated by rolling, with the addition of just sufficient fine chippings during the consolidating process to fill completely the spaces between the stones. The common method (condemned by every road engineer) of binding together the aggregate of an ordinary macadam road by the use of road scrapings is productive of the greater part of the mud and dust found so objectionable. One of the resolutions referring to macadamised roads adopted by the International Road Congress held at Paris in 1908 was:—"To use as far as possible only hard and homogeneous road materials, regularly broken; to make choice of a binder suitable to the structure of the road material used, reducing, moreover, the binder to a minimum."

As to the wearing characters of various rocks used as road metals, some definite information is available. The Town Council of Hornsey possesses a machine by which the effect of wear and tear on road stones can be tested. The stones to be tested are all broken to a 2-inch gauge and placed in cast-iron cylinders, which are made to revolve 8000 times at a speed of twenty revolutions a minute. They are tested both wet and dry, and as the result of the shaking they receive a certain amount of chips and dust is produced. The percentage loss of weight experienced by the stones is then determined. As the treatment is the

same in every case, the machine enables an estimate to be obtained of the relative power of road stones to withstand the wear and tear of traffic, and the rubbing action which takes place at the surface of a macadamised road. A series of tests with this machine was made a few years ago in connection with an examination of the constitution of the stones by H.M. Geological Survey, and the results were published in a work entitled "Attrition Tests of Road-making Stones." The table given below shows the average loss per cent. of a few typical rocks used for road-making :—

Stone	Quarry or Locality	Average Percentage of loss in dust
Quartzite	Wick, Glos.	4·0
Ferruginous Quartzite ...	Winford, Somerset... ...	4·4
Quartz Porphyrite	Quenast, Belgium... ...	3·7
Quartzite	Cherbourg	5·7
Biotite-hornblende Granite	Mount Sorrel, Leicestershire	6·6
Chalk Pit Flints	Grays, Essex...	10·4
Gabbros	St. Sampson's Guernsey	10·7
Calcareous Sandstone ...	Liphook, Hants	17·3
Foraminiferal or Mendip Limestone	Winford, Somerset ...	19

It will be seen from this table that quartzites stood the test best, that flints came out fairly well, and that sandstones and limestones are at the bottom of the list. Though the final test of a road metal can only be known by wear and tear upon the actual road, yet the results obtained by the systematic testing of stones under precisely the same conditions serve as a guide in the selection of suitable materials. They give no indication, however, of resistance to crushing. Flints only lose a small percentage of their weight by rubbing together, but they are crushed into dust by heavy traction-engines.

There can be little doubt that poor materials, with road sidings used for binding, are largely responsible for the unsatisfactory condition of many roads. A limestone road-metal is undesirable for most districts, and flints make bad roads when they are used where heavy traction-engine traffic occurs. In the long run it is less expensive to use a good road-metal than a cheap one. It does not seem to be recognised that good material can be carted as cheaply as bad, and that, properly applied, the former lasts years longer than the latter.

Assuming that a macadamised road has been properly constructed, it is worth while to consider the chief causes of damage to it. It is often said that motor-cars are responsible for the chief part of the damage; but that is not really the case. If a newly made road be noticed, it will often be seen that the ordinary motor-car traffic scarcely wears the road at all in the tracks where the wheels go, whereas the part where the horse traffic goes is worn hollow in the middle, being dug out by the hoofs. Motor-cars probably do less damage to a good road than horses. Moreover, the damage done by a 2-ton pneumatic-tyred pleasure car is superficial compared with that done by a motor-waggon with a total weight of 12 tons. The wear and tear is caused by (1) the heavy weight per axle carried; (2) the speed at which the heavy motor-car runs. Under the Heavy Motor-car Order, a car weighing 3 tons unladen, and having a load of more than 5 tons (making a total of above 8 tons), must not exceed a speed of five miles an hour, with or without trailer; but this weight and speed are constantly exceeded. It is the combination of illegal speed with illegal weights carried that is largely responsible for much serious wear and tear of roads.

It is generally believed that ordinary motor-cars cause much damage to roads by what is described as the "sucking action" of pneumatic tyres; but this action has never been proved to exist. The action which undoubtedly does remove the small particles of the road is due to a scouring or brushing of the surface by the tyres, thus leaving the large particles to be crushed into dust by the rigid wheels of other vehicles. In the case of steel-studded pneumatic tyres the brushing action is, of course, greatly increased, and is accompanied by crushing forces. To sum up, the causes of damage due to altered conditions of traffic are :—(1) Traction engines: great weight of engine; excessive vibration, rigid and ribbed construction of tyres. (2) Heavy motors with trailers: vibration, weight, rigid tyres running over road at high speed. (3) Pleasure cars: scouring action of the pneumatic tyres of cars travelling at high speed.

The chief cause of dust, as apart from its method of production, is to be found in the use of unsuitable road material. As already stated, the horse is a serious factor in the creation of dust; and the 5-cwt. battering-ram, as each leg of the horse has been called, gives a road a succession of heavy blows, apart from the screwing or puddling action, and disintegrates the surface far more than is generally realised. The motor-car, on account of its tyres and the rapidity of its movement, though it raises and scatters dust to a greater extent than any other vehicle when going very fast, does far less to create it than is generally imagined.

The dust nuisance may be lessened greatly by using nothing but high-class road metal, reducing the quantity of binding material, and reducing the cross-fall or camber of the road, so as to ensure that the traffic spreads itself over the whole width instead of always being driven to the crown of the road; but Mr. Walker Smith, in an exhaustive book recently published on "Dustless Roads and Tar Macadam," points out that even when these conditions are satisfied no very substantial improvement can be looked for. "Even when the best material and the best methods of binding are introduced, the road will always remain a pervious road. The moisture in wet weather, which tends to hold the particles of the road together, will, on being evaporated in the dry weather, leave the surface loose and friable and a ready prey to the disintegrating forces, the shock of the horses' feet, the abrasion of the steel-studded vehicle, and the scouring action of the soft-tyred ones." Mr. Walker Smith says very strongly that the binding is undoubtedly the crux of the whole question of efficient road-making and maintenance. The binding makes or mars the macadamised road, and it is, and ever has been, the weak spot in the ordinary macadam road. The Dust and Dustless Roads Committee of the Royal Automobile Club reports that, in the opinion of the whole of the road engineers with which it has been in touch, if macadam roads are to be constructed to meet the needs of the present-day traffic, with the searching demands that the traffic makes on the road surface, a bituminous binding or matrix must be employed.

The committee states that, setting aside the temporary palliatives of watering roads with chemical preparations which keep the road damp by the absorption of moisture from the air, the treatment which has been most successful in rendering roads dustless has been the surface application of tar applied either by hand or by machine. By this method great lengths of road have been rendered dustless for a whole summer season, the mud in the winter following has been reduced in quantity, and in some cases the application has lasted for more than one season. Moreover, there is almost unanimous testimony that the whole cost of the treatment is more than saved by the increased durability of the road, and already many surveyors are able to make a strong case for the extension of the treatment solely on the ground of economy alone.

The most permanent mode of treatment is that of re-making the whole of the surface of the road with tar macadam, and when a road has to be re-surfaced this treatment is also the most economical in the end.

The use of calcium chloride to keep down dust is not recommended, one reason being that the keeping of the roads moist and soft tends to the more rapid wear of the surface.

The Roads Improvement Association has issued a report showing the extent and result of the treatment of roads by tarring. From this it appears that the road must be thoroughly cleansed before treatment; about six square yards of surface can be treated per gallon of tar; sand or granite chippings must be applied after treatment; the average cost is about 1*d.* or 1½*d.* per square yard when a machine is used, and 1¼*d.* to 1½*d.* when the tar is applied by hand; at least one treatment per annum is required; the road should be dry when treated. Excellent results have been obtained at the cost of about 40*l.* per mile, and with a small consumption of tar—about one-sixth to one-fifth of a gallon per square yard.

No suggestion of tarring is, however, of any use unless the road itself is constructed of good materials, so that, with the exception of some main roads, few roads in rural districts are at present in a condition for such treatment, though the changed conditions of traffic demand a change in the character of the roads. The new conditions demand increased expenditure upon maintenance both on main and secondary roads. The annual outlay in maintenance and repair of the main roads in England and Wales has steadily increased from an average of 76*l.* a mile in 1901 to more than 100*l.* a mile in 1909. Here is an average increase of 25 per cent. in eight years, and there is no prospect that the rate of increase will diminish. It would seem that a road system which requires an outlay of about 100*l.* a mile upon the 150,000 miles of road in England must be inefficient and costly. The explanation is probably to be found in the fact that the maintenance of our highways devolves upon local authorities. It is instructive to compare our system with that followed in other countries; and this comparison is made by Mr. L. W. Page, director of the U.S. Office of Public Roads, in a paper on road administration and maintenance published in the May number of the Journal of the Franklin Institute. Subjoined is a summary of a part of this paper.

Systems of Road Administration.

The basis of the French system is the School of Roads and Bridges, one of the finest technical schools in the world, and maintained at the expense of the national Government. From the graduates of this school are chosen the highway engineers who are entrusted with the building and maintenance of the roads in France. At the head of the administrative organisation is an inspector-general of bridges and highways, under whom are chief engineers in charge of the road work of single departments and communes. Single subdivisions of departments are under the direction of district engineers and assistant engineers, the latter being equal in rank to non-commissioned officers in the army. The subdivisions are under the direction of principal conductors and ordinary conductors. Next in line come the foremen of construction gangs, the clerks employed at headquarters, and finally the cantoniers or patrolmen, each having from 4 to 7 kilometres of highway under his immediate supervision. This great administrative machine, working in complete harmony with definite lines of responsibility clearly established, accomplishes results with military precision and regularity.

In England, jurisdiction over the road is vested in, first, the county boroughs; second, the county councils; third, the urban district councils; fourth, the rural district councils. In most counties the maintenance of the highways devolves upon urban councils in the urban districts and rural councils in the rural districts. The only exception to the control of the urban and rural district councils is in the case of main roads which are highways between large towns, and the maintenance of these roads devolves upon the county councils. As to skilled supervision, it may be said that no qualifications are required by law to be possessed by the men in charge of road building and maintenance, but it is the general practice, at least in important districts, to appoint experienced highway engineers for this work. It will thus be seen that the English system lacks strong central control in the counties, there being four different classes of Government units, each acting largely independently of the others.

Germany is a confederation of States, and it follows that road administration is conducted separately by each State of the Empire. The Imperial Government exercises very little control over the highways, and does not in any way contribute toward their construction or maintenance. The Kingdom of Saxony may be taken as a representative State of the German Empire. In Saxony the highways are divided into State roads, county roads, and private ways. The State roads comprise those which are built and maintained by the State. The county roads are generally termed communicating roads, and are built and maintained at the expense of the parishes through which they lead. A striking feature of the Saxony road system is the practice of planting fruit trees along the road. The fruit yields a revenue of about 8000*l.* a year from the State roads, while the amount obtained from the fruit grown on the county roads represents a much larger sum.

The State roads are cared for by a commission of engineers. The kingdom is divided into seventeen road districts, in each of which there is a road inspector. Under these inspectors are road masters, who are employed constantly throughout the year. Each road master has about thirty-seven miles of road under his direction, and a road force of about fifteen men. In the case of the minor roads, the direct responsibility is borne by the county authorities. They levy and collect the revenues necessary for maintenance and new construction. The communities engage the road employees for the continued care of the highways. The technical supervision, however, is exercised by the road masters of the State force.

The road system of Switzerland is local in character, the various cantons having jurisdiction over the roads within their respective borders. Each canton has at the head of its road system an engineer with capable assistants. In the canton of St. Gaul, which is fairly representative, there are under the control of the engineers five inspectors or road masters who are assigned to certain districts in the canton. The engineers and their assistants must have an academic education and possess a diploma from the Polytechnic Institute, while the road masters are required to have a good technical education.

It is apparent from the foregoing that while the units of administration in European countries range all the way from the localism of England to the highly centralised system of France, through varying degrees, skilled supervision is provided for by all the systems, as well as an ample cash revenue sufficient to enable the engineers to carry out the plans for improvement and maintenance. England is the most striking example of extreme localisation, and, it is a significant fact, also the most striking example of lack of uniformity in road work and of excessive expenditure in proportion to mileage. It is also significant that the most perfect road system is that of France, which is admittedly the most highly centralised of all the road systems. France, with a total mileage of about two and one-third times that of England, expends about the same amount annually for maintenance. Certainly the inference must be plain, that centralisation makes for economy and efficiency in the administration of the public roads.

When we turn to the subject of road administration in the United States, we find that about half the States are operating under practically the same road laws as prevailed in England when America was a colony. This system of road administration provides for the payment of road taxes partly in labour, and localises the work to an extreme degree. Organisation is almost entirely lacking, and no requirements are made to secure skill or knowledge on the part of the road officials. With few exceptions, no system of accounting is in force, and no definite lines of authority are established, such as would guarantee the wise and equitable conduct of the work.

The erroneous impression often prevails that when a so-called permanent road is constructed the expense has practically all been met in the first cost. An investigation of the cost of maintaining roads in the leading countries of Europe shows how incorrect is this view. In 1901 England and Wales maintained 26,598 miles of main road at a cost of 74*l.* per mile. In 1907 England and Wales maintained 27,556 miles of main road at a cost of 89*l.* per mile, or in six years the cost of maintenance had increased 15*l.* per mile, an increase of about 20 per cent. In France the increase in cost of maintaining the national roads was about 5 per cent. in the same period. The cost of maintaining main and urban roads in England and Wales in 1905 and 1906 was 88*l.* per mile. In France the cost of maintaining all roads during 1904 was 48*l.* per mile. While these last figures are not strictly comparable, one being for 1904 and one for 1905, yet the mere fact of one year's difference in time fails to explain the difference of 40*l.* per mile in cost of maintenance—the natural inference being in favour of the superiority of the French system.

These figures express most forcibly two facts: first, that even the best of improved highways are not self-maintaining, and second, that the cost of maintenance varies tremendously with the degree of centralisation of the administrative organisation which has the roads in charge.

France, with its most highly centralised organisation, is maintaining her roads at about 54 per cent. of what it costs England and Wales with her very local and loosely centralised organisation. Furthermore, the alarming increase in the cost of maintenance has been far more rapid in the countries with local and poorly organised systems of highway administration.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SHEFFIELD.—The council has appointed Mr. A. E. Findley to the newly instituted post of lecturer of applied chemistry in the University. Mr. Findley is at present assistant lecturer in chemistry at the Bradford Technical College.

THE Mercers' Company has made a donation of thirty guineas to the South-eastern Agricultural College library for the purchase of books of reference. The Fruiterers' Company has also presented a very fine copy of that scarce work, "The Herefordshire Pomona," and the Carpenters' Company a work on forestry, to the college library.

THE July issue of the *Battersea Polytechnic Magazine* shows how successfully the authorities of the polytechnic encourage an all-round development of their students. The magazine contains two general articles; one, on the house-fly, is based on the published papers of Dr. C. G. Hewitt, and the other deals with the discharge of electricity through high vacua.

AN open competitive examination for not fewer than seven situations as assistant examiner in the Patent Office will be held by the Civil Service Commissioners in September next. The examination will commence on September 26, and forms of application for admission to it are now ready for issue, and may be obtained on request addressed by letter to the Secretary, Civil Service Commission, Burlington Gardens, London, W.

ACCORDING to the *Revue scientifique*, a national office of French universities and schools has been inaugurated under the presidency of M. Paul Deschanel, of the French Academy. Prof. Paul Appell, of the University of Paris, and Prof. Georges Lyon, of the University of Lille, have been elected vice-presidents. Dr. Raoul Blondel has been appointed director. The new department is to be installed at the Sorbonne, and its object will be to make known to foreigners the educational resources of France.

AT the close of the term of the Royal Agricultural College, Cirencester, on July 27, the principal, Prof. J. R. Ainsworth-Davis, announced that the council of the University of Bristol has enacted a temporary ordinance, which will probably be made permanent in the autumn, making the college part of the University for higher teaching in agriculture and forestry. He also announced that Mr. H. J. Elwes, F.R.S., has placed a portion of his afforested land at Colesborne at the disposal of the college for research purposes.

WE are glad to receive a copy of the July number of the *Science Journal* of King's College School, Wimbledon. It is a special photographic number of twenty-four pages with several inset plates and sheets of illustrations, and is evidence that photography at Wimbledon takes a very noteworthy place among the out-of-school subjects that engage the boys' attention. Of the thirteen papers or essays, all except two seem to be by the boys themselves, and they deal with camera construction, exposure, development, printing, optics, enlarging, sports photography, and colour photography. It is gratifying to see that the greater number of the articles refer to the writers' own experiences, and are evidence of intelligent work. There may be room for different opinions as to the usefulness of a table of poisons, with the symptoms when taken and the ordinary antidotes, because it may be thought preferable for a lad to get assistance rather than to attempt to diagnose and treat a case of poisoning himself, but with reasonable care such cases of need will never arise.

THE report (Cd. 5257) has been issued of the departmental committee appointed to consider the statement of claims to additional State assistance, and estimates of the amounts needed for the respective services, which have been supplied by the Scottish universities at the request of the Government, and to report for what objects and to what extent assistance, if any, should be granted from public funds in the interests of the proper development of the work of the universities. The committee reports that a good claim has been made out for an additional grant to Scottish universities, and recommends 40,000*l.* as a fair contribution to their more pressing needs. This sum it proposes should be allocated as follows:—Edinburgh, 12,500*l.*; Glasgow, 12,500*l.*; Aberdeen, 9000*l.*; St. Andrews, 6000*l.* The grants, it is recommended, should be on condition that their administration should be in the hands of the respective University Courts, which should submit annual reports to the Treasury. Not less than 1500*l.* of the grant to St. Andrews University is to be devoted to the conjoint Medical School at Dundee. It is further recommended that, in addition to the 40,000*l.*, 3000*l.* should be paid annually to University College, Dundee, and that the grant at present received from the University Colleges (Great Britain) Grant should be discontinued.

THE antagonism which exists in England between the mathematician and the "practical man" is so deeply rooted that any attempt to break down existing prejudices will be studied with the keenest interest. In his presidential address to the Mathematical Association last January, Prof. H. H. Turner gave a remarkable account of the efficient development of the Egyptian Survey under the direction of Captain H. G. Lyons, F.R.S., in which he states:—"Now it will be readily imagined that for work of such extent and variety it is not easy to get a suitable staff of assistants. Scientific knowledge is necessary, but so also is a knowledge of Arabic and a physique which will stand the hot climate; so also is a business capacity and a faculty of detecting the truth in its Oriental disguises. It might well be that any one of these qualities was essential, while the rest, though desirable, might have to be dispensed with; or it might be that some rare combination of them must be sought with toil. It will probably be admitted that the final opinion of a man who has gone through the trying experience of getting together a staff suitable for such work, and finds himself ultimately satisfied as to the right course, is worth hearing; and hence I feel that the association will learn with peculiar pleasure that Captain Lyons's final method is to take able mathematicians from Cambridge or Oxford and trust to luck for the other qualities. The one thing he finds needful is that when some strange situation occurs, they should have a firm grasp of the fundamental principles, and not merely a knowledge of the rules deduced, which may fail to meet some unforeseen contingency. And this essential condition Captain Lyons has found to be fulfilled by mathematicians when others have failed to meet it. His faith in them has been justified in cases where a breakdown might have possibly been admitted. Even the most complete knowledge of mathematical or physical principles could scarcely be expected to inspire a man in dealing with an Arab camel-driver who was shamming sick; or with the organisation of the commissariat for a journey in the desert; or with an unexpected attack by wandering tribes which necessitated addressing them with dignity from the hump of a camel with three rifles pointed at one's chest. But it has been proved in the best possible way, viz. by actual experience, that such situations are dealt with capably by young men selected for their mathematical ability, with no special training for the contingencies of life beyond what undergraduates all pick up from life in one of our great universities. This is a lesson which we may well lay to heart."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 25.—M. Émile Picard in the chair.—H. **Deslandres** and J. **Bosler**: The phenomena presented by the tail of Halley's comet during the passage of May 19 last. From a discussion of various observations, especially those made by R. T. A. Innes at Johannesburg, it is concluded that the tail of Halley's comet was repulsed by the earth, and the evidence is in favour of this repulsion being due to electrical causes.—P. **Villard** and