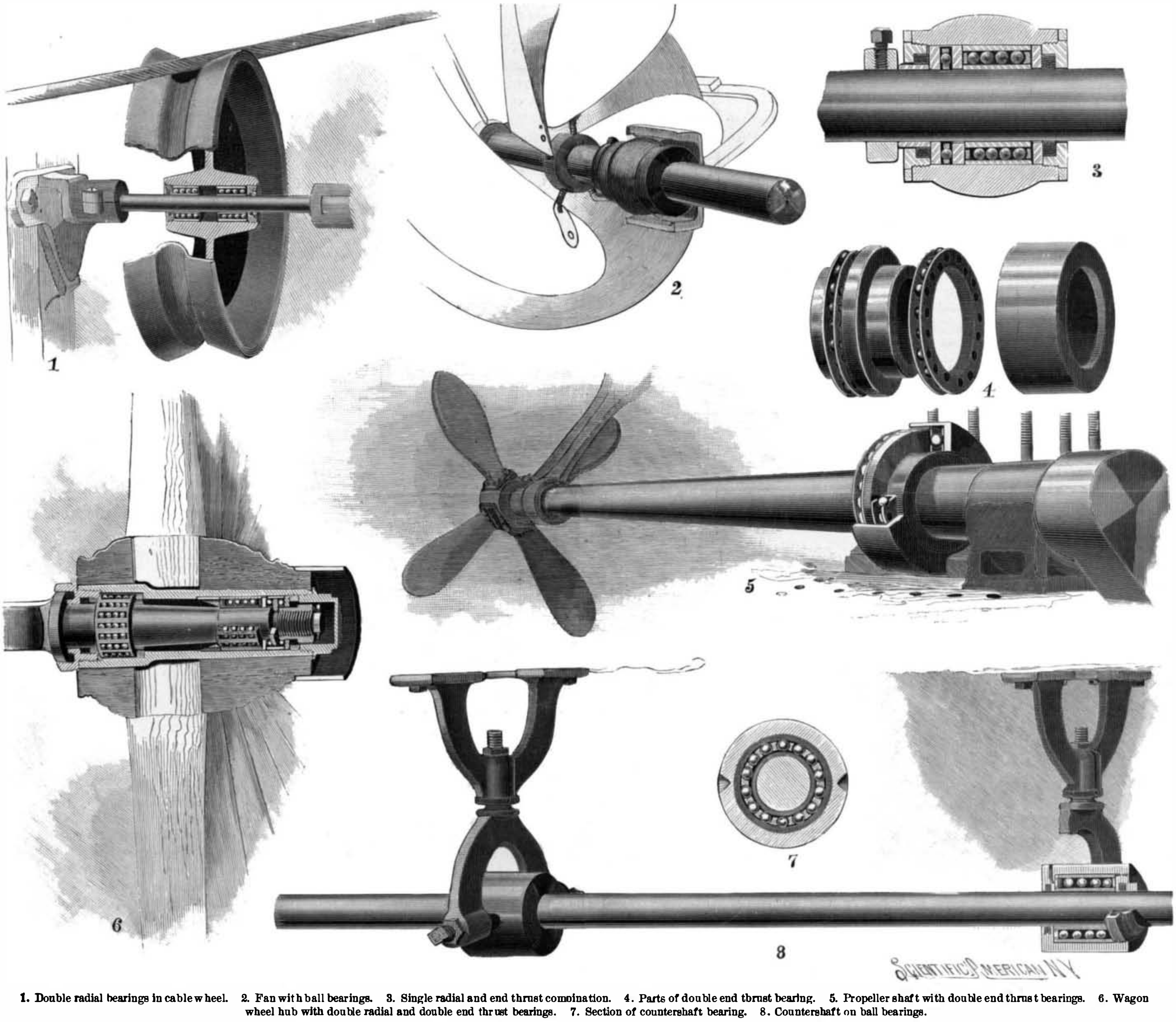
ANTI-FRICTION BALL BEARINGS.

As long as vehicles were propelled by horses or driven by steam, man was content to use the old fashioned surface bearings lubricated by oil in order to make them run more easily. As soon as he began to propel himself on the bicycle, he discovered that ball bearings added greatly to the service by reduction of resistance and by avoidance of lubricants, the latter involving also the disadvantages of want of cleanliness and collection of grit and dust. Bicycles then came to be constructed everywhere with ball bearings. The cheapest machines even are no longer made without them.

Professor Boys, of London, discovered another peculiarity about a ball bearing—that if it is properly constructed it is practically proof against wear. He weighed the balls in a bicycle bearing, rode the machine a long distance and then weighed them afterward, and found that there was no loss of weight. It is only now that the mechanical world is beginning to awaken to the importance of ball bearings.



1. Double radial bearings in cable wheel. 2. Fan with ball bearings. 3. Single radial and end thrust combination. 4. Parts of double end thrust bearing. 5. Propeller shaft with double end thrust bearings. 6. Wagon wheel hub with double radial and double end thrust bearings. 7. Section of countershaft bearing. 8. Countershaft on ball bearings.

ANTI-FRICTION BALL BEARINGS.

We illustrate to-day a number of applications of ball bearings to wagon and machinery work. The devices that we represent are those manufactured by the Ball Bearing Company, of Watson St., Boston, Mass., and they exhibit in their construction at once simplicity, efficiency and applicability to the most varied types of constructions. Referring to them by number as shown in the illustration, Fig. 1 shows what is termed "the double radial bearing," and for further elucidation of the construction of the radial bearing in general, Fig. 6 can be referred to. Its parts are as follows: Upon the shaft is thrust a hardened steel sleeve, which fits it tightly; over this goes a cage which may be seen quite clearly in Fig. 6 on the left hand of the axle. It is a brass cage open radially, which goes over the sleeve and which contains the balls, the brass not touching the sleeve. Outside the cage and resting upon the exterior surfaces of the balls is a second sleeve termed the "facing." The cage with its balls and facing are fastened in the hub of the wheel by washers. When it is thus constructed the cage touches nothing except the balls, simply holding them in place, the outer sleeve and the inner sleeve resting upon the outside and inside of the balls respectively. A wheel so mounted turns with almost no friction and the bearings will wear indefinitely. The balls, moreover, in the cage have lateral traverse allowed them so that they will work back and forth longitudinally, thus avoiding the wearing of the shaft in grooves.

Fig. 1 shows the ball bearings applied to a carrier wheel for a cable. It is evident that such bearings for the wheels would add greatly to the efficiency of a cable road.

Fig. 2 illustrates a fan rotated on ball bearings.

In Fig. 3 we have a new element introduced—the end thrust bearing. The bearing, with four balls close together, is the section of the regular radial bearing just described. To its left is seen a second circle of balls that are contained between two brass plates, which form for them a cage, and the balls bear to right and left on hardened steel washer plates. This gives an end thrust, and as the surface rotates, the balls turn around upon the surface of these plates, the brass simply serving to keep them in position. The whole construction is shown in Fig. 4, and upon observing them more closely it will be noticed that the end thrust balls are staggered, so that consecutive balls shall not follow the same path, the avoidance of the formation of grooves being again obtained.

Fig. 5 shows a double end thrust bearing arranged for push or pull, it being readily understood that the bearing shown in Figs. 3 and 4 is only adapted for thrust in one direction, while Fig. 5 shows one adapted for both stresses, and designed especially for use on propeller shafts. By employing such a bearing the friction, of course, may be reduced to almost nothing, but above all the troublesome heating of the thrust blocks is completely done away with.

Fig. 6, to which we have already alluded, illustrates a complete hub bearing for a carriage. Here we have to the right and left the radial bearings designed to give an extended axis of support to the wheel, but as the wheel is subject also to shocks in the end direction a double end thrust bearing is placed toward the outside extremity of the hub, so that when running upon an incline or upon a level, the wheel may be said to be nearly frictionless and perfect in its action.

Figs. 7 and 8 illustrate the application of ball bearings to shaft boxes and show how admirably adapted it is to this somewhat critical construction. Here we find the two boxes suspended between centers, each of these carrying its four circles of balls in the cage and presenting a really typical shaft box, and one requiring the minimum of oiling, at best a disagreeable operation and one that has frequently been the source of accidents to oilers.

Difference of Temperature Between Water and Its Inhabitants.

This has already been investigated by many experimenters with ordinary thermometers, says Gaea (Leipsic), but the results were as different as possible. Some held that the creatures in water were warmer than the water itself; others found that the water was warmer than its inhabitants, and still others maintained that both were of the same temperature. Herr P. Regnard has now made new measurements by thermo-electric methods. He thrust into a fish that was swimming in an aquarium a needle consisting of a thermo-electric element, one of whose junctions remained outside in the water. The whole was so arranged that the thermo-element could be carried about by the fish without breaking connections. The fish, at first somewhat restless, soon became still, and swam about quietly as before; then the circuit, which contained a galvanometer, was suddenly closed, and thus it was shown (by the absence of deflection in the galvanometer) that the temperature in the fish was almost exactly that of the water. (For if there had been a difference, the junction in the fish and the one in the water would have been unequally heated, and a thermo-electric current would have been generated.)

The Rail Joint Problem on Trunk Railroads.

The great increase which has taken place in late years in the weight and strength of steel rails on trunk lines has made the problem of providing a strong joint a much simpler matter than it was in the days of the old fifty pound iron rails. But though the difficulties have been lessened, they have not been removed; and an analysis of the labor expended by a section gang upon a stretch of first-class track laid with one hundred pound steel rails would show that even here a large proportion of it was devoted to "keeping up the joints."

Despite the existence of various well known and very excellent rail joints, many of which claim to make the joint stiffer than the rail itself, and can point to certified laboratory tests in proof of the claim, it is true to-day, as it was a generation ago, that the weak places in the track are invariably to be found at the joints.

It is not so difficult to provide a successful joint on street railways, because the deep girder rails which are now being used provide sufficient depth for the use of an exceedingly stiff joint; moreover, the electrically welded joint, where the weld is a sound one, gives promise of good results. The trunk railroad, however, is denied both of these advantages. Considerations of stability limit the depth of the rail, and it is not likely that the welded joint could successfully withstand the pounding of heavy express and mineral traffic during the "cold snaps" of a winter season.

The best form of rail joint for trunk lines has yet to be invented. The perfect joint will be designed on a clear understanding of two facts: First, that the rail joint has to act as a bridge across the gap at the rail ends, and must be capable of carrying the whole load of a passing wheel; second, that the ties which form the piers or abutments upon which the ends of this bridge rest are elastic and become depressed under the passing load of the train.

The weakness of the common form of splice or angle bar results from the fact that its depth is limited by the distance from the head of the rail to the rail base, and that its length has usually been made only sufficient to cover the two joint ties. These dimensions prohibit the use of a splice, or bridge, of sufficient strength to withstand the heavy pounding and wrenching to which it is subject by the heavy loads of modern traffic. The new Pennsylvania and Reading Railroad express engine has a concentrated load of twenty-five tons on a single pair of drivers; and it is evident that, to carry this load from rail to rail at the joint without any greater deflection than occurs in the body of the rail itself, requires a greater depth than the three or four inches which are obtainable in an ordinary angle bar splice. Moreover, if the joint ties were absolutely rigid, the bending moments set up in the joint by the passing load would be determined by the length of the joint itself. But as these joints are depressed under the load, it follows that a portion of the weight is thrown upon the ties adjoining those at the joint, and that the bending moments are those due to a leverage measured from these, and not from the joint ties.

This explains the discrepancy between the results of laboratory tests of a joint, in which the distance between supports is made the same as that ordinarily between joint ties, and the results in actual practice, where the distance between supports, and the bending leverage, is liable to be much greater.

The necessity for providing a greater depth of girder than could be obtained between base and head of rail led to the adoption of the subrail type of joint, of which there are some excellent types now in use. All of these, however, suffer from the common defect that, though they have sufficient depth for their length, this length is limited to the distance between the joint ties. The good results obtained with the long three-tie angle bar, such as is used on the New York Central Railroad, is largely due to its great length of thirty-six inches; and if the tie immediately under the joint were removed, and the flanges of the angle bars carried below the rail in two deep vertical webs, forming a base plate and girder beneath the two rail ends, it is probable that a great increase in rigidity and strength would be secured. To compensate for the loss of bearing due to the removal of the center tie, those at the joint could be made twelve inches instead of the customary eight inches in width.

We should thus have a heavy subrail girder joint three feet long with six or seven inches of effective depth resting upon ties six or eight inches deep by twelve inches wide. Such a joint would be costly, but it would be none too strong to resist the wear and tear of the heavy engines and cars of express traffic. It is probable that it would ultimately pay for itself in the reduction of expenses of maintenance. Of course, the roadmasters would object to the introduction of two sizes of ties and the sinking of an eight inch tie two inches deeper into the ballast than the average tie; but when a section gang had become accustomed to the new sizes, they would be found to give but little inconvenience.

Nothing has prevented the development of a good rail joint as much as the desire to keep down its size and cost, and never was economy more falsely placed. If any inventor can provide our trunk railroads with a joint which in practice shall prove to be as rigid as the body of the rail itself, and that shall absolutely preserve both level and alignment, its first cost will prove to be a minor consideration.

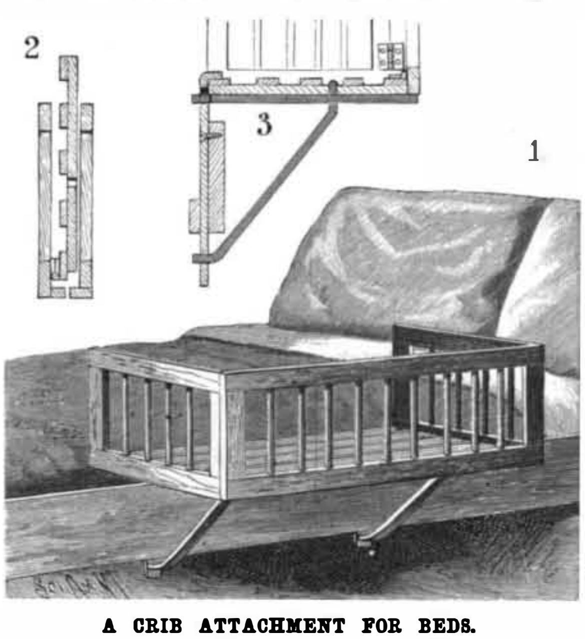
The introduction of sixty foot rails will favor the use of heavier and more costly joints, for it reduces the number of joints to the mile by just one-half. A company could spend just twice as much per joint and yet be at no greater total expense than before.

One by one the later designs have incorporated the essential features to a good joint, such as the side flanges to the angle bar, the base plate under the rail ends, and the subrail girder with its vertical strength. It now remains for some one to include all these features in a deeper and longer joint, which shall reach well back into the two rails and bridge the opening with a large margin of strength to spare.

The rail ends should be mitered, as this would materially help to smooth the passage of the wheel over the joint. Moreover a considerably heavier track bolt than those now in use could be used to good advantage.

A CRIB ATTACHMENT FOR BEDS.

The accompanying illustration shows an invention which has been patented by William H. Doughty, of 936 De Kalb Avenue, Brooklyn, N. Y. It consists of a detachable crib, which may be fastened to the bed rail, and will serve to support a child alongside the bed. The crib is supported against the bed by means of two vertical cleats attached to the inside of the bed rail, and two inclined braces, which have a secure footing in the lower ends of the said cleats. The upper ends of the braces are provided with studs which engage the outer ends of a pair of horizontal plates which carry the



A CRIB ATTACHMENT FOR BEDS.

crib, the inner ends of these plates being locked firmly into the upper ends of the vertical cleats above mentioned. By this arrangement a pair of stout detachable brackets is provided upon which the crib can be placed. It is further held in place by the upper ends of the vertical cleats, which are bent over into the form of a hook for this purpose. To provide a good bearing by which it may rest upon the top plates of the brackets, the bottom of the crib is provided with a pair of transverse cleats, as shown in Figs. 2 and 3.

The outer side rail of the crib is hinged to the outer edge of the bottom, and the end rails are respectively hinged to the ends of the side rail, as shown in the sectional view, Fig. 3. By this arrangement the crib may be folded up as shown in Fig. 2, and the brackets being easily disconnected, the whole device may be quickly detached and laid away when not in use.

To assist in holding the side and end rails in position relative to the bottom when the crib is set up, they are provided at their lower edges with inwardly extending cleats. The bottom is also held down in place by means of blocks arranged at the inner sides of each end rail and latches which are attached to the adjacent ends of the bottom of the crib and lock it firmly in place.

Patent—Name—Designation.

The Supreme Court of the United States held, in the recent case of The Singer Manufacturing Company vs. The June Manufacturing Company et al., that where under the life of a patent a name became the generic designation of the thing made, at the end of the life of the patent, the name, with the article patented, became the property of the public, and its use could not be restrained by injunction. The court further held, however, that the right did not exist to use the name indiscriminately or without qualification, so that the public would be deceived by its use into the belief that the thing manufactured was different from what it really was, or that it was made by a person or corporation other than the real maker.—Bradstreet's.

Notice to Our Readers.

In order to obtain the opinion of the readers of the SCIENTIFIC AMERICAN as to what invention *introduced within the last fifty years* has conferred the greatest benefit upon mankind, we publish the accompanying card, which please cut out and return to the editor. Those who preserve the paper for binding and do not desire to deface their files, or who read this notice at a library, will please answer by postal card. It is desired to get as full a vote as possible. The result of the vote will be published in the *Special 50th Anniversary Number of the* SCIENTIFIC AMERICAN *on July* 25.

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Heavy Rainfalls.

The heaviest rainfalls at Augusta, Me., since 1850, from records kept, are interesting in this season of freshets. The following are those exceeding three inches at one fall:

	Inches.
August 25, 1850	3·40
June 24, 1851	3·15
July 9, 1851	3·47
October 30, 1851	3·80
November 21, 1851	4·95
August 26, 1852	3·43
November 27, 1852	3·20
December 20, 1852	3·25
May 26, 1853	4·35
October 27, 1853	4·25
September 23, 1859	3·50
August 26, 1863	3·88
November 17, 1863	6·84
March 7, 1864	3·55
August 1, 1867	3·55
October 14, 1869	3·60
May 7, 1871	3·65
October 12, 1871	6·25
November 16, 1877	4·30
April 28, 1878	3·12
December 11, 1878	4·05
August 19, 1879	6·69
September 16, 1880	3·20
March 12, 1881	3·05
September 24, 1882	3·32
July 24, 1887	6·34
March 6, 1889	3·10
May 7, 1890	3·17
March 13, 1891	3·40
December 30, 1891	3·18
October 23, 1893	3·30
March 2, 1896	6·00

The following are the rains exceeding five inches at one fall:

	Inches.
November 17, 1863	6·84
October 14, 1869	5·60
October 12, 1861	6·25
August 19, 1879	6·69
July 24, 1887	6·34
March 2, 1896	6·00

On February 20, 1870, 6·75 inches of rain fell, the highest water ever known on the Kennebec. The railroad bridge was swept away at that time. It will therefore be seen that that freshet was due to the melting of enormous banks of snow and breaking up of the ice, and not so much to the rainfall.

All rainfalls that have exceeded five inches, with the exception of the last one, occurred during the summer or fall.—Kennebec Journal.

Chemical Vacuum.

Prof. Elmer Gates, director of the new Laboratory of Experimental Psychology at Washington, claims to have recently produced the first absolute chemical vacuum known to science, and from which he has created rays which exhibit strange phenomena never mentioned as being accomplished by the Roentgen rays. The method of making the absolute vacuum was so simple and apparently effective that it is worthy of notice. He took a large, thick test tube made of the hardest potash glass, whose melting point was at an extraordinarily high temperature. Into this he poured, while in a liquid form, a much softer glass, whose melting point was at a comparatively low temperature. Allowing the liquid glass to cool gradually, it formed a solid mass with the tube. After attaching a suction piston to the mouth of the test tube, the whole glass was slowly heated for about thirty hours. At the end of that time the softer glass became liquid again, while the tube still remained solid. By forcing the piston outward the greater part of the molten glass was expelled. Enough was allowed to remain at the mouth of the tube to seal it by cooling in that position. Back of this stoppage there was left a space where there had never been the least quantity of gas, hence, a perfect vacuum.—New Ideas.