tween those hours, he quickly shows that their judgment confirmed, every time, by a Detroit time is too slow for Detroit, and that the people of that city had better adopt Utica time (75th meridian or Eastern standard). On the same basis we in New York had better adopt Kennebunkport time; but perhaps to mention this at this time would be lugging in a side issue; so we will let it pass. Not having so warm a sympathy as we ought toward our brothers who live in Detroit, we had always thought that their proper course, if they didn't like to go to work at 7 o'clock by St. Louis time, was to go to work at 6:30 by St. Louis time. Living here in snug comfort, only four minutes from the 75th meridian, which is very close to the city that now rules the world (i.e., rules the greatest "world-power"), we had never thought that getting up at 6 o'clock became a hardship simply because the clock showed 5:30. But it appears that every suggestion to use the Central Standard in Detroit factories is met by the opposition of the labor unions-and no labor union is ever mistaken as to what it wants. The final and insurmountable difficulty with Central Time in Detroit is that the churches and theatres are determined to begin their evening services and entertainments at 8 o'clock, so that the poor shop man who ends his day's work at 5:30 has a half hour more time than he needs for putting on his evening suit. He loses a half hour at home in the morning, when he needs the time, and makes it up in the evening when he does not need it. The chief trouble, however, with Mr. Hargrave's plan, is that Chicago will not accept it. Could that proud city, after 21 years of normal and easy timereckoning, think for a moment of having two clocks, an hour apart, in each of its great railroad stations (except the North Western)? Never!

The general manager of the Chicago & North Western has issued a circular to superintendents and yardmasters which reads as follows:

"See that a minimum time is absolutely af-forded train and engine crews for rest as fol-

lows: "Men ten hours or less on duty, eight hours' "Men twelve hours on duty, ten hours' rest, minimum.

Men fourteen hours on duty or more, twelve

"Men fourteen nours on duty or more, twelve bours' rest, minimum. "Keep before the train dispatcher such record of movement of crews as absolutely will prevent an engineman or trainman from going out on a run without the full allotted time for rest. "(then this meters up prevently to extent

"Check this matter up personally to see that the rule is being carried out, examining reports periodically as to rest actually allowed."

In order that a check may be maintained, the proper officials at terminals are being provided with what is known as a "rest book," in which records of every crew will be kept. The reporter who publishes this circular says that all of the Chicago superintendents are considering the subject and all are of opinion that rest must be assured "except in emergencies." But why this exception? Is not an emergency just the time when some man's judgment will fail? Occasions will arise when a conductor or an engineman will be unable to take his train to destination in less than, say, 20 hours; but should not such cases be subject to the rule, without exception? If the rule makes the work-time limit 15 hours, why not require the train to be sidetracked (or, if stalled, to be deprived of its main track rights) on the expiration of that time, unless the superintendent specifically suspends the rule in each case? The trainmaster and despatcher are under constant temptation to stretch the meaning of the term "emergency," and it would be salutary to require them to get of railroad track building and maintenance another for another part. It was almost im-

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higher officer, before allowing a man to work excessive hours. The modification of restrules should be made difficult. This would tend to cultivate in the minds of all concerned a sense of the dangers that it is desired to guard against and would help the runners and conductors themselves to realize the importance of taking special pains to keep themselves awake when working longer than usual. Cultivation of an adequate sense of dangers and responsibilities is, indeed, one of the main benefits of such a circular as that which the North Western has issued; for the mere correction of hours is not in itself an infallible corrective of practice. Men sometimes sleep when they have been on duty much less than 10 hours.

Senator Elkins, Chairman of the Senate

Committee on Interstate Commerce, said at Washington this week that his committee would probably propose the creation of an interstate commerce court, to be composed of nine members, including one from each judicial circuit; but he does not think that Congress is likely to pass any law affecting rates of transportation at this session. The utterances of President Roosevelt in his annual message on the subject of railroad rate regulation have been the most prominent topic of discussion in Washington during the All are agreed that the past ten days. present Congress is not likely to act. Some of the observers say that this is due to the settled opposition of the members of the commerce committees in both houses, who have prevented action each year for several years past; while others think that a majority of both houses of Congress is now convinced that action must be taken in order to meet the pressing demands of the West, but that the technical difficulties of the subject, when it comes to the drafting of a bill, will make it impossible to reach an agreement before March 4. When, at a committee meeting last week, it was proposed to order a series of hearings on the question, Mr. E. P. Bacon, the chief advocate of a law to give rate making powers to the Interstate Commerce Commission, said that hearings were not necessary; everybody knows the facts; the thing now is to act. In this Mr. Bacon is substantially correct. Congressman Steenerson, of Minnesota, has introduced a bill to give the Interstate Commerce Commission rate-making powers. It appears to contain nothing new or different from what is already embodied in the bills presented a year ago by Senator Quarles and Representative Cooper. Some of the gossips say that the President will send to Congress another message on this subject. It was announced in Washington this week that Mr. Paul Morton Secretary of the Navy, would continue in the cabinet beyond the President's present term. It does not appear whether Mr. Morton is to remain at the head of the Navy Department or is to take one of the other portfolios; but it is said that the President desires to keep him as an adviser on the question of railroad rate legislation, on which Mr. Morton is said to believe that action is necessary. Comment on government control of rate-making will be found in another article in this issue.

### NEW PUBLICATIONS.

#### The Roadmasters' Assistant. New and Revised Edition. New York: 1904. THE RAILBOAD GAZETTE. Cloth, 290 pages. Price, \$1.50.

Within the last five or six years the art

has made rapid strides forward, and the 1898 edition of The Roadmasters' Assistant having become out-of-date, a new and re vised edition of this useful little guide and reference book was made necessary. No attempt has been made to change the arrangement or scope of the subject-matter in the present edition, but the text has been carefully edited and the illustrations revised. and new ones substituted in many places. The most important changes have been made in the chapters on Rails and Rail Fastenings, which have been entirely rewritten. The chapter on Water Supply has been added to and enlarged to include water softening plants and gasoline pumping engines. Other books have been written on track and allied subjects which are full of theory. The Roadmasters' Assistant and opinion. has been written with a different object in view. The aim has been to make a practical book for practical men, convenient in size and arrangement and simple in language.

# CONTRIBUTIONS

Suggested Changes in Standard Time.

BAY CITY, MICH., Dec. 1, 1904. TO THE EDITOR OF THE RAILBOAD GAZETTE: The object of this article is to discuss whether the irregular division between eastern and central time should not have been farther west, and instead of being where shown by line No. 1, on the first diagram, should be about where line No. 2 is drawn. In 1883 the railroad companies of the United States and Canada adopted what has since been known as Standard Time. The wisdom of its adoption has ever since been fully proven by its great convenience to the traveling public, as well as to the railroad companies. All who traveled previous to that time can well remember the great confusion of times at all places, not only where eastern and western roads met, but in almost all towns and cities through which such roads ran. For many years prior to this, the subject of some uniform standard of time that could be adopted by all the people or with which the time used in the different sections of the country could be compared, had been discussed.

Of course it is universally known, and is only mentioned here to get the subject clearly before us, that as we travel from any point westward time gets slower as compared with the starting point. Again, traveling in an easterly direction time is faster. The rate at which time changes is one hour for each 15 deg. of longitude. It makes a difference of about one hour between New York and Chicago, and three hours between New York and San Francisco. Because of the great difference between the eastern and western sections of our country, it would be practically impossible to use the same time; that is, to have the clocks in all parts of the country set at the same hour, because there would be too great a difference between part of the clocks and solar time. Before the adoption of standard time, in most cities the time due to their location on a certain meridian was in use, and in others, the time of a nearby observatory. This time was designated local time. The great dif-ficulty and inconvenience of using local time grew out of the great magnitude and importance of the railroads. The managers of the different railroads selected for their use the time of the most important or the most central city on their line. Sometimes there was one standard for one part of the line,

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possible to keep track of the times of the railroads and connecting roads at junction points. There were about 75 different times in use on the railroads of the United States. Before 1883 the railroads were in many localities running on a time of their own arbitrarily adopted, while the residents used local time; also, in many cities where local time was used by the inhabitants, different roads running into the same place would be using different times. Detroit, New Haven, and a number of other cities, had three times in general use by the citizens and railroads. In making a trip from Boston to Washington the time by which the railroads operated changed five times. Almost endless was the confusion of the traveler, and not much less that of the railroads. In 1883 all this was changed: a standard of time was adopted by the railroad companies; and now, while in the nature of things, changes of time must occur, each change is a difference of exactly one hour. The subject was discussed for years and finally the details of a plan were worked out by Mr. W. F. Allen, Secretary of the General and Southern Railway Time Conventions, held in New York and Chicago in April of 1883, where the following resolutions were adopted:

1. That all roads now using Boston, New York, Philadelphia, Baltimore, Toronto, Hamilton or Washington time as standard, based upon meridians east of these points, or adjacent thereto, shall be governed by the 75th meridian or eastern time (four minutes slower than New York time).

2. That all roads now using Columbus, Savannah, Indianapolis, Atlanta, Erie, Louis-ville, Chicago, Jefferson City, St. Paul or Kansas City time, or standards based upon meridians adjacent thereto, shall be run by 90th meridian time, to be called Central Time, one hour slower than Eastern time, and nine minutes slower than Chicago time. 3. That west of the above named section the roads shall be run by the 105th and 120th

meridian times, respectively, two and three hours slower than Eastern time. That all changes from one hour standard to another shall be made at the termini of roads or at the ends of divisions.

Standard time as agreed upon was adopted by most of the New England railroads October 7, and by nearly all the other railroads east of the Rocky Mountains Nov. 18, 1883 Most of the towns and cities soon followed

the example of the railroads, but although Standard time has been largely adopted for general use, it must be clearly borne in mind that it was invented and adopted by the railroad companies solely for their conveni-ence, without once consulting any community as to whether they would use it or not. How the clock time agreed with solar time or hours of daylight, or the convenience of

the people along their lines, had nothing to do with its adoption. To quote from one of its principal advocates: "The people will have to travel by Standard time whether they eat and sleep by it or not."

The country was divided into four irregular sections. Commencing from the east, the first section takes the time of the 75th meridian, which is known as Eastern time; the second section, the time of the 90th meridian, known as Central time; the third section of the 105th, known as Mountain time; and the fourth of the 120th, known as Pacific time. and the The limits of these sections are not regular, because the railroads had to select certain places or cities as points at which it would suit their convenience for their lines to change from one time to another. These time change points in most cases were the railroad terminals, although a very few of them were simply important divi-

a glance at which will show the different

points where the changes in time are made. It will be seen that four heavy lines, running north and south, mark the location of the 75th, 90th, 105th and 120th meridians, Standard time is faster than local time. To the ones from which the different sections illustrate: The following cities lie east of



Between Eastern and Central time changes are made at Sault Ste. Marie, Cartier, Sarnia and Windsor, Ont.; Buffalo, Dunkirk, and Salamanca, N. Y.; Butler, Corry, Erie, Franklin, Newcastle, Oil City, Pittsburg, Titusville, Union City and Washington, Pa.: Benwood, Kenova, Parkersburg, Wheeling and Williamson, W. Va.; Asheville, N. C.; Columbia, S. C.; Athens, Augusta, Central Junction and Gainesville, Ga. The changes between Central and Mountain time are made at Mandan, Minot and Portal, N. Dak.; Allianca, Long Pine, McCook and North Platte. Neb.; Cheyenne Wells and Holyoke, Colo.; Dodge City, Hoisington and Oakley, Kan.; Texline and El Paso, Tex. Between Mountain and Pacific sections at Spokane, Wash.; Troy, Mont.; Huntington, Ore.; Ogden, Utah;



## Fig. 2.

sion points. This will best be understood by Seligman, Ariz., and Deming, N. Mex. It is looking at the accompanying map (Fig. 1), readily understood that in the part of any section lying east of the meridian from which it takes its time, the Standard time adopted is slower than the local time formerly used. and in the part lying west of the meridian

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the 75th meridian, the time of which is used ing hours. The writer visited a town north during short days, darkness comes on before for Eastern standard. The numbers set opposite each city show the number of minutes Standard time is slower than local: Portland. 18 minutes; Boston, 16; New Haven, 9; Albany, 5; New York, 4.

The following large cities lie west of the meridian, so that Standard time is faster, as follows: Syracuse, 5 minutes; Rochester, 10; Buffalo, 15; Erie, 22; Pittsburg, 20; Wheeling, 23; Washington, 9; Richmond, 10; Columbia, 24; Windsor, Ont., 30. In the following cities lying in the eastern

part of the section using Central time, Standard time is slower than local time, as follows: Cleveland, 34 minutes, Columbus, 28; Detroit, 28; Dayton, 23; Cincinnati, 21; Indianapolis, 15; Chicago, 10.

Local time is often spoken of as "God's time," while Standard time is called "man's time." As a matter of fact, "God's time," or true local time, is never used because it is too irregular, which irregularity is caused by the variation of the earth in its orbit and its inclination from or toward the sun. This variation from the time known as local time amounts to over one-half hour during the course of a year, as will be seen below. The time set opposite the day of the month is the local time when the sun is directly over the meridian; 12 o'clock:

Jan. 1	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$
June 1512:00:02	Dec. 1511:54:54

It will be seen that a large variation from actual sun time was averaged up by man, when what is known as local time was adopted. Our method of keeping time was designed and adopted for man's conveni-ence. This was better understood, and the direct object when Standard time was adopted. Yet with this in view, at many points. Standard time makes worse a defect that has always existed in local time, that is, the center of the period of light does not come at the middle of the working day. It does not make much difference in the summer time, when there is always more light than is used, but in the months when daylight is the shortest, and especially in the fall, when there is much work to do, it is serious.

This causes the most inconvenience where there is much work to do, and it is difficult or undesirable to have artificial light. This includes a great deal of labor. To illustrate: October 1st the sun rises at 5.57 and sets at 5.41. As most work commences at 7 a.m. and stops at 6 p.m., it is seen that the sun rises 1 hour 4 minutes before time to commence work and sets four minutes before time to stop work. October 15th the sun rises at 6.14 and sets at 5.18. November 1st it rises at 6.33 and sets at 4.58. November 15th it rises at 6.52 and sets at 4.38; that is, it rises eight minutes before time to commence work and sets 1 hour and 22 minutes before time to stop work.

It has been the practice in many places where large numbers of men are employed to set the clocks one-half hour faster than the local time, when the days begin to shorten. In mining regions and in communities largely dominated by one or a few large manufacturing plants, it is at the present time the custom to change the clocks and blow the morning, noon and night whistles without regard to either standard or local time, and simply make the noon hour the middle daylight point, to the end of getting all of the fall and winter daylight within the work-

of Detroit containing a number of lumber, manufacturing and finishing works belonging to one company. The works and all the people were using Eastern Standard time, while the railroads were using Central Standard time. It gave great satisfaction but would have been much better had the railroads used the same time.

When Standard time was adopted in the cities lying east of the meridian from which their time is reckoned, the length of the period of daylight before the time to commence work, and the period of darkness before time to stop work, were greatly in-creased. To illustrate: Take the case of Cleveland, which uses Central time. October 1st the sun rises by Standard time at 5.24 and sets at 5.12; it rises 1 hour and 37 minutes before time to go to work and sets 49 minutes before time to stop. October 15th the sun rises at 5.41 and sets at 4.45. November 1st it rises at 6 and sets at 4.20. November 15th it rises at 6.19 and sets at 4.05. It is readily seen how great an inconvenience this causes. As a result, in cities situated as are Cleveland, Columbus, Toledo and others about on the same meridian, all the enterprises that employ labor either run by local time, or-which is the same thingcommence one-half hour earlier by the clock, keeping Standard time. Some citles, like Detroit, refuse to adopt Standard time, and the reason for not adopting it is always because of the protest of the laboring classes. The Mayor of Detroit writes: "Many ef-

forts have been made by various interests to have the city government adopt the Central Standard time, but on each occasion there has been such a protest from labor organizations, some of our merchants and others, that the plan has been overwhelmingly defeated."

The argument is often advanced, if the clock is set back, soon everything adjusts itself to the new order, and no one knows the difference. One of the main things, the sun. refuses to be adjusted by it, and factories and other industries will run approximately to the time that gives the most light during the period of work. Again, the argument is advanced, suppose work starts at 6.30 in-stead of 7 and stops at 5.30 instead of 6, is that not practically the same for the men? Granted, as far as that goes, and it would be the same if the trades people and professional men would do their work one-half hour earlier, and if the churches, theatres and evening meetings would also start by time one-half hour sooner; but they do not and will not, and the only reason that can be given is that they have been accustomed to certain hours and will not change. As a result, the men who do most of the work go to and from work by a time one-half hour earlier than in general use. After leaving their place of employment, every other place goes by the slower time, resulting in the loss of one-half hour's time in the evening, which half hour has to be made up by getting up one-half hour earlier to go to work by the faster time. There is no doubt but this is a considerable hardship and that their objections are well taken.

In some cities the schools either run on local time or have their sessions commenced earlier by Standard time. This brings the noon hour at 11.30 instead of 12, which again, in all families, except of the working people referred to above, deranges the noon day meal. In the schools which run on Standard time and usual hours the noon day meal comes at the wrong time for those using the faster time, and it is also difficult to get sufficient light for the pupils to study by late in the afternoon of the short days. In many places where artificial light cannot be had

the time for the men to stop work, causing loss to the employees and employers; loss also, because less work can be performed, and probably what is done is of inferior quality.

The writer wrote to nearly all the cities located about on the same meridian as Detroit, Toledo, Cincinnati, etc., and from the answers received it was found that practically all the factories run on either local time or one-half hour faster of Standard time; that the time as now used causes confusion, and is not satisfactory. These letters were addressed to the mayors of the different cities.

As a remedy for the troubles here recounted the writer suggests that the rail-roads move the division between Eastern and Central time farther west, and instead of having it where described above, it be made about on the line of Lake Michigan, Chicago, Indianapolis, Louisville, Nashville, Birming-ham, Montgomery and Mobile. That would make Standard time the number of minutes faster than local time indicated by the figure set opposite the names of the cities given: 

Taking Cleveland as an example we will see how the new, or Eastern (instead of Central) time will fit the conditions of light and suit all the people. Attention is called to Fig. 2. The distance between the horizontal lines, except those drawn to show 7 o'clock a.m. and 6 o'clock p.m., Eastern and Central Standard time, represents a period of one hour. The perpendicular lines represent the first and fifteenth of each month from September 1 to January 1. The lower shaded portion shows the period before sunrise and the upper shaded portion after sunset

The groups of three figures at A and B above and below the line of dates give the different times at which the sun rises and sets at the dates given. The central figures in each group show the time by local time, the upper, Central Standard, and the lower, Eastern Standard time. Lines are drawn and marked 7 a.m. and 6 p.m., local Eastern Standard and Central Standard, to show the relation between the time to commence work and sunrise, and the time to stop work and sunset by the times under discussion. By following the times denoting 7 a.m. and 6 p.m. Central time, will be readily seen that the large section of daylight before the time to commence work, together with the large period of darkness before it is time to quit work, making this time absolutely impracticable for most kinds of work.

Following the lines marked 7 a.m. and 6 .m. local, it will be seen that by local time the proper division of daylight to suit the working day is much improved, as compared with Central Standard. Again, when we follow the lines marked 7 a.m. and 6 p.m. Eastern Standard, we find still further improvement, and although by using this time the period of light is not evenly divided to suit the start and finish of the working day, it is approximately so, being a great improvement over the other times.

It has been shown that the fall and winter is when the light should be most evenly divided between the time of starting work in the morning and stopping in the evening. Using the same dates as before-October 1st, by Eastern time, the sun would rise at 6.24 and set at 6.08; October 15th it would rise at 6.41 and set at 5.45; November 1st it would rise at 7 and set at 5.20; November 15th it would rise at 7.19 and set at 5.05. It will therefore be seen that by using Eastern time in the cities mentioned and others in the same territory, the time used would not be

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#### **DECEMBER 16. 1904.**

light between the morning and evening. It other that the horizontal moving or recipro-would not only make it possible to use Stan- cating parts balance each other without the dard time wherever labor is employed, but it would also be a great improvement even upon the local times formerly used.

As all the time used is artificial and made for the convenience of the people, while we are making it why not make it as con-venient as possible? In the letters men-tioned before written to the mayors of a large number of cities and towns in the territory of which we write, the question was asked: "Would it not be better for all your people and especially those who do ordinary labor if Standard time was one hour faster?" The great majority answered: "Yes," and a few "I do not know; never thought of it." Only two said they thought as there had been so much trouble getting Standard time started. better leave it alone.

The following would be some of the advantages of the change. The railroads would have a much longer run without change of time. Some of the large lines, as the Mich-igan Central, Grand Trunk, Lake Shore and Michigan Southern, Nickel Plate, Big Four and many others, would operate their en-tire lines under one time, therefore causing less confusion to the railroads and traveling public. It would favor the people who work, scholars in schools, and all who need more light the latter part of the day during the short days. As the change would do no harm to the merchants and those whose work is connected with the professions there is no reason why they should not adopt the new time, then all the people would use the new time and the present confusion cease to exist.

The new time would also be a great advantage during very hot weather. The hottest part of the day is the middle of the afternoon, and by moving the time one hour faster a much larger part of the work would be performed before the time of the greatest heat, leaving a shorter time to work after the time of the greatest depression. The writer has talked with many and looked carefully for one reason why the plan should not be adopted and can find none.

E. C. HARGBAVE.

#### The Cole Four-Cylinder Balanced Compound.

#### Dec. 3, 1904.

TO THE EDITOR OF THE RAILBOAD GAZETTE: I am glad of the opportunity to read over Mr. Moore's criticism (see Railroad Gazette, Dec. 2, 1904,) of the counterbalance of our four-cylinder compound and to expose the fallacy of his reasoning, and his ignoring of certain elementary principles in mechanics. It may be interesting to call attention. before proceeding with the argument, to the fact that it is well within the mark to state that at least 90 per cent. of all the four-cylinder balanced compound engines which have been built in different parts of the world have the power sub-divided, the high-pres-sure cylinders driving one axle and the lowpressure cylinders the other. In France, where this type of engine has been successfully used for many years, this arrangement is used practically to the exclusion of all others; and Mr. De Glehn, who, more than any other man, deserves credit for the development and introduction of this type of engine, recommends and uses this arrangement to the exclusion of practically all others. The French roads have at the present time over 1,000 engines of this kind in service.

The statement for the New York Central says: balanced locomotive No. 3,000 that "four omitted in the wheels except enough to bal-

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quite fast enough to exactly divide the day- cylinders are so arranged in relation to each use of the customary counterweights for these parts in the driving wheels," is prac-tically correct, and the error into which Mr. Moore has fallen in his hasty criticism is, in regarding the reciprocating parts them-selves as producing the vertical force or "hammer blow" upon the rails at every revolution, which is a popular misconception, believed in to a certain extent by some persons.

> As far as the track alone is concerned. there would be no vertical action or hammer blow if the over-balance for the reciprocating parts in an ordinary engine were omitted, but it is customary to add a certain proportion of these weights in the wheels directly opposite the crank pin, in order to neutralize, as much as possible, the action of the reciprocating parts on the engine itself in order to make it run smoothly, and to save the engine frames and moving parts from unnecessary vibration and shocks. In a balanced engine, the reciprocating parts on the inside of the frames balances those on the outside which move in the opposite direction, so that the use of the customary amounts of counterweights for reciprocating parts in the wheels is rendered unnecessary. It is also well known that an engine of this description runs smoothly without the use of weights for balancing reciprocating parts. This can be shown conclusively by mathematical proof, and it is a matter of common knowledge that these engines run remarkably steady, both on the road and testing plant.

> The action of the reciprocating parts is entirely horizontal and no vertical force can be exerted by these parts except the slight vertical component produced by the angularity of the main rods; hence there can be no pressure produced upon the rail by the action of the reciprocating parts. Mr. Moore is evidently confusing the "hammer blow" in simple engines produced by the overbalance in the wheels to take care of the recipro-cating weights, with the action of the reciprocating parts themselves which have nothing to do directly with the hammer blow. So far as the principle of balancing is concerned, it makes no difference whether the main rods are connected to a single or separate axles. In either case, the reciprocating weights counteract each other and counterbalance for all the rotating weights is all that is necessary. Had Mr. Moore witnessed the test of the

> New York Central No. 3,000 at the World's Fair when running at 75 miles per hour, he would no doubt have been satisfied that the counterbalance of this engine left little or nothing to be desired. The absence of vertical motion was demonstrated by means of wires run under the wheels. These wires were flattened along the entire length.

#### KANSAS CITY, Mo., Dec. 10, 1904.

F. J. COLE

TO THE EDITOR OF THE RAILROAD GAZETTE: In your issue of December 2 there appears communication from L. E. Moore regarding the counterbalancing of the Cole four-cylinder balanced compound No. 3.000 built for the New York Central by the American Locomotive Company. He says the claim is made in print that "the four cylinders are so arranged in relation to each other that the horizontal moving or reciprocating parts balance each other without the use of the customary counterweights for these parts in the driving wheels." After describing the way in which the engine is coupled up he says: "The customary counterweights are

ance the side rods and a part of the mass of the cranks in the cranked axle." He then proceeds to show that such an engine would be anything but a balanced engine.

The writer has met master mechanics who did not understand the rudiments of dynamics, but it seems almost incredible that the designer of this engine could be ignorant or unmindful of the vertical forces acting on the main pins, cranks and cross heads due to the motion of the main rods. In the common types of engines we can balance in one direction, either horizontally or vertically, but not in both directions. In practice we have, therefore, a compromise in which we have over-balance in one direction and under-balance in the other.

The magnitude of the hammer blow of modern heavy engines when running at high speeds due to this defective balance and its destructive action on track and bridges is what has led to the building of a limited number of so-called balanced engines. The object sought in designing the balanced engine has been to practically balance all of the moving parts in both directions in order to reduce the hammer blow and to increase the driving axle loads without increasing the destructive action of the locomotive on track and bridges.

Is it not possible that Mr. Moore has been misinformed regarding the counterbalancing of the Cole engine? There is no difficulty in counterbalancing such an engine just as closely as an engine in which all of the cranks are connected on one axle. The vertical forces generated in the main rods are transmitted to the main pins or crank and to the cross heads in the proportion of about 7 to 1, depending on the design of the rods. What goes to the pins and cranks can be balanced by weights in the wheel centers. The horizontal forces of the counterweights being in opposite directions will balance each other. Owing to the transverse horizontal distance between the wheel centers and the inside rods, it might be well to divide the counterweights between the two wheels in the inverse ratio of their distances from the rods attached to them. The forces going to the cross heads are practically equal and opposite in direction, but, owing to the hori-zontal distance between their points of application, they produce an alternating couple which tends to rock the whole body of the engine. Since, however, we neglect the much larger similar couple caused by the working thrust on the main rods it is hardly necesary to consider them. Without a diagram of the engine to con-

sult, it would appear that the largest unbalanced forces in the Cole engine are due to the perpendicular distance between the centers of the piston rods on each side. the writer remembers correctly, the inside cylinders are higher than the outside cylinders; therefore, we will have two alternating couples acting on the oblique planes passing through the centers of the piston rods. These would, of course, tend to give the engine the same "duck motion" which is found in under-balanced engines of the common The magnitude of these couples is type. easily computed, but, no doubt, it is but a small fraction of the somewhat similar couples set up in most simple engines.

ELLIOT HOLBROOK

# Rail-Carrying Joints.

Paris, Nov. 25, 1904. TO THE EDITOR OF THE RAILBOAD GAZETTE: In connection with my previous communi-cations published in your issue of November 13, 1903, and January 29 of this year, I beg to call attention to Mr. Haarmann's latest publication containing his lecture before the