refinements, are only human inventions, and it is hard to believe that human skill stopped still when they were brought to their present stage, as some writers would almost seem to expect us to believe.

The "Adams" brake is not complicated, but it is gentle in its action and comparatively slow. The "Westinghouse" brake is more sudden and snatchy in its application, and more handy; but it will not be denied that in either of these systems a brake may leak off from any vehicle, either through defective packing, or other causes, without the driver who is in charge of the train, knowing anything about it. If a driver, with either of these brakes, should have any doubts about the pressure on the blocks, or the way the brake pistons are working, he cannot recharge his small reservoirs without taking all the brakes in the train off the wheels, and it would require some decision of character for a man to deliberately take all his breaks off and leave them standing off for time enough to recharge all his carriage reservoirs, while his train was rushing madly to destruction on a heavy down grade.

It will be granted that the brakes may stop on for hours under the most favourable conditions either with the Westinghouse or the ordinary vacuum systems when they have been so set, but it has been asserted as a positive fact, and has not been denied, *that they have been known to come off in three minutes.*

Let it be assumed that there were undiscovered defects in the brake apparatus of the Hawkesbury train, such defects as no ordinary inspection can exempt everyday machinery from, or that any of the triple valves stuck up, as triple valves do sometimes stick up. (See Board of Trade reports.) Then, under the conditions which existed in that train, there would be such a difference in the available effective brake power as would be sure to manifest itself at once to the driver; and if he, poor fellow, not then knowing what was wrong (as he had no means of knowing it, his guage telling him nothing) if he under such circumstances worked his valve several times in succession in his effort to get a better hold on his train, he would, as a matter of course, lose still more air and so much pressure as to bring from him the exclamation recorded, by his surviving fireman, "She has got away from us." The author does not say that was what did occur, as he is only discussing the possibilities of these brakes; but it is certain that such things might have occurred then, and they may occur again; and it cannot be controverted that with brakes as now fitted on our railways the driver has no means of knowing the pressure acting on his brake pistons *at any time*, or the pressure in his service reservoirs after the brakes have been on for some time. In fact, the working of both the Westinghouse automatic and Adams vacuum may be almost compared to an attempt at driving a horse with one rein, by having a fixed spur to act in the opposite direction; you pull the rein (figuratively) to pull the brakes off, and charge your reservoirs by charging the train pipe, but you let go of the rein altogether and trust to the spur at the other end in the shape of the reservoir when you let go your train pipe, and *you practically sever all connection between the driver and the brake machinery while the brakes are on*, for there is no further control when the brakes are on and the air out of the pipe. Without discussing the various points that have arisen for discussion out of the late accident, it appears to the author that the Official Board appointed to investigate into the same could hardly have come to any other general conclusion than they did, which may be summed up as a truism somewhat in these words: *In the brake used on that train, there was (as there is in all human machinery, more or less) an element of danger, and a liability to go wrong in several ways; and on that occasion something did go wrong.*

Now if nothing more could be said, and it was necessary to put up with any such defects as may have caused that accident, after we know of their existence, it would be better to leave the matter severely alone, and allow those gentlemen who have been so ably discussing it in the Sydney press to finish it by themselves, but the occasion seems opportune to bring under your notice an automatic railway brake recently invented in America, which certainly does possess those very important qualities which are absent in the Westinghouse and Vacuum Automatic brakes, that is:—

(1) The driver never severs his connection with his brakes.

(2) He always knows with what force they are acting.

(3) He can put them on and take them off, more or less, and as much and as often as he likes, without taking them off altogether; and

(Lastly) WHEN THE BRAKES ARE ON HE CAN KEEP THEM ON AND KEEP UP THE SUPPLY OF AIR FROM HIS PUMP TO THE CYLINDERS FOR ANY PERIOD.

This brake is known as

THE "HANSCOM,"

Straight Line Automatic Brake.

THE Hanscom brake is the invention of Mr. W. W. Hanscom, of San Francisco, one of the best-known engineers of the Pacific Slope, and it is in operation on the North Pacific Coast Railroad, of California.

This brake belongs to the type which operates by air pressure, a force pump being placed on the engine, the same as in the Westinghouse automatic system, and in its simplest form no reservoir is used. The brake blocks on each vehicle are operated by the motion of a piston in a cylinder, but, unlike other brakes, this piston motion, with the pressure operating on it, is directly and positively under the control of the engine driver, and by means of one valve placed on the engine; and it does not depend on the action of any complicated valves, or stored up energy in connection with each separate vehicle, which valves may act in a different way in each case. The pressure from the pump, through the main controlling valve, acts equally, and at the same time on every vehicle in the train, and thus does away with the violent jerks and irregular action which often occurs with other systems of brakes. The pressure on the brakes in the

Hanscom system can be increased or reduced as much and as many times as is desired, *without taking it entirely off*, as each brake cylinder is in a similar position to the cylinder of any ordinary steam engine, with its two ends directly connected to the compressing air pump, and the atmosphere, through the slide valve, or equivalent mechanism, which serves as the driver's control valve.

The direct operation of the piston in the brake cylinder, is brought into effect by the expedient of using two train pipes instead of only one (but used in an entirely different way to the two train pipes of the early Westinghouse system before referred to), the addition of the simple pipe enabling all complicated arrangements to be dispensed with, and direct communication to be established between the *one* source of air pressure, that is the pump, and either side of the piston in the brake cylinder, as desired.

The driver's regulating valve corresponds to the slide valve of a steam engine, it has a pressure or supply connection to the compressor, and an exhaust to the atmosphere, the two train pipes are continuations of the ordinary *ports* to the two ends of the cylinders, and become pressure or exhaust passages as the valve is moved to and fro.

A pressure gauge is attached *to each port*, and it shows the pressure in each train pipe, at any and all times. The regulating valve is constructed with a slight negative lap on the pressure edges, and thus, when the lever is in mid-position the pressure is slightly opened to both train pipes, and all the brakes are in equilibrium, being kept clear of the wheels by springs in the front of the brake cylinders pressing against the pistons. The two gauges at this time register the same pressure in each pipe.

When it is desired to put on the brakes, the valve lever is moved to open more pressure to the back of the brake pistons, which pistons then move forward with more or less power, according to the amount of port opened and the pressure shown on the gauge of that pipe, and when the pressure is full opened to that side of the piston, the other side is opened to the exhaust, giving the full air pressure on the area of the piston.

To withdraw the brakes the lever is reversed, and a positive pressure in the other pipe then causes the piston to go back in the cylinder, and the brakes are taken off. All the air above a certain pressure (for reasons to be presently described) is then exhausted from the back of the piston to the atmosphere. The pressure gauges at all times showing what is taking place in the pipes.

In order to make the Hanscom brake automatic, the "Brakes-on" air pipe is connected to the back end of each brake cylinder through a small and specially devised valve. This valve will allow the air to pass freely into the cylinder to put on the brakes, but it will always retain a certain regulated pressure, says 15 lbs. per sq. in. at the back of the piston acting to keep the brakes on—that is to say, it will only let out all the pressure above 15 lbs. (or such other pressure as required), when the pipe behind it is open to the atmosphere. When the pressures in the two train pipes exceed this adjusted pressure and it is equal in each, then the brake piston, as before stated, is in a condition of equilibrium, but should any accident occur and sever the connections, or should the guard open his valve on the pipe, the pressure can only be fully released from the front of the piston, and the stored-up power in the back end of the cylinder, which is enlarged to form a reservoir, automatically sets on the brakes at once.

From the foregoing description of the Hanscom brake it will be seen that there is no charging of vessels or storing-up power on each separate vehicle to be brought into operation by the indirect action of delicate mechanism like a triple valve, but that all the motions are directly and positively controlled by a driver's valve of most simple form. No wrought-iron reservoirs are required on the vehicle, as the rear end of the cast-iron cylinder serves for all the reservoir required for automatic action in case of breakaways. In the case of brakes which are worked by separate small reservoirs there is a chance of all or a great deal of the power leaking away on long down grades unless the pistons and other parts are kept in beautiful order and clean, and one vehicle may have brakes hard on and the next one have them only lightly on without the driver being able to tell that such is the case.* In the Hanscom brake the nicest gradations of pressure can be applied to and withdrawn from all brakes alike at the same time, and any leakage or waste of air can be made up from the pump direct, and the existence of such leaks can be at once detected by the pressure guages.

The North Pacific Coast Railway of California is equipped with the Hanscom brake, and the results in smoothness of working are said to have much surpassed the Westinghouse system.

It is not necessary to say anything about relative cost with other brakes, as the simplicity and non-expensive character of the parts are manifest at once to persons understanding the plans; it would probably cost one-half of the Westinghouse, and it seems hardly possible that a cheaper effectual automatic brake can be desired or devised.

It was said just now that the Hanscom brake in its simplest form was not so sudden or jerky as others in its action in stopping long trains. At the recent Burlington trials the inventor was under the disadvantage of having his gear and train fitted up in a great hurry 2,000 miles from home. He did not stop so quickly as other brakes with electro attachments, but sufficient was shown to prove, however, that it was by far the smoothest working brake on the ground, and absolutely free from the shocks or concussions in the vehicles attending other systems.

Under a form of Hanscom brake, however, especially adapted for quick stops, it is now arranged that all the air still passes from the pump through the driver's valve to the front of the cylinder to keep the brakes off, and it is only necessary, in order to put the brakes on, to reduce the pressure in that train pipe, when, by the action of a small valve interposed between the pipe and the cylinder, the air from the front of the piston escapes, until it is at a correspondingly reduced pressure, *direct into the atmosphere*, the brake acting with the pressure constantly behind the piston. An inspection of this simple valve shows that only one or two cubic

---

*** This paragraph was written only a few weeks before the Peat's Ferry accident.**

inches of air have to pass through the train pipe to the atmosphere at the driver's valve besides the contents of the pipe itself. Thus a very small train pipe suffices for very rapid action, and the same sensitiveness is secured for variations of pressure as in the simple form, and the same positive control over the action is secured at all times by the two guiding reins or train pipes which are distinctive features of the system.

In order to make provisions for stopping trains instantly by the simultaneous application of the brakes on every vehicle with slack couplings, the release valve is made with an electro magnetic attachment so arranged that when the driver makes electrical contact by moving his lever to full range, the magnets are excited and open a small leak valve in each apparatus which causes the brakes to go simultaneously on; from the diagram it will be seen that the electro magnetic valve when it moves cuts off connection between the regulating valve piston and the train pipe, and lets out the contained air, thus causing the brakes to go full on at once.

If long goods trains are ever to be stopped instantly it must be by electricity, for with slack couplings the latter part of the train would smash up the front part before the brakes could get on to it. *The Engineer* of the 10th June last (in commenting on the Burlington trials where fifty carriages were stopped from 20 miles an hour in 124 feet by the Carpenter Electro Air Brake), notes that the stored-up energy in a ton of rolling stock at 20 miles an hour or 29 feet a second is $\frac{29^2}{64 \cdot 4} = 13$ foot tons nearly, and allowing a foot of play in the buffer springs, a car weighing 12 tons would exert a compressive force of 136 tons, and that the quickest acting atmospheric brakes are quite inadmissible for such work owing to the destructive shocks, which must ensue with them. In order, however, to show that this brake is equal to meet such conditions, should they ever arise here, the Hanscom Electro Air Brake is now noticed; but it is in its simple form, easy to work and understand, and almost impossible to derange, that attention is particularly invited now, as being suitable for New South Wales requirements.

It will be very many years before we shall have enormous trains of 600 or 800 tons weight running at great speeds over the plains of this country, as is now the case in America, and consequently there will be no immediate demand for a brake to stop such goods trains in the shortest possible time ; but we have North, South, and West heavy and continuous grades over which it is desirable to make quick running with the assurance of a brake that can be depended on *under the contingencies most likely to arise.* The author does not believe in complicating the brakes of the Colony with electrical appliances at present ; but the cost of an extra train-pipe is very little compared with the security it gives. It does not add to the complication of the brake at all, but it does add amazingly to the assurance which a driver can have of the appliances under his control ; it gives him a brake that he can understand at once without the aid of a tutor, and instead of requiring most elaborate instruction, and having to study up books full of rules to distract him from his attention to other important points in the management of his train he will have his head clear when emergencies arise. The Hanscom brake does thus add much to the security which is afforded to the railway traveller. Under this belief the author has devoted much consideration for a few months past to the subject of railway brakes, and it is curious that he actually referred to the possibility of such an accident as that at Peat's Ferry only a few weeks before it happened.

In conclusion let it be understood that this paper is not written to disparage any existing brakes that have done good service, and the worth of which have already been acknowledged, but rather to further the belief that the people of New South Wales should have in the working of their railways the safest and most perfect appliances that human ingenuity can devise, and that nothing but good can come from the discussion of such a question, by such an association as is here assembled. Up to the present time it appears that for the goods traffic of the New South Wales railways, nothing has been submitted to the Government so cheap, reliable and effective as the Hanscom Brake ; and nothing tha is in use at present for passenger trains can compare with it for cheapness and efficiency if consideration is to be given to first cost, the comfort of passengers, and security of working.

DISCUSSION.

The President, in opening the proceedings, said it was very gratifying indeed to see such a large and representative gathering there that night. It proved very conclusively that the members of the association duly appreciated and recognised the importance of the subject which was to be brought under their notice. The "brake" question had been before the public for the last few weeks. The subject had excited a large amount of professional and public interest. No doubt this had been caused by the recent lamentable accident on the New South Wales railways, but it would neither be desirable nor necessary, and he thought it would be very questionable taste, to refer to that under the present circumstances. As they all knew, this question had been fought out before, but nothing definite had been arrived at, and the large amount of correspondence which had appeared in the columns of the daily press proved the existence of a healthy rivalry as to the merits or demerits of different kinds of railway brakes. The true object of their discussion was to consider as fully as possible the various appliances at present in use, and to endeavour to make the brakes as perfect as possible. As Mr. Selfe had stated, railway brakes were only human machines, and, so far, they had found nothing in machinery that was absolutely infallible. There were, doubtless, many gentlemen present who had come with the intention of speaking. Well, their time was somewhat limited, and, without attempting to place any restriction upon any one, he hoped those who spoke would condense their remarks as much as possible. It was their desire to hear as many gentlemen speak as was possible, and if speakers would limit their addresses to a quarter of an hour, there would be nothing said, but if they