VIBRATORY MOTIONS OF RAILS DURING THE RUNNING OF TRAINS.

At the inception of railways, the manner in which tracks should be laid was determined by somewhat theoretical calculations of resistance, which since that epoch have been considered as sufficient in practice, and have been preserved without any very important modifications. The sole changes that they have undergone, moreover, are due, in most cases, to the personal estimates of engineers, rather than to the result of very accurate observations. The only experiments attempted up to the present to ascertain the stability of tracks have been made, in fact, with immovable loads, and are insufficient to permit of accurately ascertaining the state of the track, during the passage of a train, under the influence of instantaneously developed reactions of all natures, such as flexion, lateral thrust of the rails, and inclination of the ties. It is these stresses and displacements, which are infinitely small as regards duration and amplitude, and which, moreover, vary from one instant to another of the train's running, that it is important to observe and to seize in their ephemeral existence; for, although they disappear immediately, it is only to reappear a short time afterward under slightly different conditions during the passage of the succeeding train, and it is their ever repeated action that wears the track and produces permanent distortions in it. They, therefore, lead to considerable expense in the way of keeping the road in repair, and may, at a given moment, be the cause of most serious accidents.

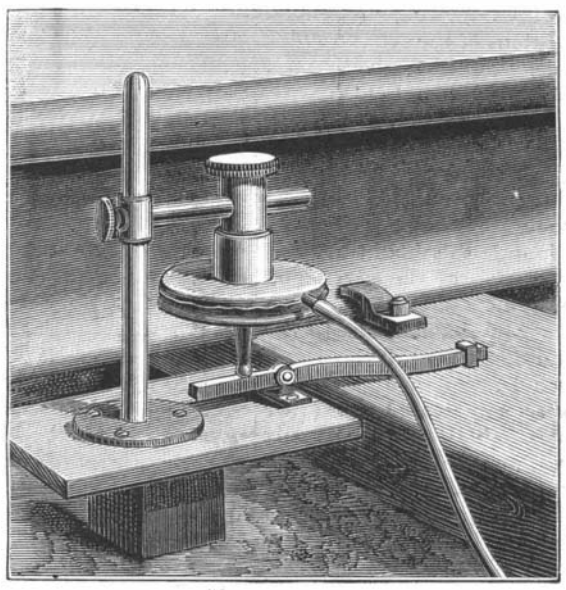

Fig. 1.—APPARATUS FOR MEASURING THE VERTICAL DISPLACEMENTS OF TIES.

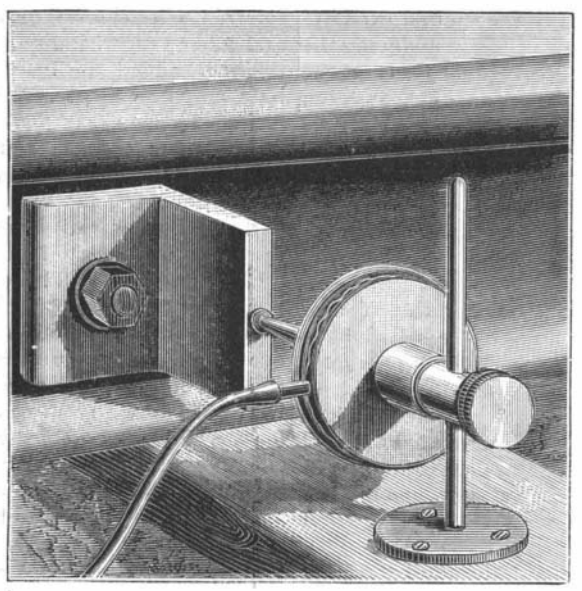

Fig. 2.—APPARATUS FOR MEASURING THE LATERAL DISPLACEMENT OF RAIL HEADS.

We have here one of the most difficult subjects of research, but one which is capable of giving most interesting results, by showing the points that are most strained, the nature and extent of the distortions, and the precautions to be taken to avoid them in the laying of the track, by supporting it in the weakest places, etc.

One of the most distinguished engineers of the Lyons Company, Mr. Couard, the inventor of an ingenious signal, has not hesitated to undertake this study (which he has now pursued for five years), and has endeavored to register those continuous phenomena, such as oscillations and vibrations of every nature, that moving trains give rise to. For inscription, the graphic method was clearly indicated, and as for apparatus of observation, Mr. Couard found these in the ones that were already in use in physiological studies for the inscription of analogous vibratory motions. Messrs. Frank & Marey's sphygmograph, which is used by physiologists in the study of the motions of birds' wings, etc., has been adapted likewise by Mr. Couard to the study of the motions of the elements of the railway, of which, so to speak, it was a question of feeling the pulse. The preliminary researches were made in 1883, with instruments lent by Mr. Marey, and led the Lyons Company to decide on the construction of analogous apparatus especially adapted for the study of tracks.

The apparatus thus arranged by Mr. Couard comprises an explorer of small bulk, placed upon the rail to be studied, and all the motions of which are transmitted to an inscribing device placed at a sufficient distance from the track to be uninfluenced by disturbing vibratory motions. The transmitting part is a simple rubber tube inclosing compressed air, and it is the variations in pressure caused by the displacements of the explorer that act upon the inscribing apparatus. We have here, as may be seen, the principle laid down in 1860 by Mr. Buisson, who applied it with success to the sphygmograph.

The explorer, which is represented in place in Figs. 1, 2, and 3, is a sort of bellows consisting of a small, round metallic box, closed by a sheet of rubber, to the center of which is fixed a rod whose rounded head bears against the rail. A spiral spring fixed to the bottom of the box repels the rubber and prevents the box from flattening without external stress. In the bottom there is a small tubulure, to which is fixed the rubber tubing running to the receiver. This latter consists of a bellows analogous to that of the explorer, but the rubber of which supports a goose quill style as light as possible that inscribes the displacements upon a cylinder covered with lamp black.

Fig. 3, which gives the general arrangement, shows four receiving apparatus mounted in front of the same registering cylinder, which might take the inscriptions of each of them at once, but only one is actuated by the tube of the explorer put in place. The blackened cylinder that constitutes the registering apparatus is driven by a clockwork movement, the uniformity of whose running is assured by a Foucault pendulum. It may be given three different velocities through appropriate gearings, or be stopped instantaneously. The inscription is taken upon the blackened paper that covers the metallic cylinder, and is afterward fixed through immersion in photographic varnish. It is then used for taking copies to serve for studying the traces obtained.

As it is very important to control the regularity of the cylinder's motion, for the exact determination of the speed of the trains, Mr. Couard has completed his apparatus to this effect by a tuning fork, whose motion is kept up by an electric current, and the intersections are noted graphically by Deprez's electro-magnetic signal.

In this way Mr. Couard has noted interruptions amounting to 100 per second, but the apparatus is so sensitive that, according to Mr. Marey, it is capable of inscribing 1,000 and even 1,200 vibrations per second.

Other apparatus that it would take too long to describe here serve for determining the precise instant of the passage of the forward axle of the train. Figs. 1, 2, and 3 show the arrangement of the explorer on the track according to the nature of the motion to be studied. That in Fig. 1 serves for taking the vertical displacements of the tie. The apparatus, as may be seen, rests upon a board fixed to a block partially buried in the earth between two ties. The board supports the axis of a lever, one arm of which is attached at the extremity to the tie to be studied, and the vertical motions of which it undergoes. The button of the explorer rod rests upon the other arm and transmits the latter's oscillations to the rubber. This arrangement permits of varying at will the respective lengths of the two lever arms and to reduce the inscriptions when the amplitude of the motions of the tie displaces that of the oscillations of the explorer.

For measuring the lateral overset of a rail on a tie, the explorers are placed externally to the track with the rod horizontal, as shown in Fig. 2, and the button bears with a certain pressure against the extremity of an angle iron bolted to the web of the rail, and is held by a wire in order to assure of an interdependence of the two motions. Under such circumstances, the horizontal displacements of the explorer are equal to half of those of the head of the rail, the angle iron being fixed at the center of the rail. It, therefore, suffices to double the indications of the explorer to ascertain the amplitude of the displacements of the rail head, for it has been found that the foot does not slide upon the tie.

Fig. 3 shows the arrangement adopted for measuring the vertical flexions of the rail independently of those of the tie. The explorer rests upon a lever supported by a horizontal board, which rests upon two straps attached to the rail by a bolt. A spring formed of a rubber band keeps the lever arm continually in contact with the button of the explorer.

With the apparatus just described, Mr. Couard has obtained most interesting data, that permit of most completely analyzing the complex motions of rails.—*La Nature.*

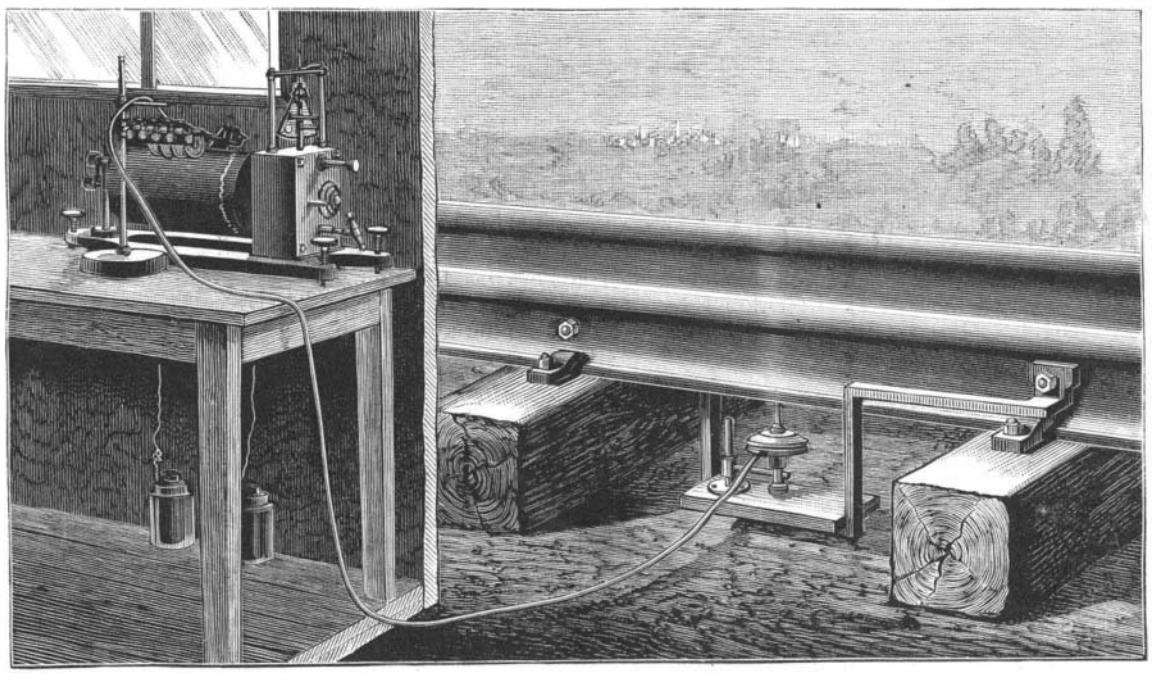

Fig. 3.—APPARATUS FOR MEASURING THE VERTICAL FLEXIONS OF RAILS.

Rivers vs. Railroads.

The authorities of New South Wales, where all the railroads in the colony are owned by the government, are greatly troubled by steamboat competition on the Murray River. The people on the banks of the river induced the government to build a railroad to take out their produce, and also to expend £200,000 in dredging the Murray. The steamboats then cut under the railroad, which put its freight rate down so as for a short time to take all the traffic, but the steamboats have more than met that cut, leaving the road nothing but the passenger traffic, which does not pay. As the roads were built to develop the country, it seems hard to the government that they should be called on to operate them at a loss, and it is proposed to put a river toll on the steamers that shall be heavy enough to restore the traffic to the government road. But this plan is open to the charge that the consequent increase in transportation rates would deprive the inhabitants of the Bourke district of the natural advantage of living on a watercourse, arresting the development due to cheap transportation, and would sink the £200,000 expended for dredging. On the other hand, it may be claimed that all other districts in New South Wales should have as cheap transportation as the Bourke district; but this might involve not only the payment of interest by the imposition of direct taxes, but a part of the operating expenses as well. The *Railroad Gazette*, looking at this matter from a distance, says: "The instance presents a curious study of the complications which may beset government control of railroads where watercourses afford opportunities for competition."

A Swiss engineer has proposed a scheme for supplying Paris with water from Lake Neufchatel, at an estimated cost of 20,000,000*l*. The aqueduct required would be 312 miles long, 22 miles of which would be a tunnel through the Jura Mountains. As the lake is 1,620 feet above the average level of the streets of Paris, the scheme includes a plan for using the surplus head to furnish power.

Improved Photographic Plates.

A considerable time has now elapsed since the promulgation of the discovery that, by the addition of certain dye stuff to the sensitized silver compound, a different range of sensitiveness is obtained to the various colors of the spectrum, whether in their native purity or as they are represented in the colors of natural objects which it may be desired to represent by photography; and that this range may be made to correspond far more closely with the effect of luminosity which such colors produce, through the eye, upon the mind of the spectator, than that given by the silver salts themselves without such addition.

It may, at first sight, appear surprising to many, considering how many years this idea has been before the public, and how much attention has been bestowed upon its development by leading scientific men among the photographic experimentalists in various parts of the world, that the advantage which such an approximation to a more truthful representation gives—enabling us to meet, so far as it goes, the greatest reproach which has been brought against photography—should not have been by this time so fully appreciated as to insure its almost universal adoption. As very commonly happens, several causes were at work tending to delay the general use of an improvement which may now be considered to be established as such. One of these causes was doubtless the fact that photographers had been led to expect results of a somewhat similar character from the substitution of bromide for bromo-iodide of silver, when the gelatine process came to take the place that had been previously occupied by collodion, and had found that practically there was no difference in the power of rendering colored subjects when used in the camera in the ordinary way for the reproduction of natural colors.

This disappointment naturally engendered among those who make photography their business a certain amount of disbelief and unreadiness to venture upon further trials in the same direction.

Another serious drawback was found in the fact that the earlier prepared orthochromatized plates commonly gave a somewhat veiled image, deficient in the brightness and pluck so necessary for successful commercial work. Yet a third drawback—and perhaps the most important one—was that, with orthochromatized gelatine plates as at first prepared, it was necessary, in order to obtain any very decided effect when photographing natural objects of the ordinary kind, to employed a colored screen, which at the same time introduced certain optical difficulties, and necessitated a considerably prolonged exposure. All these considerations militated seriously against the general adoption of orthochromatized plates for the ordinary work of the studio and the field, although the undoubted advantage of the principle of color sensitizing caused it to be more and more taken up, when a truer representation of the effect of various colors was most required, and when, as in the case particularly of copying paintings and other works of art, the disadvantage of prolonged exposure due to the use of the color screen was not serious.

The undue prominence of action by objects of certain colors, violet and blue, and the corresponding insufficiency of photographic energy displayed by others, green and yellow particularly, as evidenced by the want of lightness and life in the foliage of landscape photographing, and the excessive prominence given to freckles and to yellowish discolorations of the skin in portraiture, have steadily been kept in mind by scientific photographers, who have strenuously endeavored by research and experiment to remove this stigma upon photography, as well as by those whose bent is more in the artistic direction, and who recognize only too strongly the evils referred to, and are ready to hail with delight a remedy for or palliation of it, if only it can be shown that the remedy is a real one, and within the range of practical application.

Some landscape photographs which we have seen recently, and which we were given to understand had been produced without the interposition of a colored screen, upon plates prepared after a formula by Dr. H. Vogel, lead us to believe that the time is not far distant when a much more extended use of orthochromatized plates will be made than has been the case up to the present time. In landscape work generally the tendency is for trees and bushes to come too dark and heavy, relieved principally by the light reflected in a glistening manner by some of the leaves which happen to be at such an angle as to reflect the light from their surfaces. In the examples we have referred to, clumps of bushes and other foliage came out without excessive glitter, and with a beautiful light extending over the greater part of the objects, contrasting, as we see it in nature and in good paintings, with the bold, decided shadows of the stems and base; altogether giving that roundness to the object, as a whole, which is a beauty so much to be desired in the foliage of landscapes in a general way, and indeed which was in marked contrast with some other photographs of the same scenes, taken, as we understand, under similar conditions, with the exception that in the latter case ordinary unorthochromatized gelatine plates were employed.

In the studio, too, the employment of orthochromatized plates should, besides the better rendering of draperies, tend to reduce the necessity for retouching. There is no doubt that retouching, while an admitted necessity for those who have to make a business out of photographic portraiture, has, in many cases, been made to act as a substitute for good, sound photography, and so has been the cause of stagnation, or even deterioration, in the quality of the work produced. Retouching has been made a necessity, partly from the love of the sitter to be flattered, but partly also from the need for correcting the faults of photography itself. One of the faults, excessive blackness of the shadows, may be very much remedied by careful lighting and exposure. Another fault, that which has been referred to as the too powerful rendering of freckles and other yellowish discolorations of the skin, to which might be added the insufficient lightness given to fair hair, may now be greatly alleviated, if not entirely removed, by the use of plates having a different range of sensitiveness and color from that possessed by the haloid salts of silver alone. There is then a prospect of real improvement in photography, which we trust will stimulate our readers to do their utmost to help on the accomplishment of this long felt desideratum.

One thing more. The sensitizing of the silver compound for those rays which produce too little effect on the plate in proportion to their luminous power to the eye should—and we understand, does—exalt the sensitiveness of the plate as a whole. So then, instead of having to do with an exposure of increased length, we may, when using orthochromatic plates that are really effective when employed without a colored screen, expect to find that we are enabled to still further shorten the exposure, and so a gain all round should result.—*Photographic News.*

[SCIENCE.]

An Army of Worms.

I am in receipt of a letter, bearing the date July 6, 1888, from Mr. W. H. Cleaver, East Bethlehem, Pa., in which he states that the worms, specimens of which he sends, are at the present time very abundant in his neighborhood.

To quote from the letter, "They are traveling eastward in countless millions. They travel at night or in the cool of the morning and evening. They camp during the day by getting under sods, boards, stones, or anything to protect them from the heat of the sun. In some places during the day they are piled up in great numbers. They do not seem to destroy anything on their journey, but go harmlessly along. Fowls will not eat them, and birds do not appear to molest them."

The specimens which accompany the letter are, I think, the common *Polydesmus erythropygus*. In the absence of any complete systematic work on the *Myriopoda*, I am not able to identify the species with absolute certainty. The species is very common in this vicinity, but I have never before heard of its occurrence in such numbers as reported by Mr. Cleaver.

EDWIN LINTON.

Washington and Jefferson College,
Washington, Pa., July 7.

The Lick Observatory.

It is announced that Professor S. W. Burnham, of Chicago, well known as an efficient astronomer and amateur photographer, has been appointed on the staff of the Lick Observatory.

On the occasion of his departure from Chicago, where he has resided for some time, he was honored with a farewell dinner by a few of his numerous friends and co-workers in the art-science of photography. Among those present were Professor George W. Hough, of Dearborn Observatory, Rev. Dr. Arthur Edwards, Dr. H. D. Garrison, G. A. Douglass, Judge Bradwell, H. L. Tolman, C. Gentile, W. A. Morse, Dr. C. G. Fowler, Col. A. F. Stevenson, Professor Basten, and Lieut. Schwatka, the Arctic explorer.

The Pacific coast may well be proud in having obtained the services of Professor Burnham for the world famed Lick Observatory, while Chicago loses in him a noble friend of the sciences.

A Cheap Ice Chest.

Take two dry goods boxes, one of which is enough smaller than the other to leave a space of about three inches all around when it is placed inside. Fill the space between the two with sawdust packed closely, and cover with a heavy lid made to fit neatly inside the larger box. Insert a small pipe in the bottom of the chest to carry off the water from the melting ice, and you have a very cheap and tolerably effective ice box for family or grocers' use.

A Stopper for Rats.

A correspondent says: Soak one or more newspapers, knead them into a pulp, dip the pulp in a suitable solution of oxalic acid. While wet, force the pulp into any crevice or hole made by mice or rats. Result—a disgusted retreat, with sore snouts and feet, on the part of the would-be intruders.

THE EDISON PHONOGRAPH IN ENGLAND.

The phonograph, which has nothing to do either with the telephone or the telegraph means of instantaneous communication, is a wonderful instrument for preserving, and for repeating in any place, from a permanent acoustic record, the tones, accents, and articulate syllables uttered by the human voice, perfect discourse in its original pronunciation, as well as every kind of musical and other sounds, after conveyance of the inscribed record, by ordinary carriage, to within hearing of a future auditor. Professor Edison, of Orange, N. J., in the United States of America, renowned for his improvements of the electric light apparatus and other most valuable scientific contrivances, is the inventor of the phonograph, a rudimentary form of which, exhibited in London ten years ago, then excited much public curiosity. He has, during the past twelvemonth, brought it to a degree of comparative perfection, which was practically tested, on June 25, by experiments at the house of Colonel G. E. Gouraud, the agent in London for Mr. Edison's inventions, residing at Little Menlo, Beulah Hill, Upper Norwood; and on June 29, in the press gallery at the Handel festival, in the Crystal Palace. Our illustrations represent the scenes on these two occasions; in the first instance, a private family party at Norwood listening to the tones and words of Mr. Edison's voice, ten days after he had spoken in America, at a distance of nearly three thousand miles—the "phonogram" having been sent from New York on June 16, with the regular United States mail, by the German Lloyd's steamship Eider, to Southampton; in the other case, during the grand performance of Handel's music, the phonograph reporting with perfect accuracy the sublime strains, vocal and instrumental, of the "Israel in Egypt," received by a large horn projecting over the balustrade in the vast concert room in the north transept of the Crystal Palace. The machine was worked by Mr. De Courcy Hamilton, one of Mr. Edison's assistants, who had brought it from America. The "phonograms" being sent to Mr. Edison, all the Handel choruses, as sung here by four thousand voices, with the orchestral and organ accompaniments, will be heard in New York and in other American cities. They can be repeated to a hundred different audiences for years to come.

We can only give a brief account of the essential parts of the phonograph. There is a disk of bright metal, rather larger than a shilling piece, so poised as to vibrate in correspondence with any sound that is received by the instrument. Below, and attached to this disk, is a minute point of metal, like a fine pin, which, as the diaphragm or disk vibrates, cuts an exceedingly delicate, sinuous, hair-like line into a revolving cylinder of wax. When the record is once engraved on the cylinder, we can, by reversing the movement, get back from the instrument the sounds that were put into it. In the phonograph first exhibited in this country ten years ago, which was illustrated in this journal on August 3, 1878, the sound marks were made, in a similar manner, on tin foil; and their tone was metallic, nasal—sometimes a squeak, indeed—very often ludicrous or miserable; but Mr. Edison has now constructed a phonograph which, by substituting a composition of wax for the tin foil, and by other important contrivances, has entirely got rid of any harshness or weakness of tone.

In external appearance, Mr. Edison's wax cylinders are like ivory napkin or serviette rings, only rather larger, and about three inches long. They fit on a small iron rod, which is put in rapid motion when wanted by a little bichromate galvanic battery, seen in our illustration under the table. When Mr. Edison, in the earlier period of his experiments, desired to use one of the cylinders over again for new matter, much time was wasted in passing it through the apparatus. He now arranges a minute knife upon the same arm which bears the diaphragm stylus. The knife cuts off a shaving, and the diaphragm stylus follows in its wake; both operations being accomplished at once. Wax cylinders are made thick enough to allow the indented surface to be planed off twenty times or more, so the same cylinder can be used for as many different transcriptions. Another new device perfects the method of duplicating phonograms containing matter which may be worth selling, such as books, music, sermons, speeches, or plays. When a phonogram of special interest or value is obtained, which it is desired to multiply, it is coated electrically with nickel until a thick plate is obtained. This plate, when detached from the wax and pressed against a fresh sheet of warm wax, gives an exact reproduction of the original phonogram; and such duplicates may be made so easily and rapidly as to cost scarcely anything. To obtain the first phonogram of the book or of a piece of music may require care and special skill. Once obtained, a million can be made from this one nickel mould. So far as countless experiments in the laboratory show, there is no perceptible or audible wear in the wax phonogram, no matter how frequently it is made to repeat a message.

If Colonel Gouraud wants to phonograph a dispatch to New York, he talks into the mouthpiece, the cylinder is turned round by the electric current, the repeating disk vibrates in harmony with the voice, and the