THE CENTURY BIRTHDAY OF THE "TRAVELLING ENGINE"

One Hundred Years Ago the Successful Test of George Stephenson's First Locomotive Took Place---America Foremost in Art of Building Iron Steeds

M. W. Baldwin.

ONE hundred years ago on July 25, 1814, the progenitor of the modern steam locomotive was born. In the comparatively of a single century engineering cunning has increased the speed of these steam tractors from four miles an hour to a regular service rate of more than seventy miles an hour, and there are plenty of record runs of a round hundred miles in sixty minutes.

To George Stephenson the world owes the start that has made this extraordinary advance a fact—a man of modest birth but endowed with engineering genius. True, others led Stephenson in essaying steam traction, but the honor of having first made the locomotive engine a success is commonly accorded him.

Because of his native bent, Stephenson at the age of 17 became an engineer, and was put in charge of the pumping engine for which his father served in the humbler capacity of fireman. At the age of 31, that is, in 1812, he was employed at the Killingworth High Pit in England, and his duties gave him general supervision of all the colleries operated by a combination of interests. Some time afterward he heard of the experiments in steam locomotion being made by such men as Hackett and Hedley at Wylam, neighboring collieries. Then he went to Leeds to witness a test of Blenkinsop's engine, which was designed to draw seventy tons at the rate of three miles an hour. The engine did its work, but Stephenson was not very much impressed by the performance, remarking, so it is said:

"I think I could make a better engine than that to go upon legs."

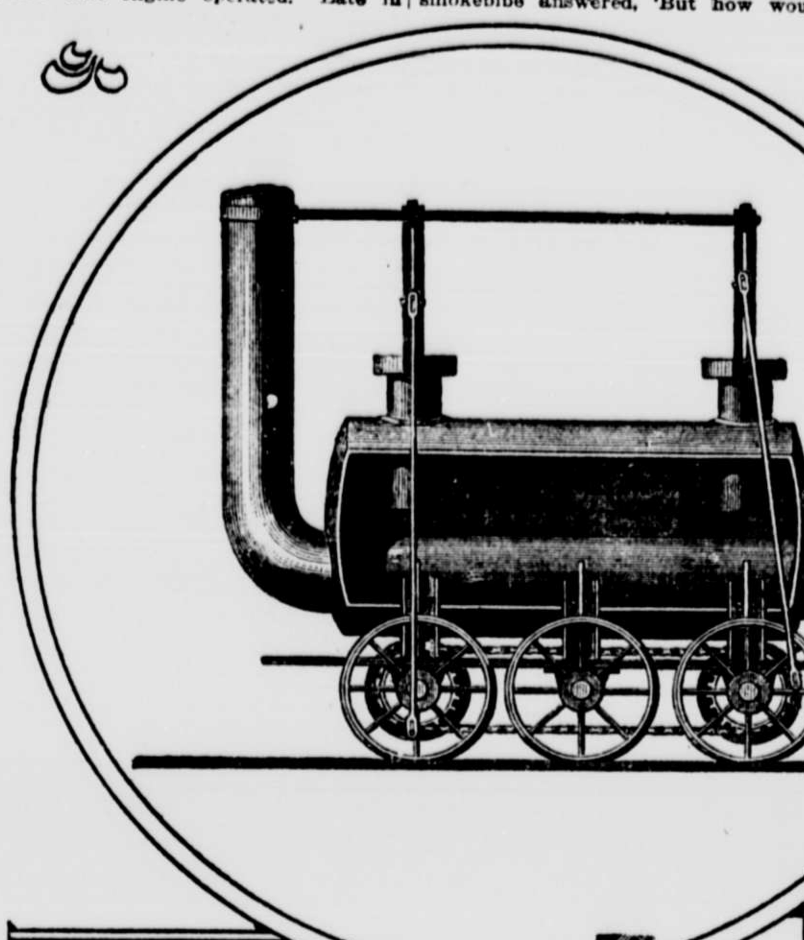
Stephenson made good his boast and managed to secure the financial aid of Lord Ravensworth for the building of a travelling engine. This locomotive was constructed at the West Moor workshops, and was completed and ready for testing on July 25, 1814. The engine was able to draw thirty tons on a rising gradient of ten feet to the mile, and attained a velocity of four miles an hour on this up hill run. But Stephenson's critical eye discovered many defects in his locomotive, and it was plain that he must do still better to achieve commercial success, because the cost of operation was just about as great as when horses were used for traction.

Accordingly, Stephenson decided to build another engine and to improve upon his original, the Blucher. The greatest difficulty he had to contend with in the Blucher was that of maintaining a sufficient supply of steam. This had likewise been the crucial problem with his predecessors, and history has it that Stephenson really hit upon a solution by chance.

As the story goes, the noise caused by the puffing locomotive's escaping steam—the exhaust being led directly into the open air—frightened draught animals along the way, and this aroused a storm of protest to the authorities. To remedy the evil he turned the cylinder exhaust into the smokestack, thereby greatly reducing the noise, but the change produced other more beneficial results.

Acting something like a siphon, the steam blast caused a partial vacuum between the smokestack and the firebed, and thus the furnace draft was greatly increased. It was possible to burn the fuel better and to double the quantity of steam raised. Naturally, the power of the locomotive was proportionally augmented, and thus a contrived nuisance became the medium of a more efficient apparatus. This feature he patented in 1815, and it is a necessary mode of functioning in every modern locomotive.

Three years after his first effort Stephenson built a locomotive for the Duke of Portland to haul coal from Kilmarnock to Troon. For thirty-one years that engine operated. Late in



Stephenson's locomotive of 1815.

1822 Stephenson was made engineer of the Hetton Railway, near Sunderland, a line eight miles long. Five of his iron horses were put in service; and, at a speed of four miles an hour, were able to draw a train of seventeen coal cars, or a total load of sixty-four tons.

In 1823 Stephenson was made the engineering authority for the Stockton and Darlington Railroad, the line being projected primarily to put the valuable coal lands of Durham in touch with tide water. Prof. Robert H. Thurston has given an interesting picture of that period in the history of steam railways in England. He says:

"A railroad between Manchester and Liverpool had been projected at about the time that the Stockton and Darlington road was commenced. The preliminary surveys had been made in the face of strong opposition, which did not always stop at legal action and verbal attack, but in some instances led to the display of force. The surveyors were sometimes driven from their work by a mob armed with sticks and stones, urged on by land proprietors and those interested in the lines of coaches on the highway.

"Before the opening of the Stockton and Darlington Railroad, the Liverpool and Manchester bill had been carried through Parliament, after a very determined effort on the part of coach proprietors and landholders to defeat it, and Stephenson urged the adoption of the locomotive to the exclusion of horses. It was his assertion, made at this time, that he could build a locomotive to run twenty miles an hour that provoked the celebrated rejoinder of a writer in the *Quarterly Review*, who was, however, in favor of the construction of the road and of the use of the locomotive upon it: 'What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling twice as fast as stage coaches? We would as soon expect the people of Woolwich to suffer themselves to be fired off upon one of Congreve's ricochet rockets as trust themselves to the mercy of such a machine going at such a rate.'

"It was during his examination before a committee of the House of Commons, during this contest, that Stephenson, when asked, 'Suppose, now, one of your engines to be going at the rate of nine or ten miles an hour and that a cow were to stray upon the line and get in the way of the engine; would not that be a very awkward circumstance?' replied, 'Yes, very awkward—for the coo!' And when asked if men and animals would not be frightened by the red hot smokepipe answered, 'But how would they know that it was not painted?'

The line was finally built, with George Rennie as consulting and Stephenson as principal constructing engineer."

The way for the partisan of the steam locomotive back in the '20s of the last century was somewhat akin to that of the traditional transgressor—extremely hard. The directors of railroad enterprises were wedded to the horse for traction purposes, and visible evidences of the powers of the steam engine made little impression upon conservative men. Such was the case when the Newcastle and Carlisle Railroad was about to be built in 1828.

However, Stephenson gained a concession—he was allowed to put on the line a single locomotive to be used in hauling gravel trains during the period of construction. Some months later, by reason of earnest pleading and persistent opposition to the adoption of the horse, the authorities of that railroad finally decided "to give the travelling engine a chance." A reward of £500 was offered for the best locomotive engine, and the following requirements were specified:

1. The engine must consume its own smoke.

2. The engine, if of six tons weight, must be able to draw after it, day by day, twenty tons weight (including the tender and water tank) at ten miles an hour, with a pressure of steam on the boiler not exceeding fifty pounds to the square inch.

3. The boiler must have two safety valves, neither of which must be fastened down, and one of them completely out of the control of the engineman.

4. The engine and boiler must be supported on springs, and rest on six wheels, the height of the whole not exceeding fifteen feet to the top of the chimney.

5. The engine, with water, must not weigh more than six tons; but an engine of less weight would be preferred, on its drawing a proportionate load behind it; if only four and one-half tons, then it might be put only on four wheels. The company to be at liberty to test the boiler, &c., by a pressure of 150 pounds to the square inch.

6. A mercurial gauge must be affixed to the machine, showing the steam pressure above forty-five pounds to the square inch.

7. The engine must be delivered, complete and ready for trial, at the Liverpool end of the railway, not later than October 1, 1829.

8. The price of the engine must not exceed £550.

Only four locomotives were submitted for the test, and out of these but two survived in the end, and between these victory went to the Rocket of Stephenson's design. This locomotive ultimately ran at the rate of from twenty-five to thirty miles an hour, drawing a single carriage containing thirty passengers. On October 8, 1829, the Rocket got up steam, starting with cold water, in something less than an hour, and then, with thirteen tons of freight in the train, ran thirty-five miles, including stops, in one hour and forty-eight minutes. This was an impressive advance upon Stephenson's first essay of fifteen years before, and it was the performance of the Rocket that led to the introduction of steam railroading in the United States.

The reports made upon the British locomotives reached this country in 1829, and Horatio Allen, afterward president of the Novelty Works in this city, and the first American to run a locomotive in this country, was asked to advise the South Carolina Railway Company as to the wisdom of substituting steam power for horse traction. Mr. Allen had been in England, and had witnessed the trials of the Rocket, and he declared that the engine was gaining favor over the horse, "on the broad ground that in the future there was no reason to expect any material improvement in the breed of horses, while, in my judgment, the man was not living who knew what the breed of locomotives was to place at command."

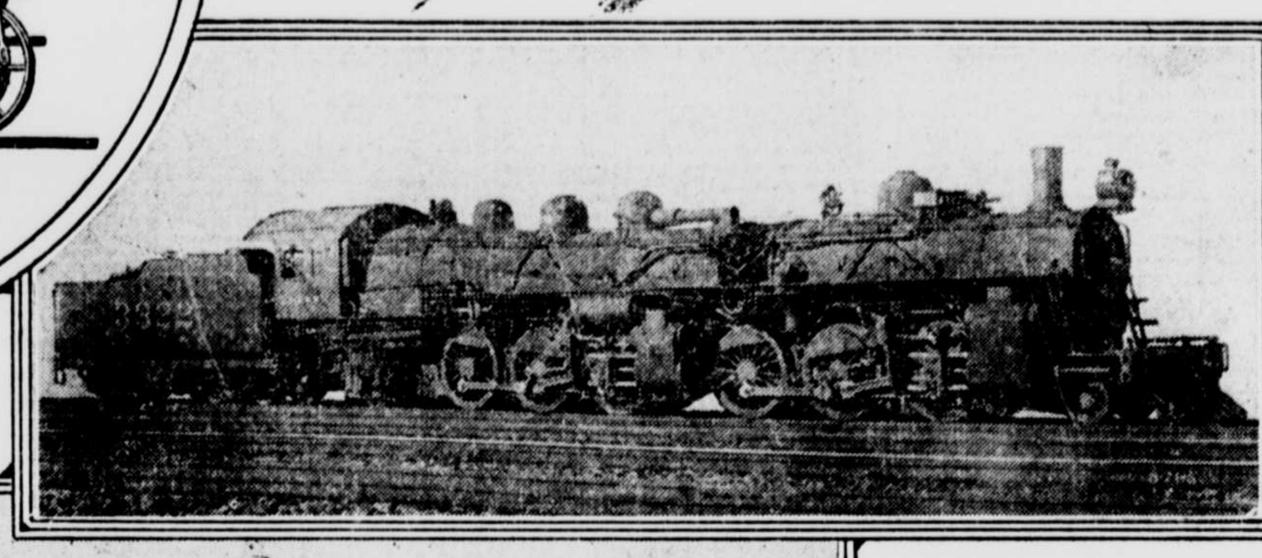
As every good New Yorker knows, Peter Cooper experimented with a little locomotive as early as 1829-30 on the Baltimore and Ohio Railroad. At a meeting of the Master Mechanics Association here in 1875 Mr. Cooper is said to have related with great glee how, upon one of those trial runs, he actually beat a gray horse attached to another car.

In 1831 that pioneer line in the transportation of freight and passengers on a comprehensive scale offered a prize of $4,000 for "the most approved engine to be delivered for trial on or before June 1, 1831, and $3,500 for the engine next best." The locomotive was not to exceed three and a half tons in weight, and on a level road was required to be able to draw day by day fifteen tons, inclusive of the weight of wagons, at a speed of fifteen miles an hour.

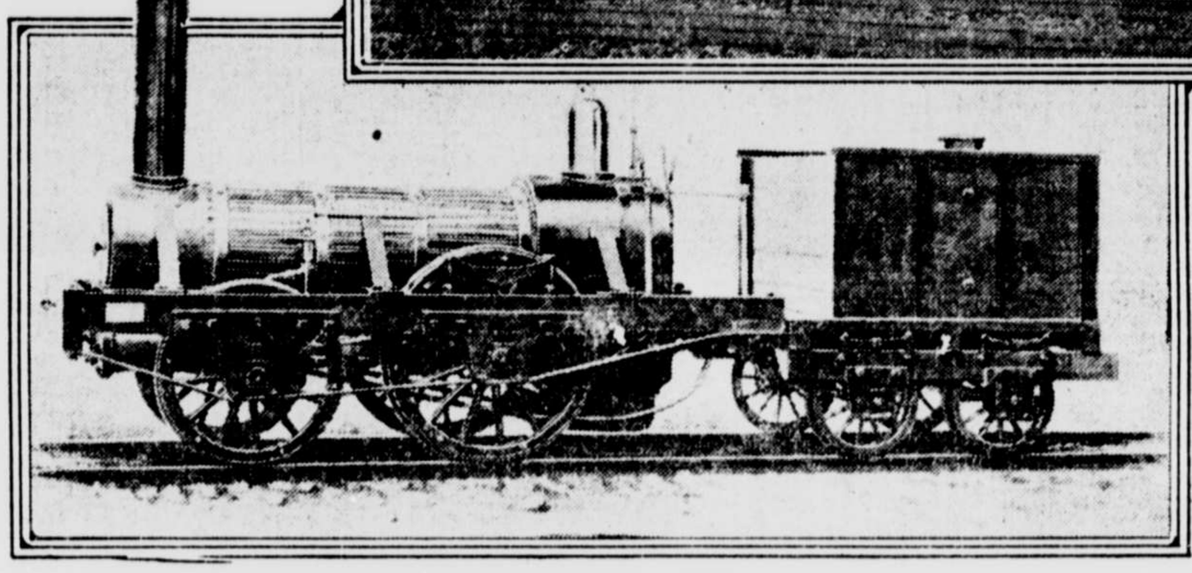
That offer resulted in the production of three locomotives, only one of which was capable of useful service. That engine, named York, was built in York, Pa., and was constructed by Davis & Gartner, after the design of Phineas Davis of that firm.

Davis was by trade and business a watch and clock maker. Nevertheless, he builded well, and the York was the progenitor of the grasshopper type of locomotive used for a good many years afterward on the Baltimore and Ohio Railroad with much satisfaction. Three of these engines built by Davis & Gartner were in active service on that road for more than fifty years, an extraordinary record.

The biggest locomotive works in the



A wonderful example of modern engineering skill.



Old Ironsides, built in Philadelphia 1831. Above—George Stephenson.

United States, if not in the world, is that of the famous house of Baldwin in Philadelphia, and the history of the founder of that great establishment, Matthias W. Baldwin, shows how necessity turned a silversmith into a manufacturer of locomotives. Trained in the jeweller's craft, in 1819 Mr. Baldwin started out on his own account with a small shop to pursue his craft. The trade slackened in the course of the following six years, and he then entered into partnership with David Mason, a machinist, and started the manufacture of bookbinders' tools and cylinders for calico printing.

That business became so brisk that steam power was needed, and so an engine was bought. This was unsatisfactory, and Mr. Baldwin set about designing and constructing an engine to meet the requirements of his shop. The room available made it necessary that the engine should occupy a minimum of floor space, and out of this necessity was evolved an upright engine of a novel and ingenious type.

Being the product of a jeweller by training, its workmanship was of especial excellence, and its performance a credit to its maker. This brought to Mr. Baldwin outside orders for stationary engines, and, with the growth of this business, Mr. Mason soon afterward withdrew from the partnership. An account of the Baldwin concern tells how the manufacture of locomotives began:

"In 1829-30 the use of steam as a motive power on railroads had begun to engage the attention of American engineers. A few locomotives had been imported from England, and one had been constructed at the West Point Foundry in New York city. To gratify the public interest in the new motor, Franklin Peale, then proprietor of the Philadelphia Museum, applied to Mr. Baldwin to construct a miniature locomotive for exhibition in his establishment.

"With the aid only of the imperfect published descriptions and sketches of the locomotives which had taken part in the Rainhill competition in England, Mr. Baldwin undertook the work, and on April 25, 1831, the miniature locomotive was put in motion on a circular track made of pine boards covered with hoop iron, in the rooms of the museum. Two small cars containing seats for four passengers were attached to it, and the novel spectacle attracted crowds of admiring spectators. Both anthracite and pine knot coal were used as fuel and the exhaust steam was discharged into the chimney, thus utilizing it to increase the draught.

"The success of the model was such that in the same year Mr. Baldwin received an order for a locomotive from the Philadelphia, Germantown and Norristown Railroad Company, whose short line of six miles to Germantown was operated by horse power. The Camden and Amboy Railroad Company had shortly before imported a locomotive from England, which was stored in a shed at Bordentown. It had not yet been put together; but Mr. Baldwin, in company with his friend Mr. Peale, visited the spot, inspected the detached parts, and made a few memoranda of some of its principal dimensions.

"Guided by these figures and his experience with the Peale model, Mr. Baldwin commenced the task. The difficulties to be overcome in filling the order can hardly be appreciated at this day. There were few mechanics competent to do any part of the work on a locomotive. Suitable tools were with difficulty obtainable. Cylinders were bored by a chisel fixed in a block of wood and turned by hand. Blacksmiths able to weld a bar of iron exceeding one and one-quarter inches in thickness were few, or not to be had. It was necessary for Mr. Baldwin to do much of the work with his own hands, to educate workmen who assisted him and to improvise tools for the various processes.

"The work was prosecuted, nevertheless, under all these difficulties, and the locomotive was fully completed, christened Old Ironsides and tried on the road November 23, 1832. The price of the engine was to have been $4,000, but some difficulty was found in procuring a settlement. * * * Mr. Baldwin finally received $3,500 for the machine."

A contemporaneous account thus describes the trial run of Old Ironsides:

"After the regular passenger cars had arrived from Germantown in the afternoon, the tracks being clear, preparations were made for her starting. The placing fire in the furnace and raising steam occupied twenty minutes. The engine, with her tender, moved from the depot in beautiful style, working with great ease and uniformity.

"She proceeded about half a mile beyond the Union Tavern, at the township line, and returned immediately, a distance of six miles, at a speed of about twenty-eight miles to the hour, her speed having been slackened at all the road crossings, and it being after dark but a portion of her power was used. It is needless to say that the spectators were delighted.

"From this experiment there is every reason to believe this engine will draw thirty tons gross, at an average speed of forty miles an hour, on a level road. The principal superiority of the engine over any of the English ones known consists in the light weight, which is but between four and five tons, her small bulk and the simplicity of her working machinery." Subsequently, Old Ironsides attained a speed of thirty miles an hour when drawing its usual train.

The success of the engine led to the following advertisement in *Poulson's American Advertiser* of November 26, 1832:

Notice—The locomotive engine (built by M. W. Baldwin of this city) will depart daily, when the weather is fair, with a train of passenger cars, commencing on Monday, the 26th instant. * * * The cars drawn by horses will also depart as usual. * * * when the weather is not fair.

This advertisement meant that in addition to their limited service in fair whether the horses should maintain their own schedule and take over that of the steam locomotive when the weather was inclement. Such was the state of steam traction in this country eighty-two years ago!

Thanks to the appreciative spirit with which native genius greeted the introduction of the "travelling engine," America to-day is in the forefront of the art of locomotive building. It would take pages to recount even briefly the inventions and the developments that have made the wonderful steam horse what it is to-day, but everybody knows what it can do in transporting billions of dollars worth of commodities over the broad expanses of the country and in seemingly shortening the distances that separate American cities. George Stephenson had the gift of prophecy and the capacity to make real some of his predictions, but it is doubtful if in his most visionary moments he ever dreamed of the locomotive as it has been developed since his day.

RAILROADS TO SAVE MILLIONS OF DOLLARS THROUGH NEW PROFESSION

THE discovery of a new profession by William Jacobus opens the door of hope to the railroads—hope of raising some of the millions they need. Mr. Jacobus calls himself a scrap metallurgist. He is the first man who has ever described himself in this way or performed the duties implied by the title. In other words, he is the first and only man to raise the saving of old metals to the dignity of a profession.

As scrap metal expert in the employ of the Navy Department Jacobus proved his right to the title by saving the Government $2,000,000 a year, thus earning praise in the 1913 report of the Paymaster-General of the navy. Now he is corroborating the compliments of the Paymaster-General by producing equally gratifying results for the Interborough Rapid Transit Company of New York and the Chicago City Railways Company of Chicago, though on a smaller scale, of course. Also he is arranging to undertake similar services for some of the steam roads that will lead to the saving of greater sums than in any job did.

To appreciate the possibilities of the new profession it is necessary to remember that the railroads use more metal of various kinds than any other one industry. Their purchases of material aggregate many million dollars a year. Every article purchased wears out rapidly, for railroad service is very severe. If worn out rails, broken down locomotives and other things were worthless it a consumption of new material would be so enormous that prices would soar entirely out of reach.

Fortunately, though, metals can be used over and over again. Of every hundred tons of metal purchased by the railroads eighty-five tons ultimately find their way back to the foundries and machine shops to be converted into new articles that will go through another cycle of usefulness, to be returned in due time to the foundry, except for the small portion worn into impalpable powder or wasted.

Of course all this is understood in a general way by railroad officials. All railroads endeavor to save the scraps, some in a happy go lucky way, others more systematically. But no matter how it is done, not a railroad in America is now getting anywhere near the real value out of its waste material. Millions of dollars go to waste annually in the railroad scrap heap.

The explanation is that something more than a casual knowledge of the value of old metals is required. The man who would get full value out of waste must not only be a real metallurgist but he must be one who has specialized in the peculiarities of old metals. Of even greater importance is an intimate acquaintance with the tricks of the old metal trade, a knowledge which is not developed by railroad training.

The peculiar usefulness of Jacobus is due to twenty years experience as a dealer in old metals. Necessity drove him to become a metallurgist specially trained in the peculiarities of old metals. He also received a training in devious methods peculiar to this trade that was impressed upon his mind by a failure. He violated all the rules by being square. Naturally he could not compete with rivals who had fewer compunctions about the niceties of trade.

However, Jacobus evened the score by accepting a job as scrap metal expert in the Navy Department, which has immense quantities of old material to dispose of. The stuff had been sold to the highest bidders. The sales were a bonanza for those of the junk men who had an agreement not to bid against one another any more than was necessary to keep up appearances. They would pay what seemed a fair market price for the stuff, but would then claim rebates and allowances on one pretext and another that reduced the net cost to about one-tenth of the real value of the material.

Jacobus went through the material and selected what could be used over again by the Department, which in itself resulted in an immense saving. What was really scrap, unfit for other disposition, Jacobus sorted properly. Then when the auctioneer was ready Jacobus made a few remarks.

He announced that all metals would have to be sold in lots just as he had sorted them; that Government weights would have to be accepted, and that there would be no rebates nor allowances on any pretext whatever. When the first call for bids was made a man stationed in the crowd by Jacobus for that purpose made a bid which was just what the lot was worth, less an honest profit. A tremendous sensation followed. When the junk men came to they fell over each other in their haste to bid. There was real competition at this sale.

The railroads have fared worse at the hands of the junk men than the Government. Here is a sample: One of the trunk lines having its Eastern terminus on the Jersey shore of the Hudson sold to a junk dealer 100,000 pounds of old brass journals at 10 cents a pound, which was less than the real value, to begin with. The material was loaded into four cars and weighed at the shops. A sight draft for $10,000, with bill of lading attached, was forwarded to the junk man, who paid it. So far all was lovely.

When the material arrived at its destination a week later the education of the railroad began. Getting the proper officer on the telephone the junk man pointed out that the railroad now had his money. Of course he did not doubt the honesty of the railroad, but if there should be a shortage what redress would a poor junk man have? In the interest of fair play, therefore, he suggested that the company send a representative to watch the unloading and check up the weights, so that if there was any shortage there could be no question. So eminently fair a proposal could not be refused.

The clerk who was sent over to check up the weights found the junk man a most agreeable person. The junk man took the clerk out to lunch the first day and the next and the day after that. On each occasion they had a very nice meal, with something better than hydrant water to drink. On the third day the clerk was invited into the junk man's office, where he was shown a desk littered with $750 in bills of small denomination scattered to make the most impressive showing.

"Would you like to earn this money?" asked the junk man.

"Surest thing you know."

"How about that shortage of 17,000 pounds?"

"I'll fix that."

Whereupon Mr. Clerk went downstairs two jumps at a time and proceeded to certify a shortage of 17,000 pounds, which meant a rebate of $1,700 for the junk man. On returning to the office in the evening for the reward of his labor the clerk was handed a very small roll accompanied with these honeyed words:

"Sorry, old man, but I had to use most of that money this afternoon. But here is $130. I'll pay you the rest next week. Come out and have dinner with me this evening and after that we'll paint the town."

When the clerk awoke the next morning and felt for his money he had just $30. The junkman had picked his pocket of $100, leaving only the $30 as the gross return for swindling his employer out of $1,700.

The railroad officials thought the large shortage so extraordinary that an investigation was ordered, which revealed the whole story. The clerk made a full confession, and even the junk man's own weighmaster testified against his boss, with the result that the latter was indicted for conspiracy, for grand larceny and for obtaining money under false pretences. The case never came to trial, because the clerk, who was the principal witness, died. The junk man was finally forced to return the $1,700.

Practically everything that a railroad buys finds its way in time to the scrap heap. Hence there is an abundant field for the exercise of expert skill in handling this old material. Much of it can be reclaimed and made over into something useful.

One railroad retaps three thousand pounds of old nuts a month at a cost of 1 cent a pound, thus saving one cent or more a pound. Asbestos boiler lagging costs new $50 a ton. Old lagging can be ground up at a cost of $1.25 a ton canand made to serve just as well as new.

Steel brake beams used in freight service are prone to bend. If reheated for straightening they lose 25 per cent. of their strength and so are useless. The Illinois Central solves this problem by reenforcing bent brake beams with angle iron 2 by $2\frac{1}{2}$ inches. This costs 63 cents and saves $1.25 on one beam. As an average of 500 brake beams are thus reenforced a month this saves the company $625 a month.

One of the neatest savings devised by the Illinois Central is in paint skins and slops, which are usually thrown away. On this road they are saved and put in the paint shop, where they are mixed with raw oil and boiled, the oil taking up both the skins and the pigment and making paint at a cost of 40 cents a gallon that is considered better than any which could be bought at 90 cents a gallon. This saves the company an average of $177 a month.

Cars and locomotives that are no longer suitable for service on railroads in this country bring high prices from second hand dealers, who repair them and sell them to minor roads in this country or ship them to South America, where there is a considerable demand for such material. When too far gone to be used, the new cars and locomotives are sent on to the scrap yard to be broken up.

Old bolts and iron suitable for making bolts are sorted out, straightened, cut to lengths, threaded and turned in to the storekeeper. Coupler pockets are sheared from the coupler by a hydraulic press and reissued. Passenger brake shoes that are no longer fit for high speed trains are taken off and reissued for freight service. Nuts are sorted to size and retapped. Journal bearings are relined and sent back to service. Air hose is refitted, often with old couplings. If too far gone to be used whole the hose is spliced and used for work train equipment.

Many track spikes and bolts reach the scrap yard that are still good; so they are sorted out and reissued. Tie plates and angle bars and railbraces are sorted over. Plates are often repunched, while the braces are straightened, when they are as good as new. Old bridge channels and angles are made into angle iron face plates for cars. Frogs and switch parts are dismantled and the good parts are reassembled for use in manufacturing new frogs and switches at the rail shops. Scrap wood is burned for fuel.

After all has been reclaimed that is possible under present methods an immense quantity of waste material still remains that must be disposed of in some way. The problem of scrap metallurgist is to save as much as possible by working the reclaiming processes more scientifically, with less labor, for every unnecessary handling of old material means a sacrifice in wages spent that the greatest saving is expected to come from obtaining the real value of material sold and in the protection of the railroads from unprincipled dealers.