

from being thrown overboard. When the slaver was captured she had no crew on board, and of course no one could be punished for that most barbarous murder. On the point of the withdrawal of the Post-office contract from Zanzibar, if true, it was the most disastrous thing that could have been done. If Government would not support the trade opened by the enterprise of British merchants, it was not likely that people in England would care to invest their capital in a place from which they could expect no relative return. Nothing was more discouraging to our merchants than that they should have to rely upon foreign steamers. But it was always the same wet blanket which was thrown over our trade, a system creating of course the greatest irritation and disgust. If that course were to be pursued, how could the trade of England be expected to increase? He would also ask what was the effect of the climate of these countries on Europeans.

Mr. HOLMWOOD, in reply to the first question asked, said, only one import tax could be levied by the Sultan, and that was an *ad valorem* import duty of 5 per cent., and it would be utterly impossible for the Government of the Sultan to go on if that tax were withdrawn. The revenue derived by the Sultan from the customs duties was about £200,000 per annum; but as yet only a small part of the coast had been developed. With that £200,000 the Sultan paid his troops, and had undertaken some very important public works. Some revenue also was derived by the Sultan from his private plantations, and until lately he had almost entirely devoted it to the public good. Five or six steamers which he had bought from the P. & O. Company, were now being run in the trade between Calcutta, Bombay, and Zanzibar, and they brought over grain which was sold at Zanzibar at the same price as it cost in India, the Sultan thus defraying the cost of transport out of his private resources. Beyond that sum—about £250,000 altogether—there was no revenue whatever for developing the country, and that was why he so strongly advocated that British merchants should provide the capital necessary for that purpose. With regard to the second question, it was true that one of the British men-of-war (*H.M.S. London*) had been withdrawn from Zanzibar, but that vessel was in a rotten state, and having become dangerous to the lives of those on board, the Government could not have done better than remove her. However, the Sultan had been so loyal to his undertakings, that except for some small smuggling traffic, the trade in slaves, by the running of the slave dhows, had been absolutely abolished, so far as Zanzibar waters were concerned, with the accompanying terrible and atrocious scenes. He did not believe the Government had revoked the mail subsidy, certainly the Foreign-office had not in any way given its consent to that withdrawal, and he could not think the statement was accurate. With regard to the climate, he had been in the country for twelve years, and it certainly

was trying, and people out there required change, but the prevalent ideas relative to East Africa on that score were very much exaggerated. No young Englishman or European who kept moderately steady need fear the climate in the least; and fathers need not hesitate to send out their sons, always providing, of course, they were free from organic disease. There was no very great heat, and no very great variations, but of course long residence out there to a certain extent "took it out" of Europeans. He might mention, in regard to a remark which had fallen from one of the speakers that evening, that he had long since proceeded to Manchester and had been before the Chamber of Commerce, and had spoken, both publicly and privately, at the Geographical Society there, and at various meetings, and he had endeavoured to impress upon them how necessary it was for Englishmen just now to be up and doing, especially in East Africa, if they wished to maintain their commercial supremacy. It now only remained for those who were practically interested in commerce to do their share towards this important object.

The CHAIRMAN thought it would be difficult to say much on the subject without going again over the ground already covered. One of the most interesting points in it was the position of the large group of native merchants who, we must feel, were British subjects. We had very heavy responsibilities in connection with them. The influence of those native merchants was great at the present moment. As had been stated by one of the Zanzibar merchants at an interview narrated that evening in the *Pall Mall Gazette*, "For every foreigner in the country there were a hundred British subjects, and for every acre held by foreigners we hold a thousand." That description gave a very good idea of the position of the colony of merchants at Zanzibar, and our responsibility towards them was very great indeed. We should not adopt a dog-in-the-manger policy of trying to prevent any other nation settling on the East Coast of Africa, but we should not allow unfair encroachments on the rights of our own subjects. The colonising capacities of Indians were very remarkable, or, rather, their facility for settling themselves down for their advantage. It was a singular feature in the native character. Therefore, although he knew personally nothing of Zanzibar, he knew the people who went there tolerably well, because they were the very class found in and about Bombay. An inferior class of Indians were to be found in the colony of Mauritius, and it was wonderful how they adapted themselves to the place. Two-thirds of its population were composed of them; they went as mere coolies, principally from the south of India, and after a period of prosperous work, and a return to their own country for a time, they went back to the Mauritius as settlers; and the natives of Southern India were not generally accounted among the best specimens of our Indian population. The

Portuguese had recently been doing something, and an expedition under Pavia de Andrada had penetrated for some distance into the interior, and had, he thought, discovered some coal very good for lighting purposes, and for mixing with other coal. It was not a very important fact, perhaps, but it showed that the Portuguese had their eyes open, though he could not say, from what he had seen of them on the West Coast, he had been very favourably struck with their administration. We ought also to keep our eyes open. As a very distinguished statesman and diplomatist had said, "what we required in the East was valour and vigilance," and that remark might be applied to all parts of the world where we were. He did not mean that as an incentive to aggression, but rather as a prophylactic. In conclusion, he expressed the hearty thanks of the meeting for the interesting and able paper they had heard.

Mr. HOLMWOOD briefly acknowledged the compliment, and the proceedings terminated.

FOURTEENTH ORDINARY MEETING.

Wednesday, March 11, 1885; FRANCIS GALTON, F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Clare, Octavius Leigh, Hindley-cottage, East Sheen, S.W.

Gilbert, William Henry Sainsbury, 9, Old Jewry-chambers, E.C.

Kirkaldy, John, 40, West India-road, E.

Partington, Charles Frederick, 47, Lower Belgrave-street, S.W.

MacWilliam, George Greenshields, 20, Bartlett's-buildings, Holborn, E.C.

Patterson, George, 85, Carleton-rd., Tufnell-pk., N.

Sharp, James, Carr-hall, Wyke, near Bradford.

Ward, Howard Charles, Yeaton, Lymington, Hants.

Watson, John, Cement Works, Gateshead-on-Tyne.

The following candidates were balloted for and duly elected members of the Society:—

Chadwick, Jesse, 6, Strand-terrace, Derby.

Mumford, Thomas William Bassett, 1, Glendale-villas, Sylvan-road, Wanstead, Essex.

Rawlins, Thomas, 45, King William-street, E.C.

Schlenheim, Ludwig, 40, Holborn-viaduct, E.C.

Smith, Josiah, 51, Park-end-road, Gloucester.

The paper read was—

EXPLORATION: AND THE BEST OUT-FIT FOR SUCH WORK.

By MAJOR-GENERAL THE HON. W. FEILDING.

I think it best to preface this paper with the Latin expression, *Quot homines tot sententiae*,

which may be very freely translated—a tot of men affords a quart measure of opinions. But, seriously speaking, it would be quite absurd for any one individual at any one period of the world's existence to attempt to lay down the law as to how exploration should be carried out.

The most that I can attempt to do is to speak in general terms on the whole subject, using such knowledge as I have gained during my own travels in various quarters of this globe. In order to treat the subject as exhaustively as the limit of time at our disposal will admit, it will be well to divide it under two headings.

1. On exploration generally, and the manner in which the subject should be considered.

2. On the outfits recommended for use by explorers under varying circumstances.

The first heading we must again subdivide into—(a.) Scientific explorations. (b.) Commercial and geographical. (c.) Military. (d.) Explorations arising purely out of a love of adventure.

Now, scientific explorations differ or vary exceedingly in their intention and their scope. Their scope depends again upon their intention, and their duration depends upon both these. For instance, botanical explorations may have for their aim a new genus, a new species, or a new variety only of some species. The scope of such exploration may embrace one or more islands in the Pacific Ocean, or the whole of the interior of some unexplored continent such as New Guinea. The duration must depend upon:—(1.) The means of transport to the primary base of operations. (2.) The means of locomotion over the whole or the various portions of the country to be explored. (3.) The physical difficulties to be encountered from man, and from natural obstacles. (4.) The financial means available in this conflict with the difficulties, foreseen and unforeseen, of exploration.

There is much truth in the old saw "money makes the mare to go," and with plenty of money many of the difficulties of exploration are greatly lessened; yet I would here impress on you that plenty of money may be a source of serious trouble, and of much worry to the unexperienced explorer. He is tempted to buy everything he is likely to want, and so encumbers himself with an amount of baggage which he finds it impossible to transport from his base, and from which he finds it most difficult to make a selection.

It would be useless to mention in detail to a general audience the various instruments, appliances, and chemicals, which should be:

taken by the explorers in search of botanical, horticultural, geological, mineral, or zoological specimens. Specialists have each their individual special outfit, suitable for the purposes they have in view.

There are, however, certain articles of outfit which are necessary to every explorer of uncivilised, of partially or totally unexplored countries, although their quality and quantity must vary with the nature, scope, and duration of the work to be done.

Most of the researches enumerated above necessitate either slow progress through a country, or a lengthened stay in various selected districts best suited for the operations of the specimen hunters. An explorer, bent on commercial or geographical discoveries, naturally contemplates travel over long distances, and, generally speaking, with less physical and fewer natural obstacles to be overcome in proportion to the distance to be traversed. On the other hand, however, he generally has to travel, and indeed to live, in a continual state of preparation for defence.

The military explorer must again work on different lines. His business is to seek information in countries occupied by a hostile population, with whom, however, his nation is not necessarily at war. He must travel unostentatiously, almost alone, and must avoid all hostile contact with the inhabitants. Such were Colonel Burnaby, when he went to Khiva, and Captain Gill, during his explorations along the Persian frontier, and his subsequent travels in the interior of Northern China. The explorations for purely sporting purposes, or arising from an innate love of adventure, require consideration equally careful, and knowledge seldom acquired otherwise than by personal experience.

For our purpose it will be sufficient for us to divide our inquiries into two different channels. To facilitate and to narrow the question, we will decide that the exploration is to be partly geographical, and so far scientific that the explorer has to report in general terms on the geological and mineral resources of the country to be traversed. There are no roads, but little timber, and that sparsely scattered, except near water, of which the quantity is small, and the quality always questionable and often bad. The rivers in drought do not exist except as chains of muddy ponds, whilst in flood they become impassable for weeks, and overflow their banks often to the extent of from three to fifteen miles on either side. In such a country game would be scarce, and

could not be depended upon as the only source of animal food to the explorers. The above data are sufficiently explicit and sufficiently difficult to meet almost every case.

We must now come to consider the manner in which an exploration of such a nature is to be carried out.

1. Would it be possible to establish some one or more subsidiary bases of operations. If the reply be in the affirmative, then comes the questions—(a) Where shall they be? (b) What shall be stored there? (c) How shall these be conveyed thither?

Now the answers to these questions must depend upon the nature of the exploration, *i.e.*, if the intention be to return to the place of starting, or to traverse a continent from sea to sea.

2. What is the nature of the transport to be? If waggons, are they to be light (though strong), many in number, and of different sizes, or are they to be few in number, heavy and solid in construction? How are they to be drawn, by oxen, by horses, or by mules? If wheeled transport be out of the question, what are the pack animals to be, camels, horses, or mules, or some of each of these animals?

Each and every one of these questions has to be carefully considered, because on the solution of one question so many others must depend. It may be well here to enumerate some of the chief circumstances which tend to govern the choice of transport.

1. Nature of the soil generally. If the country to be traversed be very broken in character, covered with thick forests, and known to be traversed by sluggish streams with deep slimy banks and bottoms, it is clear that wheeled transport, unless of a very special character, would not be suitable. Neither would such a country be practicable for camel transport; and yet there can be no doubt but that more stores can be easily carried on wheels, and by camels, than any other way by land. There are, however, very few countries in which exploration with wheeled transport may not be carried out, provided time be no object, and plenty of patience and perseverance be available. This brings us to the consideration of the general outfit of an exploring party.

1. As to stores.
2. As to the mode of transporting them.
3. As to the construction of the waggons, the pack-saddles, harness, &c.
4. As to the mode of packing them and storing them.

1. As to the stores. These must be subdivided under the headings of (a), provisions

for the mouth; (b), materials for obtaining food, or for offence and defence; (c), materials for facilitating the locomotion.

In the choice of provisions, care must be taken to select such articles as are wholesome, nourishing, small in bulk, and not liable to deteriorate by keeping. There must also be variety, so as to promote health, and a proper proportion of such articles of consumption as would diminish the risk of scurvy.

Of meat the best sort is preserved beef in tins. There is very little to choose between that preserved in Australia and that preserved in America, north and south. The tins should not be too large, and they should be rectangular and not cylindrical in shape. Essence of beef (Brand's or Liebig's, in tins or in skins) is a most valuable form of meat. Flour and oatmeal should be packed in block tin boxes, of various sizes, containing from 1 lb. to 4 lbs. each. Sugar should be cane sugar, powdered, and packed in $\frac{1}{2}$ lb. rectangular canisters. Tea—the best for the purpose is Goundry's compressed tea; it is manufactured in tablets of $\frac{1}{4}$ lb. in weight, and subdivided like chocolate tablets, into eight portions, one of which is ample for tea for three or four people. Being wrapped in lead paper, it stands any climate, and I have known it to keep good for five years. Salt should be kept in stone or thick glass jars, with screw or cork-lined stoppers. Lard should always be taken, and should be kept in stone jars, capable of being rendered air-tight. There is an excellent form of compressed and dried vegetable tablet manufactured in France; and there is also a preparation of dried potato, in powder. No expedition should be without these to keep off scurvy, that terrible scourge and bugbear of all explorers. Ginger, peppers, red and black, should be carried in thick glass pickle bottles, with air-tight glass stoppers, edged with cork. Brandy for medicinal purposes should be carried in small wooden kegs, covered with thick felt, and with a locked covering to their bungs. A provision of lime juice should be similarly carried in kegs of different sizes. There should be several spare kegs of the same description, kept constantly filled with fresh water. In addition to this provision of water, each animal should have a canvas water-bag slung by a strap round his neck. These bags keep the water cool, and each should have the neck of an old soda water bottle sewn into the orifice used for filling it; the vessel can thus be easily used, without detaching it from the animal carrying it. Water-bags on the same

principle, only much larger, are made of well-seasoned leather, and are slung by straps and iron rings on to a pack-saddle. At first the water has a nasty flavour; but the bags soon cease to affect the taste of the water, and are indispensable on long waterless marches in a hot climate.

Whilst on the subject of water, it may, perhaps, not be out of place to impress upon you the necessity in observing the greatest care in the selection, and, generally speaking, the after treatment of water. As a general rule, the only water which can be drunk with safety, without fear of evil consequences, is that which springs directly out of the ground, from rocks, or which is obtained from a permanent running stream, the bed of which is not muddy, and on the banks of which there is not an exuberant vegetation. Even in the case of water issuing from rocks, care must be taken to avoid water issuing from copper or lead-bearing rocks. In these cases a small quantity of sulphuric acid would at once detect the presence of the mineral in dangerous quantities, as the water would become discoloured.

In most countries subject to drought, the water requires special treatment; mechanical filtration is seldom practicable, or even safe. I have come across it as thick as pea soup, and sometimes covered with a growth of green or red weeds. In such cases, the first operation is that of skimming with a skimmer made out of a forked stick, with a pocket handkerchief or other piece of linen stretched tightly between the forks. This done, scatter a pinch of powdered alum into the vessel in which you have collected the skimmed water; this will cause a great deal of the matter in suspension to precipitate. Then pour the water slowly into a filter filled with the charcoal of your last night's camp fire, mixed with any sand or fine gravel which may be obtainable, and which you have previously washed. It must then be boiled, and skimmed whilst simmering, and only when no more scum arises on the water is it really fit or safe to use. It is a good plan always to fill the kettle—or, still better, the cooking pot—with water the last thing at night, and put it at the edge of the camp fire to simmer (not to boil), and always to fill up the water kegs and bottles from what is left over from each morning's cooking. It is also a good rule never to drink plain cold water in the tropics. Each man should carry in his pocket half a handful of oatmeal, and put a pinch into his pannikin of water when he fills it for drinking.

I once travelled 1,400 miles across a portion of the centre of Australia, and began my journey after a drought which had then lasted eighteen months, and which only broke up the day I reached the sea coast. It was only by the strict enforcement of these precautions that (under Providence) I never had a case of illness from fever or from dysentery. Personally, I always carried in my pocket a few "thirst lozenges," which are, I believe, nothing except a compressed form of Lampough's pyretic saline.

Before closing the enumeration of the *provisions de bouche*, it is well to add a list of the medicines and surgical instruments necessary to every expedition:—Rhubarb, essence of ginger; about 100 pills of colocynth and henbane; about double the quantity of quinine pills, made up in small doses of three grains each; some opium pills; a couple of bottles of Dover's powders; four bottles of sweet spirits of nitre; about 100 pills of podophyllin in small doses; camphor, and chlorodyne. Two lancets, two abscess knives, two catheters, two enemats; some surgical needles, and some silver wire thread for sewing wounds; a silver probe, and two vein or artery forceps; a syringe with various nozzles for various uses. Sticking-plaster of various sorts, and some prepared lint and medicated wool; and some vaseline, carbolic acid, and carbolic soap. All the medicines should be in glass-stoppered bottles, the stoppers having been lubricated with pure glycerine previous to insertion. The medicines, &c., should be divided into at least three portions, so that each waggon or each detached party should have a complete set of everything. There is no greater mistake than to have everything in one medicine chest. All boxes should be avoided, as in a very damp or a very dry climate boxes are apt to come to pieces with the rough handling that every package gets at the hands of those who often have to do the packing and unpacking of animals two or three times each day.

Clothing.—Take as little as possible when starting from England, as you can get most articles necessary for explorers at the place from which the waggons would make their start. Of personal attire, the following are those which I consider sufficient for most expeditions:—Four shirts made of grey flannel, with two buttons on each wristband, to admit of them being worn loose or tight. Four long merino drawers, double seated and double down the inside of the thighs. Four pair of thick knitted woollen long stockings. Two cholera belts,

one of knitted worsted, the other of flannel about a quarter of a yard wide and three yards in length, to be wound round the body or fastened with a safety brooch. Six silk pocket-handkerchiefs (white), and of the thickest and best quality. They are useful sometimes when travelling in the very early morning, to serve as a curtain against the sun's rays, which often at that hour strikes with great force on the nape or side of the neck under the hat. A Norfolk jacket of good woollen serge or light tweed, made double breasted, so as to be worn either open with the lappels buttoned back, or buttoned across double over the chest and stomach. It should be made like a garment known by miners as a jumper, not cut in at the waist, but merely kept in at the waist by a belt. This belt should be made of two pieces of soft leather, about 2½ inches wide, and stitched together at the edges so as to admit of dollars or other coins being kept in the belt and slipped in at either end, and prevented from falling out by a flap and button at each end.

If a sword has to be carried, it is best carried fastened on to the side of the cantle of the saddle by a round strap and button of leather. If a revolver has to be worn, it is best carried in a frog supported by a webbing belt over the right shoulder, which should be kept in its place by the waistbelt.

The best hats are of grey felt, of a helmet shape, with means for ventilation round the edge and at the top. They should be provided with a chin strap, to be worn when riding fast or against a strong wind. The best boots are those known as the Paliser boot. They reach nearly to the knee, and are laced up for about six inches from below the instep, so that the boot can be always easily got on and off, whilst remaining watertight. I prefer those made of porpoise hide to any other, as they are lighter and more supple in wear.

Dogskin driving gloves should always be taken, as their use prevents sun boils, blisters, and many sores arising from thorns, &c., on a journey. Breeches should be made very loose, except just below the knee, where they should be fastened with a buckle and strap, or tied with thongs of porpoise hide. A hunting whip with a hammer handle and a long brown leather lash is always useful, and is a necessity where there are many spare horses to be driven along with the party.

Camp Necessaries.—India-rubber buckets, two to each waggon, should always be carried, to be used for watering the horses whilst in harness. Palkee hammocks, made of water-

proofed canvas, are the best and most portable form of bedstead, and it is always inadvisable to sleep on the level of the ground. The blankets should be loosely sewn together round three sides so as form bags. This plan saves many a sleepless night. Moreover, it keeps snakes from getting in between the blankets. A waterproof sheet, with eyes round the edges, is most useful, as when thrown over the ridge pole of the hammock it can be lashed to the sides of the hammock, and serve as a complete shelter even in the heaviest storms of rain and wind. A light folding chair, or if this be too large, a beach seat with a back, is a great luxury, and is almost a necessity in wet ground.

We have now to consider the selection of such materials as are necessary to secure supplies of fresh provisions to protect life. First and foremost are guns. These should be breech-loaders of the simplest possible construction, and of 12 bore. Each gun should be provided with 20 steel cartridges. These are really indestructible, and are very easily reloaded and recapped; and having a female screw turned for a distance of an inch inside the cartridge, there is no difficulty in making the wads to keep in position.

For ammunition, shot of all sizes should be taken, the larger slugs for use against man or large animals. Powder should be carried in two small copper magazines, each containing about 7 lbs. of powder in half-pound canisters, fitting into the outer cylindrical copper case. These canisters should have screw tops with leather washers to them. The canisters should always be kept full so long as there is any powder in them. When a canister cannot be filled with powder, it should be filled up with cotton wool, rags, or even crumpled up soft paper. It must be remembered that any expedition is liable to be reduced to pack animals only, and then the attrition is so great that everything which can rub, soon gets rubbed to the finest dust.

When it is known that there are rivers or lakes, it is well worth while to take a casting net, and even a small seine net of strong tanned twine. A large provision of hooks and fishing lines of all sizes should always be taken, as they are not only useful in the obtaining of a change of diet, but are very valuable as an article of barter with natives.

For personal defence the best weapon is the largest sized Colt's revolver, with a stock which can be used at the shoulder, and is detachable. When on horseback it is best carried in a bucket, like our cavalry carry their

carbines. A good one shoots with wonderful accuracy up to 100 yards. A hunting knife, of a pattern of my own, I have found the best, as it is light, and yet strong enough to cut away a fairly large branch. The sheath is of bamboo, and there is room in it for a knife and fork of steel, flat, with wooden handles screwed on each side of the shaft. The blade of the hunting knife is made light by having two deep grooves cut out of the thickness near the centre of the blade, so that, whilst the blade is made lighter, it is also thereby rendered much stiffer.

The only other stores which we have to review are those required in reference to locomotion—*i.e.*, spare harness, leather, rivets, and copper wire for repairs, spare nuts, screws, iron clips, splinter bar caps; tools, such as augurs, centre bits and braces, saws, files, chisels, screw wrenches, screw drivers, gimlets, awls, sewing needles, wax and strong thread, felt for saddle cloths, roll of flannel for saddle linings, raw green hide, and skins of dried leather, half-inch iron rods, flat iron hooping for strengthening splittings, adzes, jack planes, spoke shaves, sharpening hones, files, punches, rasps, horse shoes, nails, and shoeing tools, felling and trimming axes, cross-cut saws, hand saws of three or four different sizes, from 3 ft. 6 in., to 13 in., clamps, light and heavy hammers, a few pairs of blacksmith's pincers and tongs, a couple of good bellows (hand), an assortment of nails, screws, copper and steel, D's, buckles of different sizes, and straps of various lengths and widths.

Having enumerated the stores necessary to an expedition, the next thing to be settled is the means of their transport.

It is rare that the only transport available is man, but yet in some tropical countries, covered with thick jungle, and where the ground is too rocky and broken even for mules, donkeys, or cattle, it is necessary to use men, and men only, for this purpose. Chinese and Japanese coolies will carry great weights balanced on two ends of a long bamboo cane, which rests on the shoulders. Sometimes two men will carry a heavy package for weeks at a stretch, slung on a bamboo cane between them. In Africa and South America, the natives prefer to carry heavy things on the top of the head. When packages are carried slung, the slings should be made of plaited ropes of green hide, kept well greased. Everything else wears out almost immediately. Every expeditionary force should be provided with pack-saddles, and with the means of constructing

them. Personally, I prefer the sort in use by the Basque population in the Pyrenees. It has the advantage of simplicity and cheapness of construction, and of being easy to use and to repair. The best form of camel pack-saddle is the one used by the Arabs, who contract with pilgrims to and from Mecca. Numnahs of felt should always be used, both with saddles and pack-saddles. If carefully adjusted, they admit of animals being kept in work with sore backs, should it be necessary.

The best form of bridle for all animals are those made entirely of tanned twine webbing. It is quite impossible to break them, and they are comfortable both to the heads of the animals and to the hands of the rider or driver. Besides this, they do not become slippery in wet weather, neither do they require any care to keep them in working order, as leather does in hot or dry climates.

Hitherto, we have treated entirely of man or of animal transport; but there are very many countries where it is not only possible, but very advisable, to adopt wheeled transport.

The class of wheeled transport must depend upon three conditions:—1. The nature of the country to be traversed (I put roads as out of the question). 2. The quantity of stores to be carried. 3. The quantity and quality of the animals available for its traction.

It is now almost an exploded idea that a waggon must of necessity be a heavy, cumbersome vehicle, with thickness and weight as the governing virtues of all its component parts. The Boers and others in South Africa still adhere to the old pattern, from habit and ignorance more than for any known reason. In America and in Australia, where the country is just as difficult to traverse, very much lighter vehicles are used with great success.

It is well to have several sizes and types of vehicles in every expeditionary outfit. Two-wheeled carts, long and broad, with draught from the shafts and outriggers at the sides of the shaft, which would admit of its being drawn, if necessary, by three horses abreast; four-wheeled waggons, light and medium, with pole draught, with side springs, and india-rubber buffers on the axles, these latter being connected by a perch. All waggons and carts should have lever brakes, capable of being worked by hand and foot by the driver. There should also be iron skids, or shoes and chains to be used if required, in addition to, or to replace the brake. The chief things to

be borne in mind in the construction of vehicles for expeditionary transport are—

1. Great simplicity of construction.
2. As few parts as possible.
3. Screw clips should be used in preference to bolts and nuts, inasmuch as every bolt weakens the wood traversed by it, in proportion to the diameter of the bolt.
4. All parts should be made of such shapes that they can be readily copied and replaced by an unskilled workman.
5. The wood should be perfectly seasoned, neither so dry as to diminish its toughness, nor too full of natural moisture or sap, and no iron should be used except where absolutely incapable of being broken, or where the use of wood would be incompatible with strength and endurance. It may, however, be used where, in the event of its breaking, it could be easily replaced by wood.

6. The height of the axles from the ground should be the same, and not less than two feet. It is seldom that a waggon has to be turned at a very acute angle, therefore no great amount of "lock" is necessary. When making a track through a forest, much time and labour are saved by cutting the trees off at about two feet from the ground, as they are not nearly so large in girth at that height, and it is less fatiguing to the men felling them with cross-cut saws or axes.

7. The various parts of each waggon, excepting the bodies, should be interchangeable, so that in the event of a complete breakdown, the unbroken portions of the disabled waggon could be utilised in the repairs of others. This is very essential, as tending greatly to the reduction in the quantity of spare stores.

We may, therefore, proceed to consider the construction of a waggon under the following heads:—

1. The under carriage, including the wheels.
2. The mode of traction.
3. The body (including the tilt where necessary).
4. The means for suspension of the body.

As stated under paragraphs 6 and 7 above, the parts should be interchangeable, and the axles should not be less than 2 ft. from the ground. It follows, therefore, that the wheels should be of the same diameter, and not less than 4 ft. 2 in.

One of the great troubles in all explorations, especially in very hot and dry climates, is the difficulty experienced in keeping the wheels in working order. The spokes shrink, and unless this is immediately found out and remedied,

by caulking the gaps left in the wheel stock and felloes with white lead and cotton waste, or with oakum, wet gets in, and the end of the spoke soon rots away. The slightest sign of looseness anywhere in the wheel must be at once attended to and remedied; green hide (cut in strips half an inch wide) wound in and out the spokes near the stock, greatly strengthens a wheel of which the parts have begun to shrink. In some very dry climates, no wheel of ordinary construction will stand. On one of my expeditions I had each night to take off all the wheels and lay them in water till daylight, in order to keep them together, and even with this precaution, the wheels eventually turned inside out and fell to pieces. There is, however, a form of wheel which seems to me to be likely to last longer than the sort in ordinary use. It is that known as the Madras pattern, and the invention is claimed by an American named Sarven. The spokes fit round an iron stock, and are kept in position by two circular plates, bolted from outside to inside the wheel. This would admit of a broken or damaged spoke being easily replaced, or they could be wedged up from the centre by the insertion of thin bits of iron, tin, or some hard substance, between the inner end of the spoke and the stock. Another difficulty arises from the difficulty of keeping the tires on. In England it is easy enough to remedy the tendency which all tires have to lengthen. They can be cut, shortened, and re-shrunk on the wheel. In exploring work, the tires, as a rule, do not permanently increase in circumference, as they do from use on hard roads here, but the wheels shrink away from them with the heat, and this same heat expands the iron tire, and so causes it to lose its contact with the felloes.

The evil results arising from these causes may be minimised in two ways:—

1. By constructing the tires slightly convex on the inner circumference, and by making a corresponding concavity in the outer circumference of the felloes.

2. Sometimes, however, the shrinkage is so great, that it becomes necessary to cut and shorten the tire. As it is almost impossible to secure a good weld to reclose it, it has to have the two ends filed to a feather edge, brought together, and then firmly clipped to the felloe at either end of the splice. The tire may be wedged tight, and secured with clips.

The axle-trees should be of the best toughened iron, bedded in tough timber, and

clipped. In length they should be 3 ft. 8 in. to 3 ft. 10 in.

The greater the breadth (in moderation) the greater the stability of the vehicle when moving across an incline. Moreover, with all the wheels of equal diameter, the lock is increased by leaving a greater space between the waggon body and the front wheels. The axle-trees of the fore wheels and hind wheels should be connected by a straight perch made of tough wood, such as hickory. Inasmuch as there is very little "lock" required, there is no necessity for any complicated or delicate wheel-plate (or fifth wheel). A stout transom, with an iron eye through which the king bolt would pass, and the axle-bed connected with the splinter bar by two wheelirons, and braced at the rear by a stout sway bar, is all that would be required. These should be all straight pieces as far as practicable, and clipped together (not bolted). In very broken and precipitous ground the pole might be taken out, and the movement controlled by ropes held by men.

As regards traction, it would be a great gain if the pole could be dispensed with, inasmuch as in very rough ground it knocks the wheelers about sadly, and it is more frequently broken when working in difficult ground with untrained horses and bad drivers than any other part of a waggon. It is, however, sometimes necessary, and must therefore be provided for. It should be attached firmly to the splinter bar, and the bar allowed to move freely. The attachment should be by means of two iron bars passing through eyes clamped on to the splinter bar at the two ends, ending in two iron stays coming out from the bars at an angle of about 20 degrees, and clamped on to the pole. The pole is thus worked freely up and down, and the pressure would be taken off the jaws of the futchells by the two jointed iron bar stays.

The hanging pole, moreover, necessitates a contrivance to relieve the horses from having constantly to support its weight. This can be done by having a strong hook, fastened by a clamp, at about one-sixth of the length of the pole, from the splinter bar. On to this hook is fastened a chain, or strap of plaited raw hide, which, running through a sheave (firmly fastened by a broad plate bolted on to the footboard), is hooked at its other end on to a hook fastened to the under side of the front of the body of the waggon. These hooks must be strong, and have a broad bearing where fastened to the carriage body. It would even be

advisable to introduce a spiral spring at one end of the chain, to take off the sudden strain occasioned during the passage over very rough ground.

When driving four or more half-trained horses on broken ground, it is safer to use no pole piece and bars, but to use long traces made of green hide rope, kept up by loops hanging from the wheeler's trace carriers, the leader's traces being kept apart by means of very light hickory bars, kept from slipping by green hide thongs passing through the ends of the bars, and fastened through loops in the leader's traces. It is well, however, to be able to use the pole and bar draught; with that view, the pole piece should be fastened by clamps, counter sunk round the pole head. The hook should be made on a twist, to avoid the necessity of using a strap, as with wild horses it is necessary to be able to detach the leaders with as little delay as possible.

Germane to the subject of traction is the question of how to bring it into control. The ordinary skid or shoe cannot be depended upon in rough, rocky ground, as the wheel is apt to jump out of the shoe. The ordinary hand brake, acting on the front of the hind wheels, is insufficient. To these two should be added a friction brake working on the hinder circumference of the hind wheels by means of a bar, shod at the two ends, which can be compressed against the wheels by a screw working on the end of the perch, prolonged for this purpose.

If the tires should be secured by clips at any part of the journey, the projections would interfere with the brake blocks, so the brake blocks should then be applied with enough pressure to prevent the wheels revolving.

Suspension.—If very rough country has to be traversed, it is well to have the body of the waggon suspended on springs, so as to save the damage done to the stores, as well as to the waggon by the jolting.

The best form of spring appears to me to be that adopted by some of the best carriage makers in the construction of gentlemen's omnibuses for station work with heavy loads.

The springs are single, and coupled to the scroll iron on the body by a shackle, inside which is an iron coupling or robin. These are practically unbreakable, as the coupling takes off the strain from any sudden and heavy jolt. There should be, however, india-rubber buffers fastened on to the body to minimise the shock, if it were to be so severely jolted as to come down suddenly on the bed of the spring.

I have found it very useful to have a strong swinging tray (made of strong ash planks one inch thick) fastened so as to hang between the axle-trees. The planks should not be too close together to prevent axes, spades, picks, and such like heavy articles being attached to the planks by means of thongs tied round the planks, and passed through holes in the handles of the implements. The whole tray should be constructed that it can be readily taken to pieces, and the planks utilised in the passage of boggy ground, or in the sandy beds of rivers, or in running the waggons up very steep inclines in soft ground. I have found them of great use, especially in deep ground, where they can be put under the wheels. Another advantage arising out of the use of this tray is, that as in it are placed heavy articles, the centre of gravity is brought lower than if the same weights were carried in the waggon itself. There should also be a small water barrel, covered with felt, hanging under the waggon at the rear.

Covering.—Every explorer's waggon should have a tilt, to serve as a shelter from sun and rain. It should be made of waterproofed canvas, and have a fall-down piece in front to shelter the driver, and a curtain behind, with thongs to enable it to be kept closed when needed. The framework is best made of hickory, fitting into rectangular sockets well outside the framework of the body, so as to allow of ventilation from under the sides, and to give greater head-room space in the interior. There should also be a ridge pole of hickory running through rings clamped on to each rib. This ridge pole can be utilised for slinging a hammock in case of sickness or wounds during the march.

Fittings.—Under the driver's seat should be a moveable box, in which to place all the tools and materials necessary for mending the harness, or any part of the waggon. The box should be constructed in trays, so that each thing may have its place, and be readily available. Each waggon should have its camp kettle, which should be slung on hooks under the rear of the body. On the splash-board there should be hung a stout leather bag, in which might be kept strong twine, a sharp knife in a sheath, and a hatchet and hand-axe for ready use. Each waggon should have a strong lantern for use, with good wax candles.

Harness.—The great desideratum is to have as little harness as possible, and that it be strong without being heavy. Headstalls and

bridles may be made of stout webbing dipped in tan. The reins should be round, and of plaited green hide. There should be as few buckles as possible, and the ends in the driver's hands should never be buckled, but merely kept together by a loosely made reef knot, which can easily be undone in the event of being necessary to let the leaders go clear. The traces should either be made of plaited raw (or green) hide, or of the best two-inch rope.

It is well to be provided with both collar and breast draught, so as to be able to change from one to the other form of draught in case of need. Copper rivets and copper wire are most useful for mending harness and saddlery, and plenty of it should be with the stores. There should also be plenty of hobbles to prevent horses from straying too far from camp at night in search of feed. Some horses, however, become so clever in hobbles that they can even gallop in them. In such places the best plan is to attach a cord from the head collar to the hobble of one leg. It is well to have a few cattle bells to attach to the necks of some of the horses most likely to stray. By these means much annoyance and delay in starting are to a great extent avoided.

Horseshoes.—Although in most expeditions the horses are not shod, it is wise to take a small supply of shoes and nails, to be used in the event of it being necessary to cross a tract of stony or rocky country, where horses would soon wear down their feet, and become tender-footed and useless. The class of shoe must depend upon the breed and class of horses used. The Afabs, who ride their horses over very rocky and stony ground, most frequently shoe their horses with plate shoes, covering the whole of the sole; but this form is not suitable to a wet soil or a stiff clayey country. Every party should have a blacksmith amongst its members, and it is well that most of the party should be able to shoe a horse without driving the nails into the quick.

Packing the Waggons or Pack Animals.—There are certain principles in packing, whether it be waggons or pack animals, which should never be lost sight of.

1. To make each waggon or group of pack animals complete in itself, *i.e.*, it should contain everything necessary to the existence of those in charge.

2. So to arrange the stores that those most frequently used should be so packed that nothing else need be disarranged in order to get them out.

3. To arrange the stores in such a manner

that the heavy packages should be equally distributed over the surface of the waggon, or amongst the beasts of burden, and that the lighter articles should always be so well secured as to prevent the possibility of their becoming loose, and thus spoiling their contents.

I have known hard biscuits reduced to powder by the omission to pack the case with paper, so as to keep the box always full; clothes worn into holes by attrition from their having been placed in contact with hard corners; maps, and even books, destroyed in the same manner.

Now, as regards the packing of animals, it is quite impossible to do more than lay down first principles, *viz.*:—

1. That the panels of the pack saddle must be well and evenly padded; this should be looked to at every halt and promptly remedied, otherwise sore backs will ensue.

2. That the weights should be quite evenly divided on either side of the saddle, so as to avoid the necessity of having to draw the girths too tightly, or of having to stop frequently to re-arrange and trim the burdens.

3. The weights should be kept low, so as to lower the centre of gravity as much as possible. This is especially necessary when any mountainous country has to be traversed.

4. The packages ought not to stick out too much laterally, especially when wooded country or a narrow rocky pass has to be traversed.

5. Where practicable, it is best to put some soft or yielding package outside the others, as the pack animals often run against one another, and damage in such cases might arise both to the animals and to the packages, if the latter were hard and unyielding. Moreover such a plan enables the surcingles to be better arranged.

6. Never attempt to pack an animal alone. The weights having been arranged on the ground, the animal should be led between them, and the packages should be placed on the hooks simultaneously.

7. The same precautions should invariably be taken when unpacking, as at that time it is so very easy to "wring" and to "rick" an animal's back.

8. At every halt of more than an hour the packs and pack saddle should be removed, and, where practicable, the backs should be washed with salt and water, alum and water, or carbolic soap and water, then rubbed dry; and just before repacking, the back should be

regards durability. He would also insist on the point that, given good material and workmanship, there was no need to make wheels very heavy on account of the roughness of the ground. In a matter of this kind the expense of construction should be a secondary consideration. With regard to axles, it was a question whether common axles, or the Mail or Collinge pattern, should be used. Common axletrees were extremely simple in construction and not liable to accident, but, on the other hand, they required lubricating every morning, which must be a disadvantage when every hour was of importance. If a Mail or Collinge axle were not too delicate in its mechanism, it would save time, as once in two months would be often enough to lubricate it. He was not prepared to agree with General Feilding's suggestion that tires should be made convex and the felloes concave, because the tyre being put on red hot, there would be a danger of burning the edges of the felloes next to the sunk surface, and thus all the advantage would be lost.

Mr. J. MATTHEW remarked that the means of transport must vary with the character of the country, and, as a matter of fact, the countries in which you could travel on wheels at all were very limited in extent. In the Soudan and in great parts of Syria all transport had to be effected by means of beasts of burden.

The Rev. E. L. BERTHON said there was nothing very remarkable in the whale boats used on the Nile, either in form or material, except that the material used was so scanty that the Canadian boatmen complained bitterly of their frailty, and the frequent accidents which had occurred, were in consequence of the far too small scantling. But the builders were confined to certain limits, the boats being specified to weigh not more than half a ton, and to be 30 ft. long, which involved a crux which no boat-builder could get over. The wonder was not so much at the goodness of the boats as at the excellence of the soldiers and others who managed them. He had had the honour of building a good many boats for the Government for this purpose, but had not yet heard a word about them; they were the same size as the other boats; but were similar to some exhibited that evening, except that they were in three sections instead of two, and when collapsed were only about 10 in. wide. Each part weighed about 2½ cwt., so that they could be easily taken out of the water when rapids were reached, carried to any required distance, and launched again. Seven years ago, the great man whom they were all lamenting, his friend General Gordon, had several of these boats in the Soudan, and found them very useful, and 250 of them made in two sections had been supplied for the French service. They were admirable for tropical climates, as no heat affected them. They were essentially life-boats, for if one of the outer skins were injured, you only got water into one compartment, and they would stand concussion against rocks much better than wooden

boats. When made in two compartments, they could be set up on end, as shown downstairs, and the sail or sheet thrown over made an admirable tent, which could be erected in a few seconds.

Mr. H. LIGGINS said he had been, for forty years, sending carts made in England out to the West Indies for carrying heavy loads connected with the sugar industry, and he could state most positively that there was not a cart-builder in England who could make one fit for the purpose. Even Mr. Hooper could not make wheels which would stand the wear and tear of the West Indies and the heat of the sun, for the simple reason that they would be made of English wood, which was not suitable for that climate. He had had experience of the best agricultural implement makers in England, but the result was far inferior to those produced by negroes who had no notion of finished work, but who used native wood, bullet wood and other kinds, which practically would last till doomsday. English wheels would not stand in South America, where the climate was very variable; the nights were very damp, and English wood would absorb moisture far too readily. As a rule, every traveller should provide himself with his outfit in the country he was in. He had a friend who had just crossed the Cordilleras from Valparaiso to Rio Janeiro, but he travelled in native carts and waggons. General Feilding did not recommend leather traces but ropes, which was only carrying out the same principle. Everything which could be obtained in the country should be employed. He was surprised the reader of the paper had not mentioned several things connected with the outfit, such as a compass, sextant, drawing materials, and scientific instruments. With regard to the boats on the Nile, he could not agree with Mr. Berthon; they were very good boats, like ordinary steamboat gigs, made for easy lowering in a gale of wind, safe in the water, easy to row, and capable of carrying a great weight, and he thought they had proved more successful than could have been anticipated; if they had been made stronger, they would have been very heavy to row. The only mistake, in his opinion, was in not having them built on the spot by native boat-builders, and from native timber. Boats made to take to pieces, and to collapse, were, in his opinion, only fit for use on ornamental water like the Serpentine. Although he knew many ships were supplied with Berthon boats, he had never seen one used, and such an one would be the last he should choose if his life depended on it; he would rather choose the smallest dinghy made of wood.

Mr. HAMPTON said he had had some experience, during the last three years, of wheeled vehicles, within five or six degrees of the line, in carrying up heavy machinery for the gold mines, and he found that none would stand like those made of the native bullet wood.

General BAILLIE said he too had been rather dis-

appointed at not hearing more about the scientific instruments which should be taken by an exploring party. With regard to wheels, the Madras wheel seemed to have been recently claimed as a new invention, but he recollected it well when he went to India in 1842, and he was pretty sure it had been in use at least ten years before that. It was certainly an excellent thing in a tropical climate, where it was utterly impossible to get well-seasoned wood, and he was only surprised it had not been introduced into our artillery long before ten years ago, when it first made its appearance. He had some experience in the wheels of a battery sent out to India at the time of the mutiny, which were found utterly useless, and they had to be taken off; fortunately some were borrowed from a battery belonging to Holkar, which fitted the axles of the English battery, or it would have been utterly useless. He should himself, in the construction of a travelling waggon, be more inclined to adopt the design of the old artillery waggon, or something more in the form of a limber with a waggon attached to it, which was in fact two joined together. In that case you got rid of the perch, which was very liable to fail in a long journey, and had nothing but the two axletree beds and the pole, and the pole of the limber carriage was simply hooked on the axletree bed of the foremost one.

The Rev. E. L. BERTHON said he doubted if Mr. Liggins had ever seen his boats, as they were not supplied to any ships crossing the Atlantic, though they were to Indian troopships. The seamen preferred them as they were set up instantly, and sailed faster than any boats in the world. One had recently made an expedition from the Azores to Southampton, and the last 350 miles was at the rate of ten knots an hour. That was a boat which would have carried seventy men. He had himself been in Algoa Bay in a gale of wind when the *Spartan* had to let two anchors at once two miles from shore, and the only boat which could be trusted to go off to the land was a Berthon boat. That boat was now six years old, she had never had a farthing's worth of repairs, and was as good now as she was then.

Mr. P. A. MAIGNEN, referring to the question of water supply, and to the statement that mechanical filtration was impracticable, said his filters had been supplied to the Government for use in Egypt, and had proved thoroughly successful. He was now supplying 100 for carrying on pack-saddles, to each of which was sent enough charcoal to renew it 100 times, and another was being constructed for camp use, 4 ft. by 4 ft. and 3 ft., which would filter 1,000 gallons per hour.

Major-General FEILDING, in reply, said there was no wood at all on the Lower Nile suitable for boat-building: on the Upper Nile, the boats were built of acacia wood, the supply of which was very limited, as also were the number of boat-

builders, and, therefore, as time was of the utmost importance, it was absolutely necessary that the boats should be built in this country and sent out. He had not thought it necessary to refer to scientific instruments, their use being so obvious; even in Europe a man would take a compass with him if going in a strange district, and naturally in a strange country where there were no roads, and of which, perhaps, there was not even a map, he would take some kind of a sextant so as to ascertain where he was each day. The particular form of compass he preferred was shown downstairs, the dial being made of mother-of-pearl of different colours, which could be always seen, and did not cockle. He always weighed his things when starting, in order to see that the weight was properly distributed. With regard to axles, he preferred the common one, with all the delays it might occasion. The simpler the construction of such a thing the better, and there was always time to grease the axles when necessary. He had already discussed the question of convex tires with Mr. Hooper and Mr. Robinson, and was still rather inclined to it, though he might perhaps be wrong. He entirely agreed that a waggon should be built of the wood of the country, and in Australia he had his waggons built there, though for the wheels he preferred hickory, on account of its toughness, even if not so hard as iron wood, jarrah, and some other native woods.

The CHAIRMAN then proposed a vote of thanks to Major-General Feilding, which was carried unanimously, and the meeting adjourned.

The paper was illustrated by articles exhibited by the following firms:—

Anderson, Anderson and Co., Victoria-buildings, Queen Victoria-street, E.C.—Regulation waterproof cloak; regulation waterproof valise (bed and knapsack combined); portable collapsible bucket, basin, and bath; waterproof top boots.

Berthon Boat Company, Holborn-viaduct, E.C.—Patent folding boat in two parts; combination folding boat and tent.

Bowring, Arundel, and Co., 11, Fenchurch-street, E.C.—The "Combination" pack-saddle, boxes and bedstead.

C. Churchill and Company, 21, Cross-street, Finsbury, E.C.—Cross-cut saws, axes, hatchets, hammers, combination wrench, and other tools.

J. C. Cording and Co., 19, Piccadilly, W.—"En Route" saddle and hand-pack; waterproof poncho ground sheet; regulation bed; Ashantee hammock; improved hammock; "The Land and Water" bag.

B. Edgington, 2, Duke-street, London-bridge, S.E.—Small size double-roofed "Ridge" tent, four-fold, for hot climates, "Suakin" pattern; folding camp bed and other fittings. Models and photographs of various forms of tents.

Firmin and Sons, Limited, 153, Strand, W.C.—Patent "Universal" pot-box for cooking or for use as a steam inhaler or fumigator; new "Hartglas" wicker and felt-covered water bottles.

J. Forbes-Watson, LL.D., M.D., 16, Lullington-road, Anerley, S.E.—Patent felt helmets with fibre and sponge lining for protecting the head from the heat of the sun in tropical climates.

C. Lancaster, 151, New Bond-street, W.—Colonial breech-loading gun for shot or ball (with hammer); ditto (hammerless); patent four-barrel hammerless pistol, non-fouling, smooth oval-bore rifling, to take regulation ammunition.

P. A. Maignen, 32, St. Mary-at-hill, E.C.—Patent "Filtre Rapide," in various forms suitable for camp and transport.

Patent Waterproof Paper and Canvas Company, Limited, Willesden, N.W.—Samples of paper and canvas treated by the Company's patent waterproofing process. Photographs and model, showing various applications of the waterproof paper, &c., to buildings.

Pfeil, Stedall. and Son, Broad-street, Bloomsbury, W.C.—Warner wheel, having a stock or centre similar to a plain wheel, but with the addition of an iron mortised band, through which the spokes are driven into the wooden stock.

Silicated Carbon Filter Company, Church-road, Battersea, S.W.—Canvas travelling filter; pocket filters.

S. W. Silver and Co., 67, Cornhill, E.C.—"Regina" hammock; ebonite water-bottle and felt-covered water keg; zinc bucket canteen with enamelled iron fittings, cooking stove, &c.; anti-cholera, money, and other belts; pith helmets for tropical climates; Mexican poncho, forming combination coat and ground sheet; Australian saddle, tethering rope, web bridle, and raw hide girth; pack-saddle; explorer's knife in sheath; portable leather medicine case.

Society of Arts, John-street, Adelphi, W.C.—Model of a Cape waggon, presented to the Society by Dr. R. J. Mann.

Louis Vuitton, 289, Oxford-street, W.—Patent folding trunk bed.

War Department, Woolwich Arsenal.—Wheel used for gun carriages.

J. P. Wright, 3, Park-road, Redhill, Surrey.—Patent special explorer's folding boat; model of a collapsible boat.

Miscellaneous.

INTERNATIONAL INVENTIONS EXHIBITION.

H.R.H. the Prince of Wales has fixed Monday, May 4th, for the opening of the Exhibition.

A special railway guide, under the title of the "International Inventions Exhibition Railway Time and Guide Book," is being prepared by Mr. J. R. Somers Vine, the City and official agent of the council. The first issues, to the number of a quarter of a million, will be distributed gratis, copies being sent by post to householders living within 20 miles of the Exhibition. It will contain a small outline map of the railways and stations in and around London, and under the name of each station the average number of trains running thence towards the Exhibition between midday and 8 p.m., the cost, first, second, or third class, of the whole journey, including admission to the Exhibition, the average time the journey takes, the point at which the visitor would enter the Inner Circle from the suburban line, and the time at which he must leave the Exhibition in order to catch either of the last two trains by which he can get home. This is to render easier the working of an arrangement made with the railway companies under which the visitor starting from any place within about 20 miles of the Exhibition will be able to take a through ticket, including admission to the Exhibition, so that he will not have to re-book at any point. Except in the case of those arriving at Fenchurch-street Station, who must walk to Mark-lane to get upon the Inner Circle, visitors once at their own local station will be under cover until they enter the south galleries of the Exhibition through the new subway from the South Kensington Railway Station. This covered way is being rapidly pushed forward, and the excavations have already reached the post-office in Exhibition-road. Here it will turn to the westward, passing to the Exhibition by the rear of the post-office. The objection to the lighting and ventilation of the subway as originally proposed, on the side of the grounds of the Natural History Museum, has been overcome, and a short distance beyond the crossing in Cromwell-road the passage is driven beneath the footpath.

Correspondence.

TEMPERED GLASS.

In your report of Mr. Frederick Siemens's paper read on February 26th, and in the discussion thereon, I see no mention of the fact that the process of tempering glass, as carried on at the Dresden Glass Works for the last six years, was carried on at Stockport in 1877-78.

On March 30th, 1878, I conducted a party of students from the Manchester Architectural Association over the works; and having with me a number of samples, each 6 inches square, of 16 oz., 21 oz., and 26 oz. sheet glass, had half of them tempered by the process of heating to redness and then chilling between iron tables or slabs permeated by cold water tubes. The sheet glass, when so tempered, only broke when the weight fell three times the height (or 9-fold percussion) required to break the usual sheet glass; and a piece of $\frac{3}{8}$ in. rough plate resisted a 2½ lb. lead weight dropped from a height of about 40 ft., or 383 times the percussion which broke common $\frac{3}{8}$ in. rough plate. I used some tempered sheet glass for windows of a mechanics' shop, and it well resisted the iron chips from the cold chisels. The manufacture ultimately failed, apparently from not being annexed to a glass works, but being carried on as a separate business.

J. CORBETT.

Manchester, March 10, 1885.

Notes on Books.

THE ANIMAL FOOD RESOURCES OF DIFFERENT NATIONS, with mention of some of the special dainties of various people, derived from the Animal Kingdom. By P. L. SIMMONDS. London: E. and F. Spon. 1885.

The plan of this book is to some extent an enlargement of that of a former work of the author's, "The Curiosities of Animal Food," now out of print, but the substance is entirely new. In his introductory chapter Mr. Simmonds discusses the question of the effect of diseased meat upon the eater, and he then devotes some space to the consideration of the practice of cannibalism. Two chapters are given to flesh food from mammals, extending from monkeys to porpoises, one to food furnished by the feathered tribes, one to eggs, and one to reptiles, snakes, and amphibians eaten as food. The food products of the sea are discussed in two chapters, and the last three chapters are devoted to insects—as bees, ants, caterpillars, and locusts—to crustaceans, mollusca, and radiata. Among the last items of animal food to be mentioned are leeches and earthworms. Besides a full account of the different articles of animal food, this volume contains a large number of statistics relating to production and consumption.

WOOD-CARVING, PRACTICALLY, THEORETICALLY, AND HISTORICALLY CONSIDERED, with Notes on Design as applied to Carved Wood. Edited by Fred. Miller. London: Wyman and Sons.

This is one of a series of technical handbooks, two of which (Pottery-Painting and Glass-Painting) have

already been noticed in these pages. The author gives practical directions for the mechanical portion of the subjects, and explains the necessary tools and the characteristics of various woods used by the workman. He then deals with the more artistic side of the subject, and explains some of the chief examples of the two schools of wood-carving, the Gothic and the Renaissance. The volume is fully illustrated.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday evenings at Eight o'clock:—

MARCH 18.—"The Rivers Pollution Bill." By J. W. WILLIS-BUND. Lord ALFRED S. CHURCHILL, Vice-President of the Society, will preside.

Papers for reading after Easter:—

"The History and Manufacture of Playing Cards." By GEORGE CLULOW.

"The Musical Scales of Various Nations." By A. J. ELLIS, B.A., F.R.S.

"A Marine Laboratory as a Means of Improving Sea Fisheries." Professor E. RAY LANKESTER, M.A., F.R.S.

"Recent Improvements in Coast Signals." By Sir J. N. DOUGLASS.

"The American Oil and Gas-fields." By Professor JAMES DEWAR, F.R.S.

INDIAN SECTION.

Friday evenings at Eight o'clock.

MARCH 13.—"The Present Condition and Future Prospects of Female Education in India." By MANCHERJEE M. BHOWNAGGREE, late Secretary of the Alexandra Girls' English Institution, Bombay. MATTHEW ARNOLD, D.C.L., will preside.

APRIL 17.—"The Parsis and the Trade of Western India." By JEHANGEE DOSABHOY FRAMJEE.

MAY 8.—"The Ancient and Modern Methods of Treating Epidemics of Small-pox in India." By ROBERT PRINGLE, late Sanitary Department H.M. Bengal Army. Sir PHILIP CUNLIFFE-OWEN, K.C.M.G., C.B., C.I.E., will preside.

MAY 15.—"The Golden Road to South-Western China." By R. K. DOUGLAS, Professor of Chinese at King's College, London.

FOREIGN AND COLONIAL SECTION.

Tuesday evenings at Eight o'clock.

MARCH 17.—"The Congo and the Conference, in reference to Commercial Geography." By Commander CAMERON, R.N., C.B.

MARCH 31.—"Kilimanjaro and the Surrounding District of Equatorial Africa." By H. H. JOHNSTON.

APRIL 28.—"The Federation of the Empire." By J. E. GORST, M.P. The Right Hon. W. E. FORSTER, M.P., will preside.