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On the Origin of the Plough, and Wheel-Carriage.

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From Professor AGASSIZ.—Bulletin of the Museum of Comparative Zoology, Harvard College, Vol. VI, Nos. 1 and 2.

From the INSTITUTION.—Journal of the Royal United Service Institution, Vol. XXIII, No. 103.

From the EDITOR.—Revue Internationale des Sciences, No. 2, 1879.

From the COLLEGE.—List of the Fellows, &c., of the Royal College of Physicians, 1880.

From the SOCIETY.—Proceedings of the Royal Society, No. 200.

From the SOCIETY.—Transactions of the Geological Society of Glasgow, Vol. VI, pt. 1.

From the SOCIETY.—Proceedings of the Asiatic Society of Bengal, No. IX, 1879.

From the SOCIETY.—Journal and Proceedings of the Royal Society of New South Wales, 1878.

JOHN HALL GLADSTONE, Esq., F.R.S., was elected a member of the Institute.

Dr. DALLY exhibited a collection of Ethnological objects from British Columbia.

The following paper was read by the Author:—

*On the ORIGIN of the PLOUGH, and WHEEL-CARRIAGE.*

By E. B. TYLOR, Esq., F.R.S., President.

THOUGH much has been written on that great engine of civilisation, the plough, yet the whole line of evidence as to its development from the simplest and earliest agricultural implements seems never to have been put together, so that I venture to lay before the Anthropological Institute the present notes.

Not only the beginning of agriculture, but the invention of the plough itself, are pre-historic. The plough was known to the ancient Egyptians and Babylonians, and the very existence of these nations points to previous thousands of years of agricultural life, which alone could have produced such dense, settled, and civilised populations. It was with a sense of what the plough had done for them, that the old Egyptians ascribed its invention to Osiris, and the Vedic bards said the Açvins taught its use to Manu, the first man. Many nations have glorified the plough in legend and religion, perhaps never more poetically than where the Hindus celebrate *Sitâ*, the spouse of Râma, rising brown and beauteous, crowned with corn-ears, from

the ploughed field; she is herself the furrow (*sitā*) personified. Between man's first rude husbandry, and this advanced state of tillage, lies the long interval which must be filled in by other than historical evidence. What has first to be looked for is hardly the actual invention of planting, which might seem obvious even to rude tribes who never practise it. Every savage is a practical botanist skilled in the localities and seasons of all useful plants, so that he can scarcely be ignorant that seeds or roots, if put into proper places in the ground, will grow. When low tribes are found not tilling the soil but living on wild food, as apparently all mankind once did, the reason of the absence of agriculture would seem to be not mere ignorance, but insecurity, roving life, unsuitable climate, want of proper plants, and in regions where wild fruits are plentiful, sheer idleness and carelessness. On looking into the condition of any known savage tribes, Australians, Andamaners, Boto-cudos, Fuegians, Esquimaux, there is always one or more of these reasons to account for want of tillage. The turning-point in the history of agriculture seems to be not the first thought of planting, but the practical beginning by a tribe settled in one spot to assist nature by planting a patch of ground round their huts. Not even a new implement is needed. Wandering tribes already carry a stick for digging roots and unearthing burrowing animals, such as the *katta* of the Australians, with its point hardened in the fire (Fig. 1), or the double-ended stick which Dobrizhoffer ("Abipones," part ii, chap. 13) mentions as carried by the Abipone women to dig up eatable roots, knock down fruits or dry branches for fuel, and even, if need were, break an enemy's head with. The stick which dug up wild roots passes to the kindred use of planting, and may be reckoned as the primitive agricultural implement. It is interesting to notice how the Hottentots in their husbandry break up the ground with the same stone-weighted stick they use so skilfully in root-digging or unearthing animals. (J. G. Wood, "Natural History of Man," vol. i, p. 254). The simple pointed stake is often mentioned as the implement of barbaric husbandry, as when the Kurubars of South India are described as with a sharp stick digging up spots of ground in the skirts of the forest, and sowing them with ragy (Buchanan, "Journey through Mysore, etc.," in Pinkerton, vol. viii, p. 707); or where it is mentioned that the Bodo and Dhimal of North-East India, while working the ground with iron bills and hoes, use a 4-ft. two-pointed wooden staff for a dibble (B. H. Hodgson, "Aborigines of India," p. 181). The spade, which is hardly to be reckoned among primitive agricultural implements, may be considered as improved from the digging-stick by giving it a flat paddle-like

end, or arming it with a broad pointed metal blade, and afterwards providing a foot-step (*see* the Roman spade in Smith's "Dictionary of Greek and Roman Antiquities," s.v. "pala.") In the Hebrides is to be seen a curious implement called *caschrom*, a kind of heavy bent spade with an iron-shod point, which has been set down as a sort of original plough (Rau, "Geschichte des Pflugs," p. 16; Macculloch, "Western Islands," Pl. 30); but its action is that of a spade, and it seems out of the line of development of the plough. To trace this, we have to pass from the digging-stick to the hoe.

All implements of the nature of hoes seem derived from the pick or axe. Thus the New Caledonians are said to use their wooden picks both as a weapon and for tilling the ground. (Klemm, "Culturwissenschaft," part ii, p. 78). The *tima* or Maori hoe (Fig. 2), from R. Taylor's, "New Zealand and its Inhabitants," p. 423, is a remarkable curved wooden implement in one piece. It is curious that of all this class of agricultural implements, the rudest should make its appearance in Europe. Tradition in South Sweden points to waste pieces of once tilled land in the forests and wilds, as having been the fields of the old "hackers," and within a generation there was still to be seen in use on forest farms the "hack" itself (Fig. 3), made of a stake of spruce-fir, with at the lower end a stout projecting branch cut short and pointed (Hyltén-Cavallius, "Wärend och Wirdarne," part ii, p. 110; i, p. 43). Even among native tribes of America a more artificial hoe than this was found in use. Thus the hoe used by the North American women in preparing the soil for planting maize after the old stalks had been burnt is described as a bent piece of wood, three fingers wide, fixed to a long handle. (*See* Charlevoix, "Nouvelle France," Letter 23; Lafitau, "Mœurs des Sauvages Américains," vol. ii, p. 76, and Plate 7). (I do not venture to copy the hoe shown in this plate: a mere fancy picture.) In other North American tribes, the women hoed with a shoulderblade of an elk or buffalo, or a piece of the shell of a tortoise fixed to a straight handle. (*See* Loskiel, "Mission of the United Brethren in North America," p. 66; Catlin, "American Indians," vol. i, p. 121). From this stage we come up to implements with metal blades, such as the Kafir axe, which by turning the blade in the handle becomes an implement for hoeing (Lane Fox, "Lectures on Primitive Warfare," No. 2, p. 10). The heavy-bladed Indian hoe (Sanskrit *kriddāla*) called *koddy* in Malabar (Klemm, "Culturwissenschaft," part ii, p. 123), which is shown here (Fig. 4), is one example of the iron-bladed hoe, of clumsy and ancient type. The modern varieties of the hoe need no detailed description here.

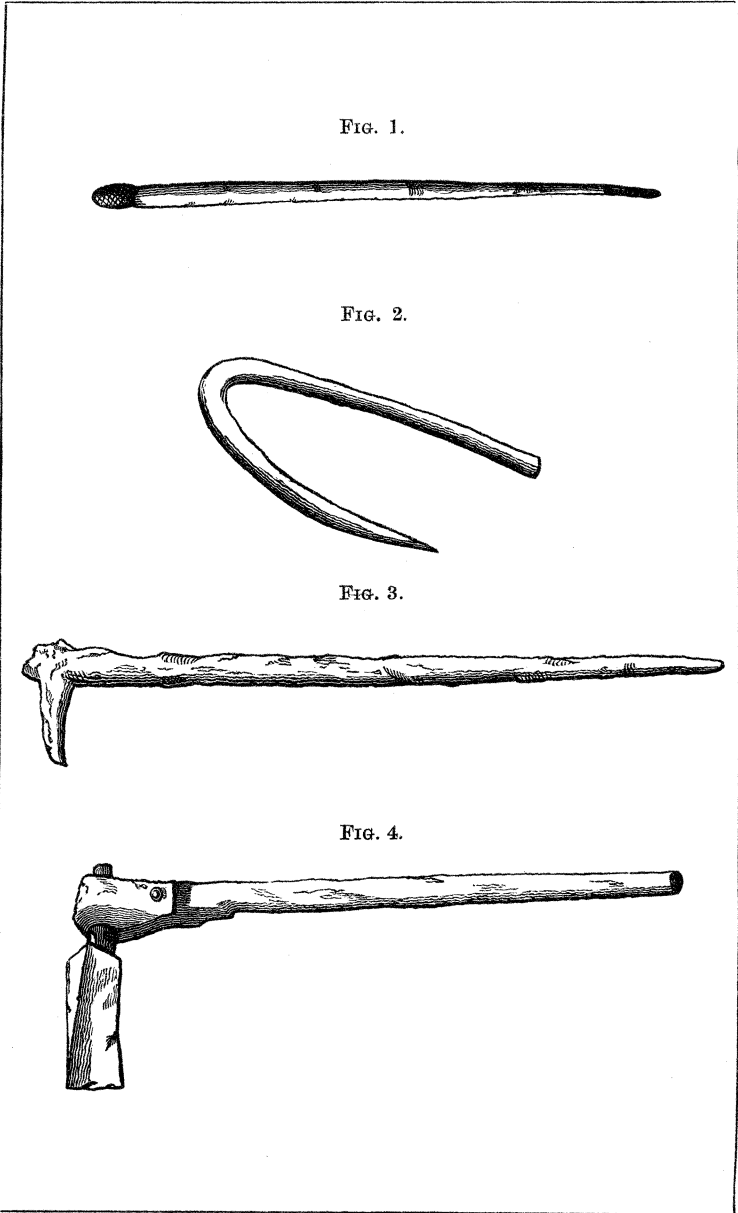
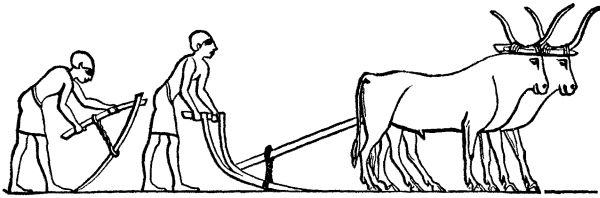


Fig. 1, Australian "Katta." Fig. 2, "Tima," or Maori Hoe.  
Fig. 3, Swedish "Hack." Fig. 4, Indian Hoe.

That the primitive plough was a hoe dragged through the ground to form a continuous furrow, is seen from the very structure of early ploughs, and was accepted as obvious by Ginzrot ("Wagen und Fahrwerke der Griechen und Römer," vol. i, and Klemm, "Culturwissenschaft," part ii, p. 78). The evidence of the transitions through which agricultural implements have passed in Sweden during the last ten centuries or so, which was unknown to these writers, is strongly confirmatory of the same view. It appears that the fir-tree hack (Fig. 3) was followed by a heavier wooden implement of similar shape, which was dragged by hand, making small furrows; this "furrow-crook" is still used for sowing. Afterwards was introduced the "plough-crook," made in two pieces, the share with the handle, and the pole for drawing. The share was afterwards shod with a three-cornered iron bill, but the implement was long drawn by hand, till eventually it came to be drawn by mares or cows. (Hyltén-Cavallius, part ii, p. 111.) Thus in comparatively modern times a transformation took place in Sweden remarkably resembling that of which we have circumstantial evidence as having happened in ancient Egypt. The Egyptian monuments show a plough, which was practically a great hoe, being dragged by a rope by men. (See Denon, "Antiquités de l'Égypte," vol. i, Pl. 68.) Still more perfect is the ploughing scene here copied in Fig. 5. (See Rosellini, "Monu-

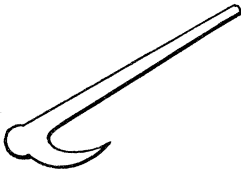
FIG. 5.



menti dell' Egitto, Pl. 32-3; Wilkinson, "Ancient Egyptians," chap. 6.) Here the man who follows the plough to break up the clods is working with the ordinary Egyptian hoe, remarkable for its curved wooden blade longer than the handle, and prevented from coming abroad by the cord attaching the blade to the handle half-way down. This peculiar implement, with its cord to hold it together, reappears on a larger scale in the plough itself, where the straight stick is lengthened to form the pole by which the oxen draw it, and a pair of handles are added by which the ploughman keeps down and guides the plough.

The Valley of the Nile, where the lightness and richness of the alluvial soil is favoured by the inundations with their fresh deposit of river mud, was no doubt one of the regions where the higher agriculture earliest arose, and looking at this sketch of hoeing and ploughing, we might be tempted to think that here the transition from the barbaric hoe to the civilised plough is to be seen as it first took place in the world. Egypt may possibly have been the birthplace of the plough, but so many forms of rude ploughs are to be found represented on coins and sculptures

FIG. 6.



of the ancient world, that it is safer to be content with the general idea that they are enlarged and transformed hoes, without attempting to fix the date, place, and nation, to which this inventive transformation belongs. The following figures are selected from those copied by Ginzrot and Rau. The old Syracusan form (Fig. 6),

as likewise some old Etruscan patterns, are remarkable as being so close to the original hoe-pattern as not to have the tail or handle. This want is supplied in other rude forms of ancient Italy, of which Fig. 7 shows one. A more angular Roman form is thought to represent the ceremonial plough, with which the wall-line was traced in founding a new city, and Fig. 8 is another archaic

FIG. 7.

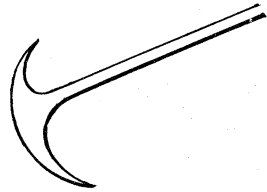
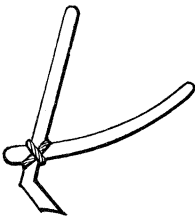


FIG. 8.

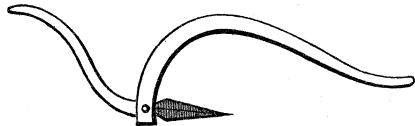


form; the projection of the pole behind was for the ploughman's foot to press the share down.

*Depresso incipiat jam tum mihi taurus aratro  
Ingemere, et sulco attritus splendescere vomer.*  
(Virg. Georg. I, 45.)

Fig. 9 is Greek, from an early MS. of Hesiod's "Works and Days." Looking at forms of plough as rude as these to be seen at this day in Asia and in backward countries of Europe, one wonders to find that already in classic ages the husbandman had ploughs of construction far more nearly approaching that of our best modern implement-makers. Pliny (xviii, c. 48), after describing the simpler kinds of plough, mentions that in Rhætia, a plough with the addition of two

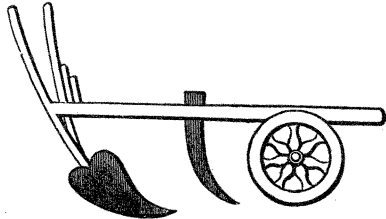
FIG. 9.





small wheels had been recently invented, and was used for land already under tillage. He also mentions the coulter (*culter*). This knife, fixed in front to make the first cut ready for the share to turn the sod, is a great improvement on the primitive ploughs, where the ploughshare has to do the whole work. In Pliny's

FIG. 10.



time, though only forming part of some ploughs, it was evidently well-known. Thus he recognises the whole construction of the wheel-plough (Fig. 10) as figured by Caylus from an ancient gem. The ordinary modern plough used

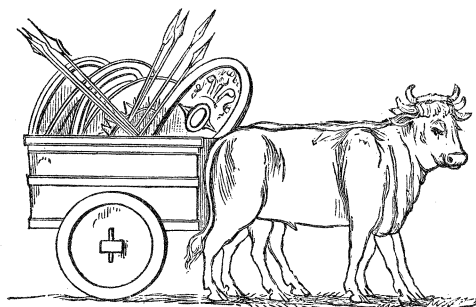
by the English farmer improves upon this rather in details of construction and material than in essential principle, though a new start in invention is taken by the self-acting plough which no longer needs the ploughman to follow at the plough-tail, and by the steam-plough which substitutes engine-traction.

The plough, drawn by oxen or horses, and provided with wheels, has taken on itself the accessories of a wheel-carriage. But when the plough is traced back to its earliest form of a hoe dragged by men, its nature has little in common with that of the vehicle. Though the origin of the wheel-carriage is even more totally lost in pre-historic antiquity than that of the plough, there seems nothing to object to the ordinary theoretical explanation (*see* Reuleaux, "Kinematics of Machinery," and others), that the first vehicle was a sledge dragged along the ground, that when heavy masses had to be moved, rollers were put under the sledge, and that these rollers passed into wheels forming part of the carriage itself. The steps of such a transition, with one notable exception which will be noticed, are to be actually found. The sledge was known in ancient Egypt (*see* the well-known painting from El Bersheh of a colossal statue being dragged by men with ropes on a sledge along a greased way, Wilkinson, "Ancient Egyptians," vol. iii.) On mountain-roads, as in Switzerland, as well as on the snow in winter, the sledge remains an important practical vehicle. The use of rollers under the sledge was also familiar to the ancients (*see* the equally well-known Assyrian sculpture of the moving of the winged bull, in Layard's "Nineveh and Babylon," p. 110.) If now the middle part of the trunk of a tree used as a roller were cut down to a mere axle, the two ends remaining as solid drums, and stops were fixed under the sledge to prevent the axle from running away, the result would be the rudest imaginable cart. I am not aware that this can be traced any-



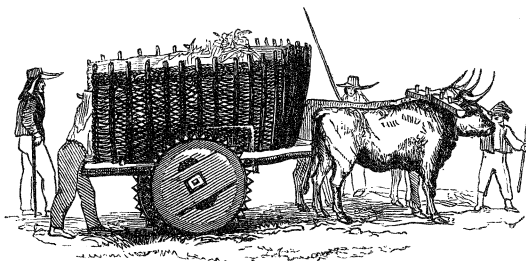
where in actual existence, either in ancient or modern times; if found, it would be of much interest as vouching for this particular stage of invention of the wheel-carriage. But the stage which would be theoretically the next improvement, is to be traced in practical use; this is to saw two broad drums off a tree-trunk, and connect them by a stout bar through their

FIG. 11.



centres, pinned fast, so that the whole turns as a single roller. The solid drum-wheel was used in the farm-carts of classic times (*see* the article "Plaustrum," by Yates, in Smith's "Dictionary of Greek and Roman Antiquities"). The ox-wagon here shown is taken from the Antonine column (Fig. 11); it appears to have solid wheels, and the square end of the axle proves that it and its drum-wheels turned round together in one. A further improvement was to make the wheel with several pieces nailed together, which would be less liable to split. The ancient Roman farm-carts were mostly made with such wheels, as are their successors which are used to this day with wonderfully little change, as in Greece and Portugal. The bullock-cart of the Azores (Fig. 12) (from Bullar, "Winter in the Azores," vol. i.,

FIG. 12.



p. 121) is a striking relic from the classic world; its wheels are studded with huge iron nails by way of tire. From old times it was common to make wooden rings, sockets, or bearings underneath the cart for the axle to turn in, much as children's toy-carts are made, as has often been remarked. But a drawing of a modern bullock-cart taken near Lisbon, represents only a pair of pieces of wood acting as stops, so that the body of the cart can be lifted off its wheels. In looking at these clumsy vehicles we certainly seem to have primitive forms before us. There is, however, the counter-argument which ought not to be overlooked, and which in some measure accounts for the lastingness of these rude carts, namely, that for heavy carting across rough ground they are convenient, as well as cheap and easily repaired. Considering that the railway-carriage builder gives up the coach-wheel principle, and returns to the primitive construction of the pair of wheels fixed to the axle turning in bearings, we see that our ordinary carriage-wheels turning independently on their axles are best suited to comparatively narrow wheels, and to smooth ground or made roads. Here they give greater lightness and speed, and especially have the advantage of easily changing direction and turning, which in the old block-wheel cart can only be done by gradually slewing round in a wide circuit.

As early as history goes back, the carriage-builder had already begun to make spoked-wheels with metal tires, whose well-made nave turned smoothly on the axle. It is needless here to extract from Wilkinson and Layard particulars of the beautifully-made Egyptian and Assyrian chariots, nor to go into details of classic, mediæval, and modern carriage-building. As bearing on the origin of the art, it must be noticed that the point where the developments of the plough and carriage join, is in the way of attaching the drawing oxen or horses, which was much alike in both. The pole and yoke was no doubt the original mode of draught, not only for the plough and the heavy ox-cart, where it may be often seen still, but also for the chariot and light car. (*See* "Schlieben, Die Pferde des Alterthums," p. 154.) The war-chariot, with its yoked steeds, has a remarkable similarity wherever we meet with it in the ancient world, which seems to point to its invention by some one particular nation, though which has not yet been made out, whence it spread to distant countries. How such inventions found their way is well shown in a point of detail, which incidentally shows how far the ancient Britons were from the uncivilised state popularly attributed to them, namely, their use (Mela iii, 6) of scythe-chariots, such as were used in Oriental armies, like that of Darius (Diod. Sic. xvii, 53), or of Antiochus Eupator, when

he came into Judea with horsemen and elephants, and 300 scythe-chariots (2 Maccab. xiii, 2). War-chariots were from the first drawn by the pole. The Homeric chariots appear to have been without traces, as where in the Iliad (vi, 40), Adrastus' scared horses snap the pole amid the tangled tamarisk, and set off straight for the city, evidently having nothing but the pole to hold them. In ancient Egypt, one inner trace was used, but the stress was on the pole. Eventually, in looking at the harness of various nations, we come to the present plan of draught by collar and traces. The change is interesting, as seeming to prove that the earliest use of draught-cattle is that still seen in the yoke of oxen. It has been argued by Pictet ("Origines Indo-Européennes, part ii, p. 94"), that the yoke, Sanskrit *yuga* = that which *joins*, was first invented for the pair of oxen to draw the plough with, it being likely that they were first put to this heavy work, and afterwards used for drawing carts, rather than that the idea of drawing a cart by oxen should have occurred before putting them to plough. This, though not absolutely certain, seems a very reasonable argument, while the yoke and pole being so much better suited to the ox than to the horse, points to oxen as the earliest draught-beasts. The history of successive changes seems well shown in the Latin *jumentum*, a beast of burden, from *jugumentum* = yoke-ment, which word keeps up the memory of the original yoke, though other modes of transporting burdens had come in. The Latin *jumentum* is used for the horse, etc., but not for the ox, and French *jument* has still further lost the old idea, now meaning merely a mare. One further remark is suggested by the harness of the ancient Egyptian chariot, where the yoke is provided with two saddles coming down on the withers of the horses. As is well known, cavalry was by no means general among the armies of the ancient world. The early Aryans, like the Homeric heroes, were charioteers, not horsemen, nor are there any ancient Egyptian horsemen to be seen on the monuments. On the other hand, the warriors of Palestine are there to be seen on horseback, and horse-soldiers appear on the Assyrian sculptures. In old times, however, the horseman is mostly seen riding a bare-backed horse, or with a cloth or pad only. It seems to have been gradually that saddles proper began to be used in Assyria, and among the Greeks and Romans. Looking now at the Egyptian yoke-saddles of the chariots, one may suspect that from them were derived not only the harness-saddles in modern use, but also our riding-saddles.

## DISCUSSION.

Mr. DICKINS remarked that the Chinese language—that great repository of ancient facts—corroborated the President's observations upon the hardened stick as the earliest instrument of tillage. The Chinese character, *lei*, for spade, to dig, etc., consisted of the character for tree or wood, combined with an abbreviation of a character meaning easy, the whole being simply a piece of wood, perhaps a mere branch, shaped so as to be easily used for turning up the ground. This was developed, by having a broad and flattened end, into a sort of wooden spade, the blade of which was afterwards made of metal. The Chinese plough seemed to be derived from this spade, rather than from any kind of hoe. The character for plough, *li*, consisted of the character for "ox," surmounted by an abbreviation of a sign meaning "black"—the black ox being the most prominent object on the cultivated plain—thence we may suppose that in China the plough was always worked by an ox, not by human agency. The plough did not appear to be much used in husbandry in China, where spade and hoe cultivation predominated. The same was the case in Japan; where, indeed, Mr. Dickins did not remember ever to have seen a plough at work. The Japanese name for plough, *kara-suki*, meant a Chinese (*kara*) spade or digger (*suki*). With respect to wheeled vehicles, he (Mr. Dickins) had seen Chinese pictures representing the drum-wheel or mere disc of wood, which was sometimes perforated with holes, round or otherwise shaped, arranged symmetrically, no doubt to lighten the wheel. This perhaps was a link between the drum-form and the wheel of the present day. While on this subject, Mr. Dickins begged to call attention to two most extraordinary modes of vehicular locomotion common in the Far East: the wheelbarrows in North China, adapted for the muddy paths with raised narrow stone causeway in the middle, and the jinrikshas of Japan. The word "jinriksha" was not Japanese, but Chinese, meaning man-power vehicle. Up to about ten years ago they were unknown in Japan, kagos and norimons alone being used on journeys of any length. The jinriksha was like a hansom cab with the top removed; in the shafts was not a horse, but a man, who could drag his fare along at an average rate on good ground of about 5 miles an hour, and as much as 30 miles without change of coolie. These vehicles were, it is said, invented by an American Missionary in Japan; they are hung upon springs, and are probably not a Japanese invention. The extraordinary thing about them was the marvellous rapidity with which they superseded kagos, which in a few years had almost disappeared from the country. In Yedo there were over 20,000 of these strange vehicles plying for hire. There they fulfilled the office of our cabs. The quickness with which they were adopted showed the imitative faculty of the Japanese; while the fact that for so many hundred years they had remained without them, betrayed their want of inventive power—

the more so, in that a sort of cart drawn by men and capable of holding several passengers had been in use for many years, centuries probably, on some parts of the Tōkaidō. Mr. Dickins referred to the Chinese Book of Nature ("San-tsai-t'u) and the Japanese "Wakansansai dzu-ye" (founded on the first-named work), with the "Kin-mō-dzu-i" ("Illustrated Instructor of Youth").

Mr. W. G. SMITH remarked that very ancient agricultural implements were, in all probability, mounted with stone. He said he had found it by no means uncommon whilst going over ancient British positions, to find large pieces of worked flint, differing materially in shape from axe and adze forms. The former large pieces were, he said, generally somewhat rude, and might be looked upon as the mounting-pieces of ancient hoes or even ploughshares. Mr. Smith exhibited a large flint implement from his collection, worked to a hoe or ploughshare form.

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MARCH 9TH, 1880.

FRANCIS GALTON, Esq., F.R.S., *Vice-President, in the Chair.*

The minutes of the last meeting were read and confirmed.

The following presents were announced, and thanks voted to the respective donors:—

FOR THE LIBRARY.

From the EDITOR.—"Nature," Nos. 539, 540.

From the EDITOR.—"Revue Scientifique," Nos. 35, 36, 37.

From the EDITOR.—"The Athenæum," Part 626.

From the EDITOR.—Correspondenz-Blatt, February, 1880.

From the EDITOR.—Matériaux pour l'histoire de l'homme, Tom. X, 1879.

From the SOCIETY.—Journal of the Society of Antiquaries, Vol. VIII, No. 1.

From the SOCIETY.—Journal of the Society of Arts, Nos. 1423-1424.

From the SOCIETY.—Proceedings of the Royal Geographical Society, Vol. II, No. 3.

From the BERLIN ANTHROPOLOGICAL SOCIETY.—Zeitschrift für Ethnologie, 1879, Heft 3-5.

From the ACADEMIE ROYALE DES SCIENCES A AMSTERDAM.—Verslagen en Mededelingen, Afd. Natuurk, 2e Rks. Dl. XIV. Jaarboek, 1878.

Processen-Verbaal, 1878-9.

From E. W. BRABROOK, Esq.—"Was Adam the first Man created?" By Argus.