3. That the sources from which the various kinds of malaria arise, are the decomposing animal and vegetable matters which are wholly or partly excluded from the free contact of atmospheric air; and that the kind of decomposition taking place under such circumstances depends on temperature and other causes.

4. That organic matters, freely exposed to the air and not saturated with water, will not produce compounds of the nature of malaria.

5. That the conditions necessary to prevent the formation of malaria are (in addition to a free access of atmospheric air) the same as those we should use to prevent putrefaction; and the means used to destroy it would be by the action of oxydizing agents and antiseptics.

A discussion followed, in which the Chairman, Mr. Haywood, Dr. Alexander, the Rev. W. Thorp, and Mr. W. S. Ward took part, and the obligations of the Society were expressed to Mr. Haywood for his valuable and opportune paper.

A Paper was then read—

ON A MECHANICAL COMMUNICATION FOR THE WORKING OF SIGNALS AND BREAKS ON RAILWAYS. BY WILLIAM SYKES WARD, ESQ., OF LEEDS.

Much attention has lately been paid to the effecting a communication between the engine drivers of railway trains and the guards in charge of the carriages; and also to provide means of communication between the passengers and the guards or engine drivers; but no method has yet been suggested so unobjectionable as to meet with general encouragement or support.

The directors of railways object to the expense of making
any considerable changes in the present system of carriages, and also to the employment of any contrivances, the working of which would be dependent on the other carriages of the train being provided with corresponding apparatus; inasmuch as the transmission of carriages from one line of railway to another is so frequent, that on many of the great lines of narrow guage rails we seldom find a train which is composed of carriages all belonging to the same company, or of uniform construction.

Many engineers express a decided objection to allowing passengers any means of communicating with the driver, considering that more accidents and inconveniences might arise from the abuse of such power than would be prevented by its employment; but certainly there ought to be no objection to permitting passengers to communicate with the guard, who, after ascertaining the cause of alarm, might communicate with the driver.

Any means of communicating signals would be objectionable if subject to uncertainty of action, and particularly if any supposed signal might be accidentally given by the motion or oscillation of the train itself.

Signals given by whistles, or other means of producing sounds, may be perfectly audible to persons on any carriage following that on which such signal is given, but when the train is travelling very rapidly, the loudest sounds from the last carriage of a train are not easily heard by the engine driver.

The giving signals on railway trains by means of electricity is attended with many difficulties and sources of uncertainty. The currents which can be made practically available are slight, and are capable only of affecting delicate apparatus. If such currents are applied to produce the retention of a keeper to an electro-magnet, so that the signal be given by breaking the continuity of the circuit, the keeper is liable both to be permanently attracted so as not to detach itself
when required, or it may detach itself by vibration; in the first case not giving a signal, in the second not giving a signal when required.

The exhibition of a flag or a light would afford an excellent means of communication if the attention of the party to receive the signal could be first obtained with certainty.

A simple mechanical contrivance for effecting a communication between the last carriage of the train and the engine, so as to ring a bell or communicate with a steam-whistle, perhaps affords the best means of attracting the attention of the driver, and is the most likely to be generally adopted if certain inconveniences be obviated.

It has been proposed to make a communication by means of a cord extended along the train. Such cord would be liable to require too much attention to its connexions or couplings when carriages are removed or added to the train; and if this objection were overcome, the lengthening and shortening of the train by the extension of the tug-rods and the compression of the buffers (amounting to ten, fifteen, or even twenty feet on a long train) might break the cord, give false signals, or, if the cord were very slack, prevent the giving a signal until a considerable length of cord had first been wound up.

It has occurred to me that the most perfect method of making communications on railway trains is by the circular motion of rods, extending under the carriages so as to form a system of shafting, which I call torsion-rods. This I propose to effect by means of rods moving in slides and having springs attached, so as to extend the rods in like manner as the buffers of the carriages; each set of rods having a portion in the centre capable of revolving on bearings attached to the framework of the carriage or carriage-wheels, and connected by universal joints with the sliding portion of the rods; and which revolves in, and is
supported on bushes placed on springs, so as to give a little play both laterally and vertically. At each end of such system of rods is placed either an universal joint, capable of being attached to a similar joint, or a portion of a hollow cone, with a spike in the centre, and teeth or claws on its outer edge; so that two carriages on which the rods are applied being coupled together, such cones on the adjacent set of rods are pushed together, and will be held in contact by the springs, and form a coupling joint, capable of communicating circular motion from one set of rods to another; so that such rods will, when the carriages to which they are attached are coupled together, form a continuous line of shafting. Such system of torsion-rods will be extensible or compressible in length, and also yield laterally, according to the motion of the carriages; but will, when turned on their axes, communicate circular motion.

This may be more clearly understood by reference to Plate X., Fig. 1, in which A represents the central portion of a shaft revolving in bushes B and B. C and C are universal joints, the construction of which is well known. D D and D D are rods on which the cross-pieces, E and E, slide, and to which are attached the rods F F, sliding into the necks G and G, revolving in the bushes at H and H. On the ends of the rods, F F, are placed hollow cones of metal at I and I, with teeth on the edges. Within the cones are spikes, K K, for the purpose of guiding the cones and teeth together, and which pass into the rod F, made hollow for the purpose.

In Fig. 2 is shown an enlarged view of two of the cones pushed together and shown as a section, so that the manner in which the spikes are intended to pass into the rods may be more fully seen. On the centre rod, A, (Fig. 1) is placed the grooved pulley, L. M M (Fig. 2) are springs formed of elastic bands of vulcanized India-rubber, which tend to
force the ends of the rods outwards. The bushes are supported on springs, as shown in Fig. 3. The pulley, L, Fig. 1, is geared with another pulley in the interior of the carriage, as shown in Fig. 4, or on the tender. N represents a disc, painted so that its motion may be readily observed, and having a handle for the purpose of turning it round.

In Fig. 5 is shown an arrangement by which the gearing of the discs may be left moderately slack, so as to avoid friction when the same are only required to receive signals; and the bands may be considerably tightened by the guard giving additional pressure at A when he requires to communicate a signal, a spiral or other spring maintaining the ordinary pressure.

I have drawn the rods D E and F, in Fig. 1, in order that the principle may be easily understood. I, however, believe that in practice it will be advantageous to substitute a tube, of the form of which a section is shown in Fig. 6, in the interior of which the cross-piece, E, will slide.

I do not consider it necessary now to specify any series of signals, as it is obvious that by such torsion-rods the discs may be turned to the right or to the left continuously or Interruptedly, so as to communicate a number of preconcerted signals; and catches may be added to the disc so as to set in motion an alarum, or strike a bell.

In Fig. 7 are represented some of the carriages of a railway train and a tender, showing the intended method of attachment.

I propose to apply the system of torsion-rods for communicating signals between the guards and engine-drivers of railway trains, affixing the rods under the carriages; so that the rods, forming a continuous shafting, may give simultaneous motion to discs or wheels placed in the guards' carriages, and also to similar discs placed upon the tender or engine, under the inspection of the driver; pulleys being fixed upon
the central portions of the shafting under the carriages, to and from which communications are intended to be made; the pulleys being geared by elastic bands, with corresponding pulleys in the carriages, suitably placed for being turned by the guard or engine-driver, and also observed by him if motion be communicated from any other part of the train; thus affording the means of communicating a limited number of useful signals.

Such systems of torsion-rods might be attached to various parts of railway carriages, but for uniformity, and in a great measure to avoid injurious lateral motion, I prefer that such rods be placed centrically, and immediately above the axles of the wheels. The bearings or bushes of the rods may be attached to the carriages themselves, but as many railway carriages are constructed with framework connected with the bearings of the axles, I prefer attaching the bearings of the torsion-rods to such framework.

Whatever method of communicating signals on railway trains be adopted, little will be effected towards the prevention of accidents unless some efficient mode of quickly stopping the trains be also adopted.

When railway trains were seldom composed of more than five or six carriages, and the maximum speed was about twenty-five miles per hour, it was found that shutting off the steam and applying breaks to the tender was sufficient; but now, as railway trains consist of from ten to fifteen carriages, travelling at fifty miles per hour, the breaks on the tender and on the one carriage occupied by the guard are evidently insufficient.

Breaks, as applied to a single carriage, cannot probably be made to act much more efficiently than those at present used, and which are already capable of arresting the revolution of the wheels of the carriage, and making them act as a sledge on the rails. In fact, considerable care is required on
the part of the breaksman to avoid this; for if the wheels be made to slide over the rails, a flat surface is formed, and the wheel is always liable to be stopped in the same position, so that the wheel rapidly becomes unserviceable by being so worn as to give a very uneasy motion to the carriage, and eventually is liable to jump off the rail.

An objection also arises to the applying very powerful breaks to the tender, and reversing the steam or applying breaks to the engine, that when the first part of the train is suddenly checked or retarded, the other carriages press forwards one on the other, having a tendency to throw some of the carriages off the rails, the train being as though squeezed together.

It therefore appears to me that the means of obtaining control over the speed of the train will be by increasing the number of breaks which can be brought into action simultaneously. Any method for effecting such purpose must, however, be simple, and must not require the employment of additional guards.

To effect this I propose to employ torsion-rods, similar to those I have already described, but made somewhat stronger, to communicate circular motion from one carriage to the adjoining carriages in the same train; so that the guard or breaksman may, in addition to working the breaks of the carriage on which he is riding, work breaks on the adjoining carriages; thus working breaks on three carriages, in lieu of working only one, as at present; and each of such breaks might be worked separately.

It has been proposed to connect the breaks with the buffers of railway carriages, so that when the buffer-springs are compressed the breaks will be brought into action against the wheels; and, in a long train furnished with such self-acting breaks, as each preceding carriage is pressed by the succeeding carriages, the buffers will put the breaks in action, and
the train be quickly stopped. Such an arrangement occurred to me several years ago, but I saw the objection thereto, that the moving backwards a train provided with such breaks would be very inconvenient, unless some provision be made for disconnecting the breaks from the action of the buffers. The late Mr. Stephenson, at a meeting of civil engineers, at Birmingham, proposed a similar arrangement, but which has not been brought into use; I believe on account of the objection I have just alluded to, no provision being made for throwing the breaks out of gear simultaneously; it being necessary, according to his plan, that the breaks on each carriage should be thrown out of gear separately.

I have, however, proposed the application of torsion-rods, so as simultaneously to withdraw bolts or connecting pieces, and disconnect the breaks from the action of the buffers when it is required to do so.

If only a few carriages be supplied with such self-acting breaks the torsion-rods could very easily be applied; but if many breaks be used, and it is also required to use the torsion-rods for the purpose of giving signals, the requisite arrangement is not quite so simple. But I have devised an arrangement by which the torsion-rods may be used both for the purpose of communicating signals, and also putting the self-acting breaks in or out of action. The manner in which I propose to arrange such torsion-rods may be understood by reference to Figs. 8, 9, and 10, in which like letters are used.

Fig. 8 is a sketch of the buffers on one side of a railway carriage, for the purpose of showing a method of concentrating the action of the four buffers of a railway carriage on one piece, A.

In Figs. 9 and 10, A represents the last-mentioned piece acting upon the lever B E, which moves on a joint at C, upon two strong upright pieces fixed on the shaft D, and which communicates motion to the breaks. On the end of
the lever is formed a small inclined plane at E, so as to push away the bolt, F, when the same is not prevented moving, as hereinafter mentioned. The said bolt, F, moves in a suitable hole or slot made through the uprights, and has connected with it the spring, H, for the purpose of bringing it back. The spring, I, *Fig. 5*, tends to return the lever, B E; which latter has a segmental arm, G, to prevent the bolt, F, passing behind it. K represents a pulley, placed upon the central part of the torsion-rods. L is a piece pressed upon the said pulley by the spring, M, and which serves to raise the catch, on the end of the crank or bent lever. The mode of action is as follows:—In the first place, if K be not turned previously to the buffers of the carriage to which such apparatus is applied being pressed in the piece, A presses on B, which, remaining firm, causes the breaks to be put in action. But if, by the torsion-rods, the pulley, K, be turned in the direction designated by the arrow, the catch is raised; and when the piece, A, presses on the lever, B E, the bolt, F, is forced out; consequently there is no action on the breaks. A spring should be also applied to keep the breaks, when not in action, from pressing on the wheels, but which, to avoid confusion, is not shown in the drawings.

I would suggest that, for the purpose of increasing the safety of railway travelling, all trains should be furnished with some means of communication between the guards and engine-drivers;

That the three carriages nearest the engine should be supplied with self-acting breaks; and

That the guard placed on the last carriage of the train have the means of working the breaks on the last three carriages, so that there would be six breaks to a train of ordinary length, instead of only one, as at present.

Mr. West (Mr. Barnes having been called away) then
took the Chair, and briefly announced that the paper by the Rev. William Thorp, of Misson, their worthy Secretary, "On the Derbyshire Coal Field," would not then be read, as it was now time to adjourn for dinner. He was satisfied that Mr. Thorp would not feel disappointed at this, as, under the circumstances, the important paper he had proposed could not receive that attention which it demanded. With regard to the Evening Meeting announced, the Council had deemed it advisable not to hold it, as the paper of Mr. Thorp would not be sufficient to occupy their attention for an entire meeting. After stating that the next Meeting was intended to be held at Wakefield, the Chairman vacated his seat, and the proceedings terminated shortly after four o'clock.