

The Life Story of Meccano

Romance of the World's Greatest Toy

By Frank Hornby

EVERY normal healthy boy has hobbies, and I often think that the earnestness and thoroughness with which he follows them is an index to the kind of man he will make when he grows up. A boy without a hobby always seems to me to lead an aimless and rather miserable existence; and whenever I come across such a boy I long to sit down beside him and talk to him, find out what his interests are, and start him off then and there on a suitable hobby. It always gives me the greatest pleasure to see a boy following his hobbies with keenness, trying to find out more about them, and to improve his knowledge and skill in every possible way. I know that this keenness will become part of the boy's nature, and that when he grows up he will tackle the serious things of life in the same splendid spirit.

In my boyhood days my primitive workshop was my hobby. I think that most boys take up their hobbies in the first place through some kind of accident; and I have always realised that the accident that first aroused my interest in mechanics was the reading of a book that I had given to me. This book contained the life stories of famous inventors, and described the difficulties that they encountered in working out their ideas before success ultimately crowned their efforts. I was very young at the time, and this was one of my first books. Nothing that I have read since has exercised such a strong and lasting influence on me. I read many of the chapters over and over again, and as I did so there grew up in me a great desire to succeed as these great men had done. Of all the stories in this book the one that fascinated me most was that of Palissy and his discovery of a white glaze for earthenware.

I used to read with unflagging enthusiasm of how Palissy struggled on in the face of failure after failure. I well remember how I used to picture him sitting by his furnace day and night, and how excited I used to be at the point where, when all his fuel was exhausted, he broke up chairs and tables and tore down shelves to feed his furnace!

It was one thing to decide to become an inventor, but quite another to know how to set about it. At that time perpetual motion was being very widely discussed, and I conceived the idea of trying to invent a machine that should solve the problem. I felt that if I could make such a machine I should have accomplished something very wonderful. I certainly should! I little knew when I set to work that I was attempting an impossible task, and it was fortunate that this was so, for I worked away in my little workshop with the utmost enthusiasm, and also began to study the principles of mechanics. In the end I failed, as thousands had done before me; but in the effort I had learned something of engineering, and had considerably improved my mechanical skill.

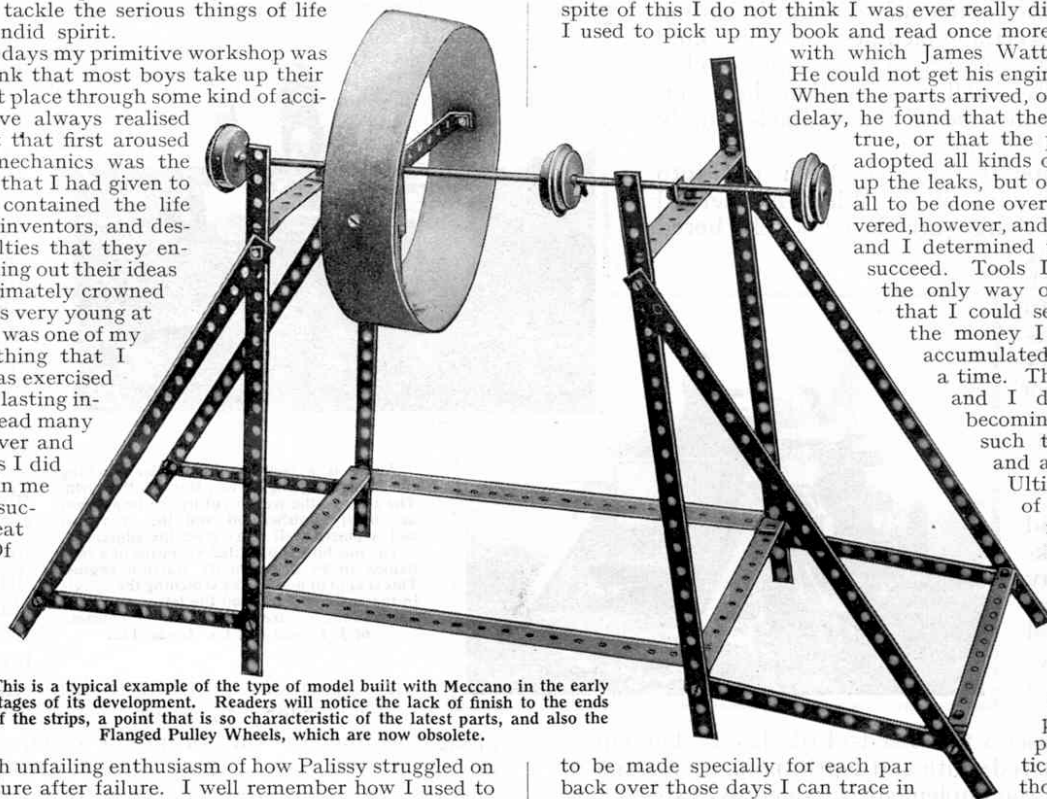
After my setback in regard to perpetual motion I turned my attention to simpler and more practical matters, and during the next few years I produced a number of small inventions. Most of them were of little or no practical use, but the perfecting of each one was a source of the utmost pleasure and excitement. I have forgotten now what most of these inventions were about, but I do remember one of them—a submarine, which on being

placed on the water and set going submerged itself and continued to propel itself for some distance under the water. There was just one little flaw in this invention—the vessel would not come to the surface again of its own accord! And so my submarine never brought me fame or fortune.

At this period my little workshop was my paradise where I spent my spare time in working out all kinds of ideas as they came to me. Although I was happy at my work I had many difficulties to face. I was badly handicapped by the lack of suitable tools, those I possessed being so few and so crude that, however much care I took over a job, the result was often disappointing. In spite of this I do not think I was ever really discouraged. Often I used to pick up my book and read once more of the difficulties

with which James Watt had to contend. He could not get his engines made properly. When the parts arrived, often after weeks of delay, he found that the cylinder was not true, or that the pipes leaked. He adopted all kinds of schemes to stop up the leaks, but often the work had all to be done over again. He persevered, however, and finally succeeded; and I determined that I also would succeed. Tools I must have, and the only way of obtaining them that I could see was to save all the money I could, and as it accumulated buy one thing at a time. This was slow work, and I despaired of ever becoming the owner of such things as a lathe and a drilling machine.

Ultimately I got most of the tools that I really needed, but the weary waiting turned my thoughts in the direction of interchangeable parts that could be used for a variety of purposes, instead of parts that had to ticular job. Looking those vague ideas



This is a typical example of the type of model built with Meccano in the early stages of its development. Readers will notice the lack of finish to the ends of the strips, a point that is so characteristic of the latest parts, and also the Flanged Pulley Wheels, which are now obsolete.

to be made specially for each part back over those days I can trace in the germ of the Meccano system.

After I was married and had boys of my own I still made models as eagerly and enthusiastically as ever; and when my boys were old enough it was my delight to make mechanical toys for them and join in their play. We were always working and playing together, always thinking out something new; and most of my spare moments were spent in planning out new ideas and games. By this time I had a fairly good equipment of tools, but I still felt that a great deal of time and labour was wasted in laboriously making parts that would only serve for one particular model, and were useless for the next model I devised.

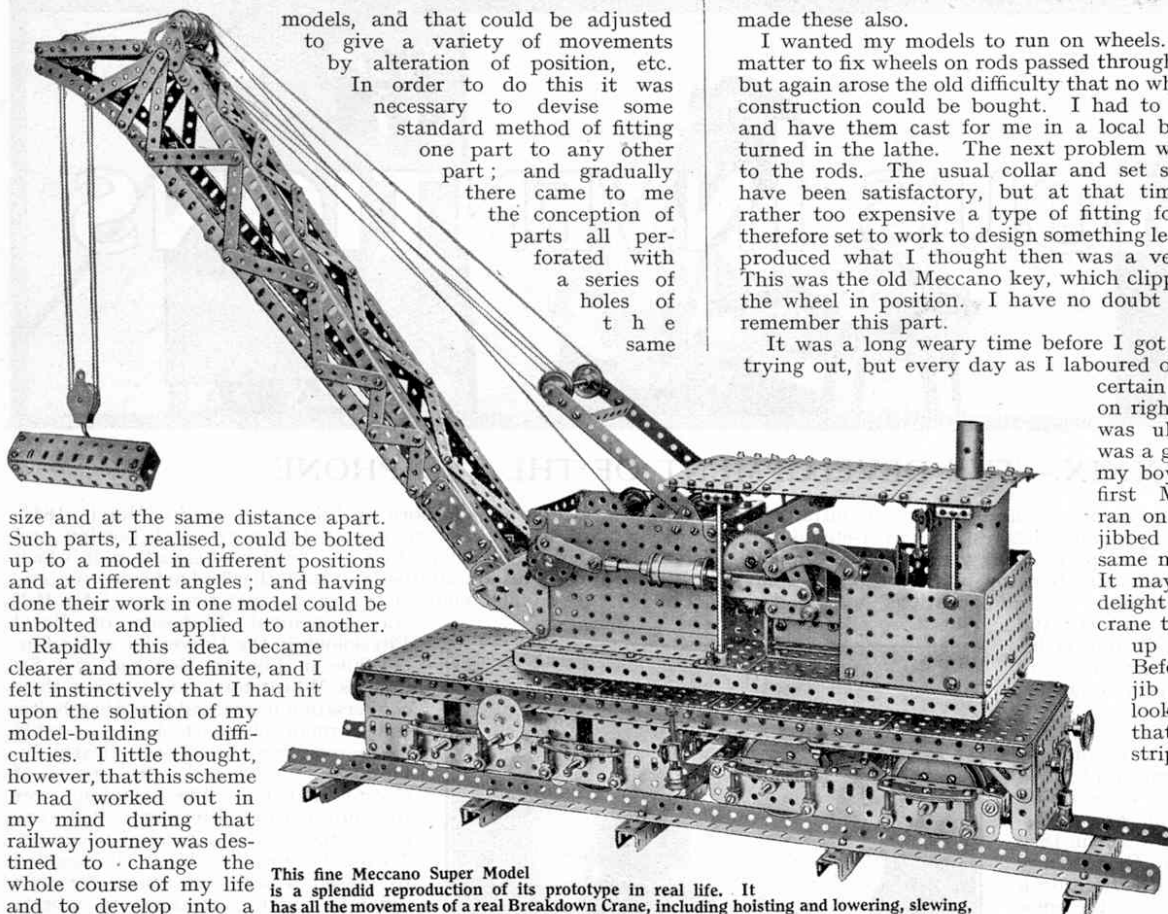
One snowy Christmas eve I was making a long railway journey, and as I sat in my corner seat my mind was as usual turning over new schemes for my boys' enjoyment. At that time we were experiencing trouble in our little workshop through lack of a number of small parts for building up a splendid model crane that we were making. I had tried in all directions to buy these parts, but apparently nothing of the kind existed. Clearly it would be a long and monotonous process to make them, and as I thought over the matter in the train I was more impressed than ever before with the waste of time and labour involved in making a part specially for a single purpose. I felt that what was required was parts that could be applied in different ways to many different

models, and that could be adjusted to give a variety of movements by alteration of position, etc. In order to do this it was necessary to devise some standard method of fitting one part to any other part; and gradually there came to me the conception of parts all perforated with a series of holes of the same

made these also.

I wanted my models to run on wheels. It was quite an easy matter to fix wheels on rods passed through the holes in the strips, but again arose the old difficulty that no wheels of suitable size and construction could be bought. I had to design my own wheels and have them cast for me in a local brass foundry and then turned in the lathe. The next problem was to fix the wheels on to the rods. The usual collar and set screw would, of course, have been satisfactory, but at that time this seemed to me rather too expensive a type of fitting for my requirements. I therefore set to work to design something less costly, and ultimately produced what I thought then was a very effective substitute. This was the old Meccano key, which clipped on the rod and held the wheel in position. I have no doubt that many readers will remember this part.

It was a long weary time before I got all my parts ready for trying out, but every day as I laboured on I felt more and more certain that I was proceeding on right lines and that success was ultimately assured. It was a great day for me and for my boys when I built up my first Meccano crane, which ran on wheels and luffed and jibbed splendidly, just in the same manner as a real crane! It may be imagined what a delight we took in taking the crane to pieces and building it up again several times. Before we attached the jib the base of the crane looked so much like a truck that we added a few more strips and made it into a real truck, and I shall never forget the fun we had playing with the model in this way. At this stage I carefully considered the system that I had developed, and it



This fine Meccano Super Model is a splendid reproduction of its prototype in real life. It has all the movements of a real Breakdown Crane, including hoisting and lowering, slewing, luffing and travelling, all of which are controlled by two levers.

size and at the same distance apart. Such parts, I realised, could be bolted up to a model in different positions and at different angles; and having done their work in one model could be unbolted and applied to another.

Rapidly this idea became clearer and more definite, and I felt instinctively that I had hit upon the solution of my model-building difficulties. I little thought, however, that this scheme I had worked out in my mind during that railway journey was destined to change the whole course of my life and to develop into a hobby that would bring untold hours of pleasure to boys of every nation and every age throughout the world.

As soon as I possibly could I set to work to translate my ideas into practice. I began with the simplest parts, and I used copper to make them, because it is a soft metal and was easy for me to work. I quickly realised that making parts more or less at random, simply because I thought they would be useful, would not do. Before any real progress could be made it was necessary to think out carefully a series of parts of the most useful types and sizes, keeping in mind the relation they would bear to one another when built into models. First of all I determined to deal with the simplest type of part, the strip. After careful thought I decided that I would make all my strips half-an-inch in width, with equal sized holes along the centre at half-inch intervals. I first made a 2½ in. strip, then a 5½ in., and so on up to a 12½ in. strip, which, I remember, seemed to me at the time quite an enormous part! It was a long job to make all the strips that I required, but I spurred myself on with the thought of how useful they were all going to be, and so I never got tired of the work.

The dimensions of the strips, the size of the holes, and the distance between them that I adopted at that time have never been changed during all the years in which Meccano has existed. I look upon it as very remarkable that I should have been fortunate enough, with so little experiment, to hit upon what have proved to be the best standard dimensions.

Nuts and bolts were my next trouble. I had expected to be able to buy these, but although I sought high and low I could not find any that were suitable for my purpose. Once again I had to fall back on my own resources and make every nut and bolt myself. This job seemed as though it would never end! Now cropped up the difficulty of fastening the strips together at right angles; and for this purpose I devised angle brackets, and I

seemed to me to be so good that I consulted a patent agent in regard to obtaining some protection for it. On the advice of this agent I at once took out patents.

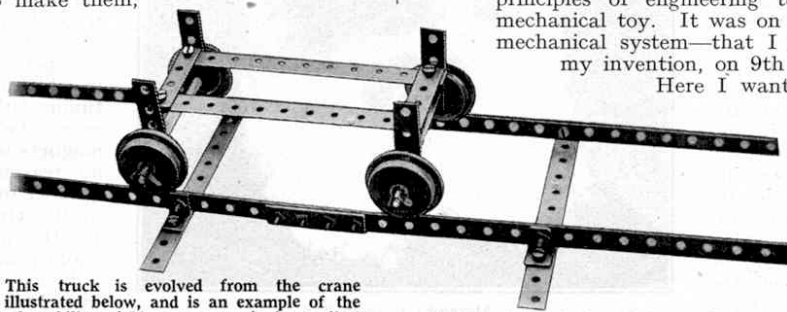
I claim that Meccano is the original application of the basic principles of engineering to a metal constructional or mechanical toy. It was on this basis—that is as a metal mechanical system—that I obtained the first patent for my invention, on 9th January, 1901.

Here I want to digress for a moment in order to say something about the many imitations of my invention. Probably no article or commodity of outstanding merit was ever produced that was not imitated by envious competitors. Meccano is no exception

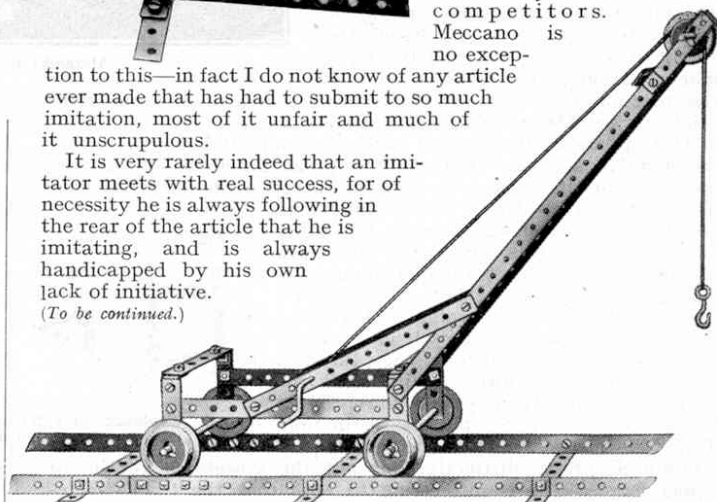
to this—in fact I do not know of any article ever made that has had to submit to so much imitation, most of it unfair and much of it unscrupulous.

It is very rarely indeed that an imitator meets with real success, for of necessity he is always following in the rear of the article that he is imitating, and is always handicapped by his own lack of initiative.

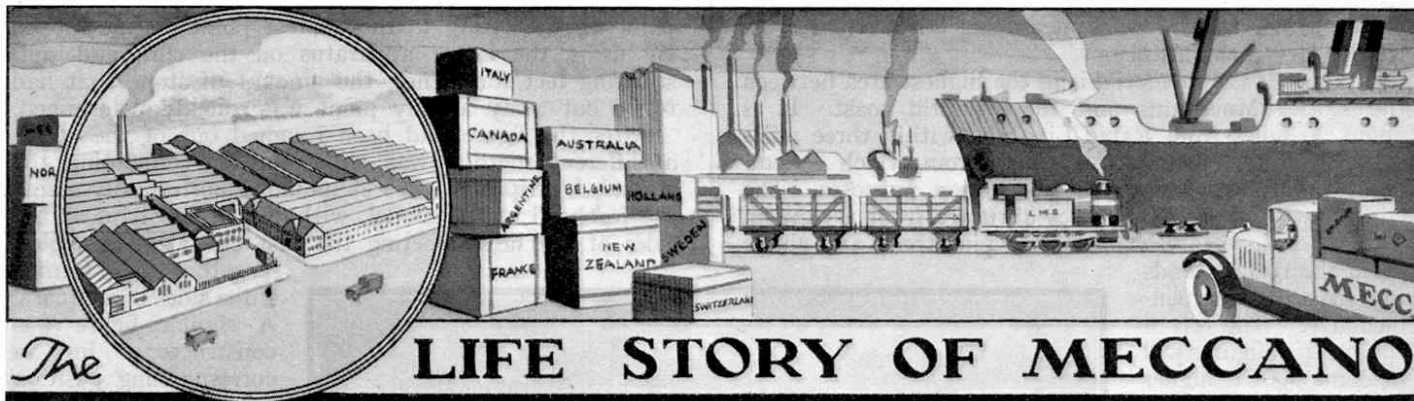
(To be continued.)



This truck is evolved from the crane illustrated below, and is an example of the adaptability of Meccano even in its earliest stages.



A simple model of a crane constructed with one of the first Meccano Outfits 30 years ago. Some idea of the enormous progress made may be obtained by comparing this model with one of the latest Meccano Super Models, the Railway Breakdown Crane shown above.



The LIFE STORY OF MECCANO

By Frank Hornby

LAST month I described the earliest stages of development of the Meccano System, and referred to the fact that few articles ever made have had to fight against so much imitation.

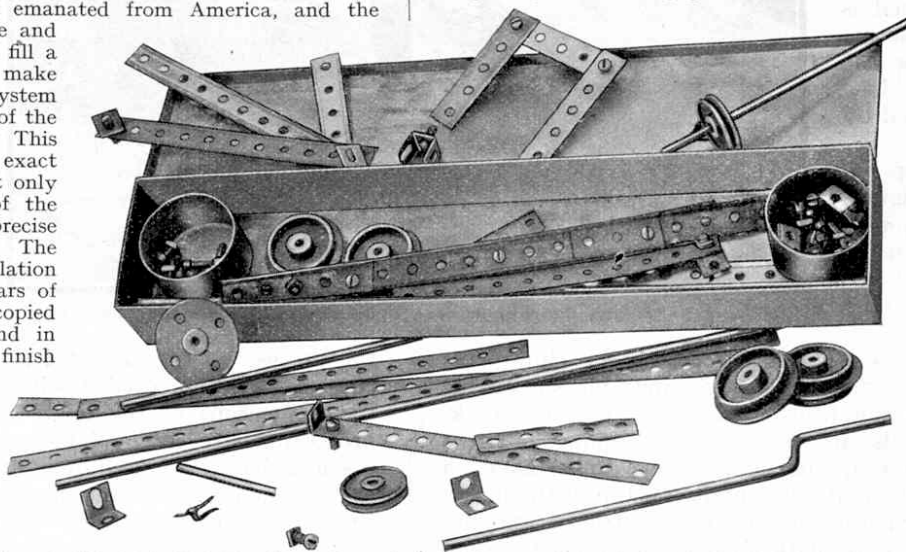
I think that probably the greatest number of imitations of the Meccano System have emanated from America, and the complete history of the rise and downfall of them all would fill a large volume. The first to make its appearance was a system introduced under the name of the "American Model Builder." This system was almost an exact duplication of Meccano, not only in regard to the design of the parts, but even to the precise contents of each outfit. The Meccano Manual, the compilation of which had taken me years of thought and study, was copied almost in its entirety; and in fact, except for the inferior finish of the parts and the generally less attractive arrangement, one of these imitation outfits might easily have been taken for a genuine Meccano Outfit.

You may imagine the deep concern I felt when I discovered that all for which I had worked and striven for so many years had been misappropriated by a newcomer, whose sole intention was to rob me of the business I had built up. I immediately sailed to New York and had a consultation with a well-known firm of attorneys in regard to the steps to be taken to put an end to this grossly unfair form of trading. It seemed to me that such a flagrant breach of the laws of copyrights and patents could very quickly be ended, and I felt sure that I should soon be able to compel the manufacturers of the imitation system to withdraw their outfits from the market. I was destined to have a bitter experience of the slowness of the law, however. The case lasted for no less than nine years and cost my company many thousands of pounds; but it ended in the final and complete establishment of our copyrights, patents, and other privileges.

Since the conclusion of the case against the "American Model Builder," which was tried before the United States Circuit Court of Appeal, I have had the briefs, the transcripts of record of the evidence, and all documents connected with the proceedings collected together and bound. They are too bulky to be included in one book, and therefore they are made up into four large volumes, looking like so many big family Bibles! The case was considered of the utmost

importance in America, and was closely followed by the legal profession. The final judgment was both sweeping and emphatic, and in my opinion it stands as the finest possible tribute to the originality and sterling qualities of the Meccano System.

The late Hon. H. C. Hollister, United States District Judge, in delivering his opinion, spoke of Meccano as a "toy of great utility and educational value, stimulating the imagination, appealing to a boy's creative faculties, that not only gives enjoyment, but is highly instructive." He went on to say that the "American Model Builder" was in his opinion not only a fraud on the public, but also a fraud on Meccano Limited. He further said that the "Meccano



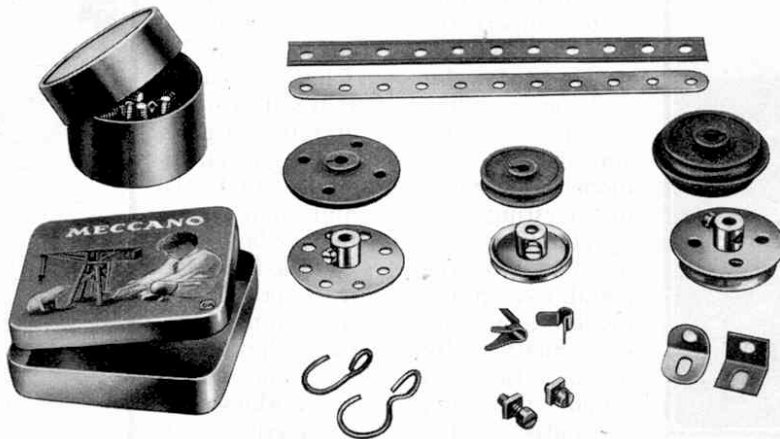
An early "Mechanics Made Easy" outfit box and some of the parts it contained. The box was made of thin sheet metal, and the lid carried the printed label that is shown at the top of the opposite page.

Manual is not unlike a key by which the really wonderful treasures contained in the various parts of the outfits may be unlocked." I do not think that a more equitable judgment was ever delivered.

Throughout the whole proceedings, although these were often wearisome and tedious, the most painstaking efforts were made by the judges to arrive at the truth in what proved to be an extremely complicated case. Although I was a stranger and a foreigner in the country, and the proceedings were against a firm of American nationality, a spirit of the utmost fairness characterised the entire proceedings, and left me with a high opinion of many sides of American law procedure. The decision in this case naturally had

its effect upon the many other imitators that had sprung up, and one by one they dropped out and disappeared from the market.

Imitators sprang up also in Europe. One of the earliest of these systems consisted essentially of bars of wood perforated at regular intervals with holes, and capable of being fastened together in various positions by metal pins passed through these holes. By means of this system it was possible to build a variety of houses and other fixed structures, but it was impossible to construct engineering models or mechanisms that worked. No matter how the parts



Ancient and modern! Some of the earliest Meccano parts photographed side by side with corresponding present-day types.



were joined to one another, the result in every case was a fixed position—there was no means of producing movement. The opening words of the patent specification of this system read:—"The subject of the invention is a toy building set, by means of which structures can be put up closely resembling real structures erected by carpenters . . ." This phrase places it beyond all possible doubt that the object of this system was to produce fixed structures based on the principles of carpentering. Meccano, on the other hand, is designed to produce working structures built on the principles of engineering.

My claim was, and is, that Meccano is the original application of the basic principles of engineering to a metal constructional or mechanical toy. It was on this basis—that is, as a metal mechanical system—that I obtained the first English patent for my invention on 9th January, 1901—more than two years before the above mentioned patent was granted for the wooden unmechanical system.

In the course of the next few years the German manufacturers, who at that time largely dominated the toy business in this country, became alarmed at the success of Meccano, and an avalanche of imitations followed. They all went badly astray, however, for they left the path of engineering and introduced makeshift fastenings, couplings, and odd contrivances of all kinds, that they evidently thought were good enough for a toy that was to be played with by boys. Many of these German imitations had some vogue on the Continent before Meccano became well known there. The best that can be said of them is that they had attractive labels on the box lids. One or two of them tried to get a footing in this country, but neither the public nor the dealers would pay any attention to them, so that little was heard of them.

I must return now to the time when I took out my first patent. It had by then become my unshakable opinion that every boy in the country would derive as much pleasure from my system as my own boys did; and I determined that I would leave nothing undone to make it known throughout the length and breadth of the land. If I had foreseen the trouble and difficulties that I was destined to encounter, I do not think that I should have been so eager and so confident. Indeed, I sometimes wonder whether I should ever have tackled the job at all!

I gave the name "Mechanics Made Easy" to my invention, and I was firmly convinced that I had only to show it to manufacturers and dealers for them to be tumbling over one another to be the first to make and sell it. I was quickly undeceived. The dealers considered it to be crude and unattractive in appearance, and were very emphatic that it was not in the least likely to meet with a favourable reception from the public; and the manufacturers would not even look at it. Although these rebuffs were very disappointing, they did not shake my confidence in the ultimate success of my invention. By degrees I succeeded in persuading a few dealers to take it up, in many cases against what they called their "better judgment"! I was convinced that as soon as boys saw the invention and realised its possibilities they would be keen to possess an outfit; and to my unbounded joy—and to the astonishment of the majority of dealers—this proved to be the case. For a time progress was very slow, but it increased steadily, and I was now faced with an entirely new problem—that of producing the parts in sufficient quantity.

At first I had the various parts made for me by different manufacturers. This arrangement worked fairly well for a while, but presently, as the system became known and the demand for parts increased, all kinds of troubles developed. I could never rely on all the parts being ready at the same time; and frequently

outfits for which dealers were becoming impatient were held up because one firm had failed to supply a particular part by the time specified. A further and even more serious trouble arose from the fact that there was no uniformity of finish among the parts. Not only was there a wide difference in the quality and appearance of parts made by different firms, but also I could never be sure that two batches of parts made by one firm would be alike. It began to be obvious that only by centralised production in one factory could the parts be turned out in the necessary quantity and with the necessary and finish. Thus I found myself entirely new adventure. From an inventor I became

so crude, in fact, often wonder how at all! It con-equipped

a very crude affair—that looking back I we produced anything sisted of a single room with a few hand presses, a lathe or two, and a small gas engine which, in spite of its many protests, we succeeded in persuading to provide the necessary power!

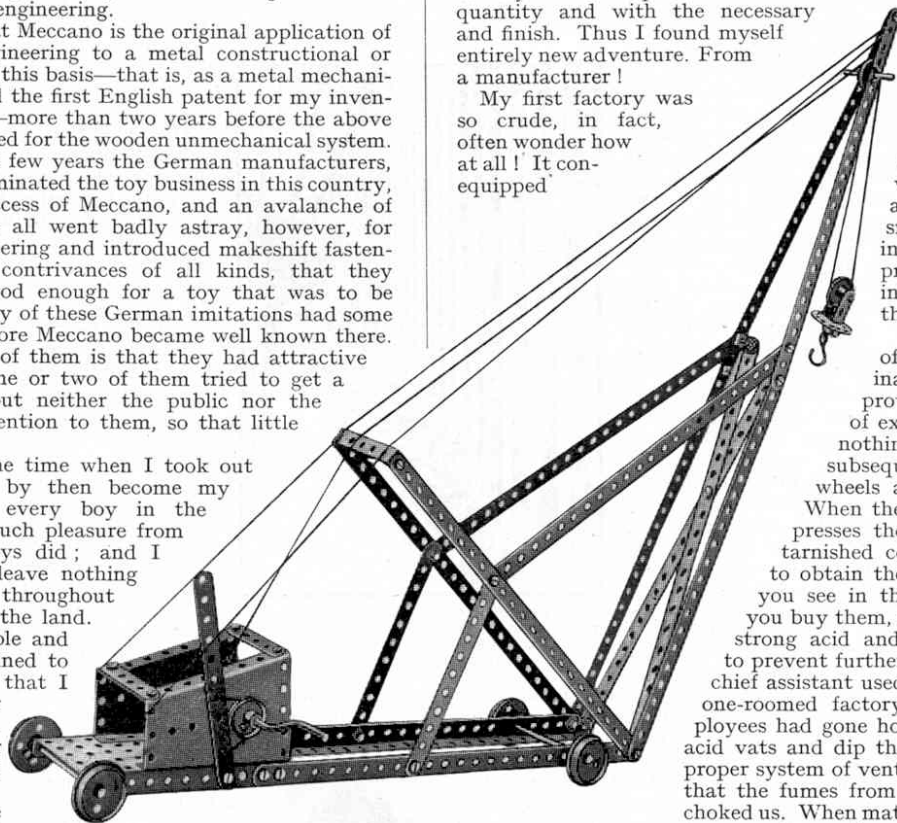
The actual production of the parts with our inadequate machinery provided us with plenty of excitement, but this was nothing to the thrills of subsequently cleaning the wheels and other brass parts. When these first come from the presses they are in a dirty and tarnished condition, and in order to obtain the brilliant surface that you see in the finished parts when you buy them, they are first dipped in strong acid and afterwards lacquered to prevent further tarnishing. I and my chief assistant used to stay behind in our one-roomed factory after the other employees had gone home, and bring out the acid vats and dip the wheels. We had no proper system of ventilation, with the result that the fumes from the acid often nearly choked us. When matters got too bad we had to suspend operations abruptly, and dash out into the open air to recover, and at the same time give the air in the room a chance to clear again! Gas masks had not been

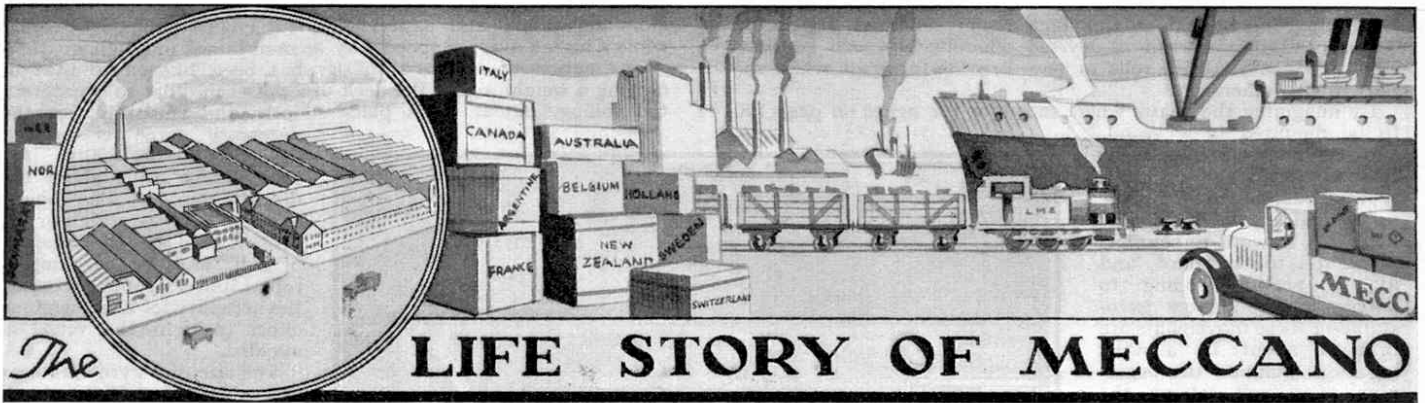
thought of in those days, but they certainly would have been very useful to us! Every now and then I take a walk to the splendidly equipped and perfectly ventilated room in which this process is carried on in the present Meccano factory; and as I watch the work proceeding smoothly and swiftly I recall the difficult days through which we passed in my first factory.

With such a primitive system of production it was inevitable that things frequently should go wrong. As fast as we overcame one difficulty, another cropped up at some unexpected point. To use a familiar phrase, we were always "up against it"! In spite of all obstacles, however, we always managed to "deliver the goods."

It was during the time that I was in this factory that I decided to change the name of my outfits from "Mechanics Made Easy" to "Meccano." The latter was a handier and shorter name, and I thought it would enable boys to identify my goods more easily. Also I could register this name, so that no one else could come along at any future time with imitation goods and palm them off on the public as being the real thing. I registered "Meccano" in England on 14th September, 1907, and in Germany in July, 1912. As a result no one else can ever use the word "Meccano," and of course without this name no parts are genuine. (To be continued)

Meccano models have always been designed on real engineering lines. The crane seen on the early box label shown at top of page, for instance, was so soundly constructed that its design has scarcely been altered at all. This is shown by the lower illustration of this model in its present-day form.





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THE output from my first factory was of course small at its best, but nevertheless Meccano began to attract much attention. I received gratifying letters from boys and from parents in every part of the country, and these gave me a great deal of encouragement at a time when I badly needed it. By this time I

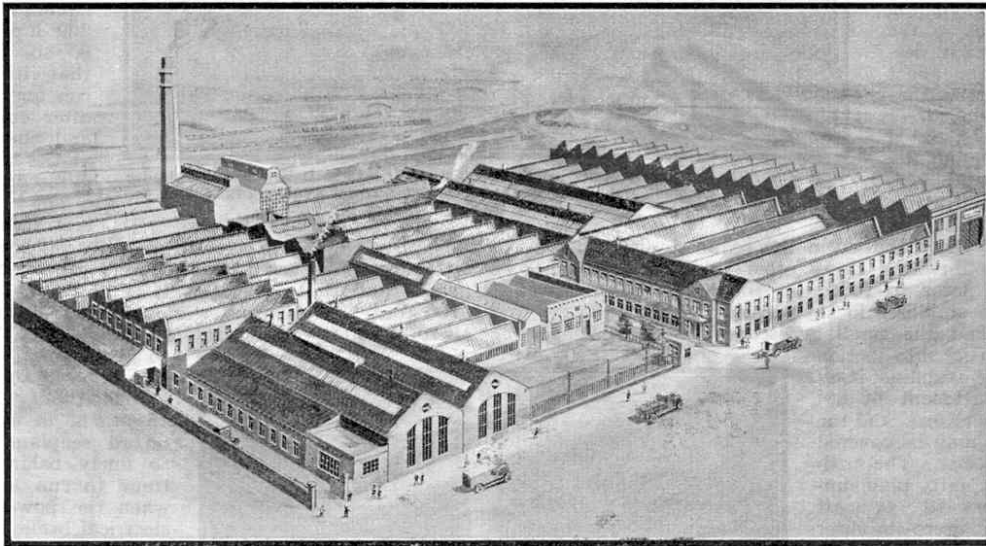
had begun to describe Meccano as "Real Engineering for Boys," and in order to make quite certain that I was justified in doing so I submitted outfits to some of the leading engineers and professors of engineering. Their replies surpassed all my expectations. Each expert expressed the utmost interest and pleasure in the invention, and assured me that I was working on correct engineering principles, so that any boy who followed the hobby enthusiastically and intelligently would inevitably acquire a sound knowledge of real engineering. These favourable opinions scattered to the winds my last lingering doubts and filled me with renewed energy.

I had supplied a Manual of Instructions with every Outfit from the very beginning. The first edition of this Manual was printed hurriedly and with little thought for appearance, my sole object being to have it ready in time for inclusion in the first outfits. I now began to feel that this Manual was not good enough for the purpose, and also that it was not distinctive in appearance. I therefore set to work, with the assistance of experts, to design a Manual that should be a standard type of publication that all boys would immediately recognise as coming from my firm. You will have noticed that in all our advertisements, leaflets, etc., the word "Meccano" is printed in a specially designed type-face—the letter "C" is rather unusual in its formation, and the final "O" slopes a little. This and other little peculiarities give the word an artistic and distinctive appearance, and this special design is our exclusive property.

At the top of the cover of the Manual of Instructions there is a drawing of two boys in easy boyish attitudes working away at a Meccano model. The model itself has been changed occasionally, and the boys' clothing has been brought up to date from time to time; but otherwise the drawing has not been altered. I think you will agree that the cover of the Meccano Manual is a most artistic production, and you may be sure that no changes will ever

be made in it without good reason. The same cover is issued for every country in the world, but we make a distinction by changing the colours, using certain colours for certain countries to facilitate identification for storing and packing.

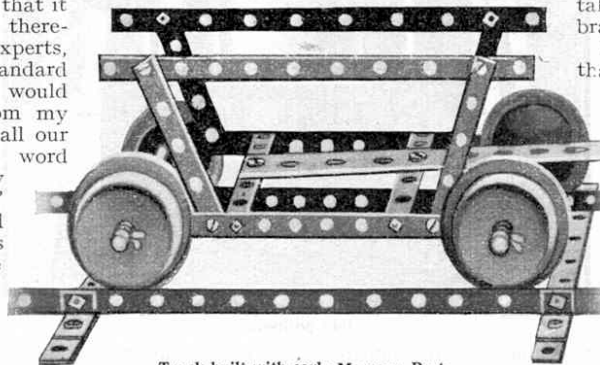
You will have noticed that in all the Meccano Manuals the instructions for building the various models are written in technical language; that is to say correct engineering terms are used in every case. When you are talking with an engineer or a mechanic you may use with confidence any word or phrase employed in the Meccano Manuals of Instructions. Your meaning will be understood perfectly, because you will be speaking the language of engineering. I have no hesitation in saying that any boy who has built a series of



An aerial view of the Meccano factory, which now covers an area of nearly five acres.

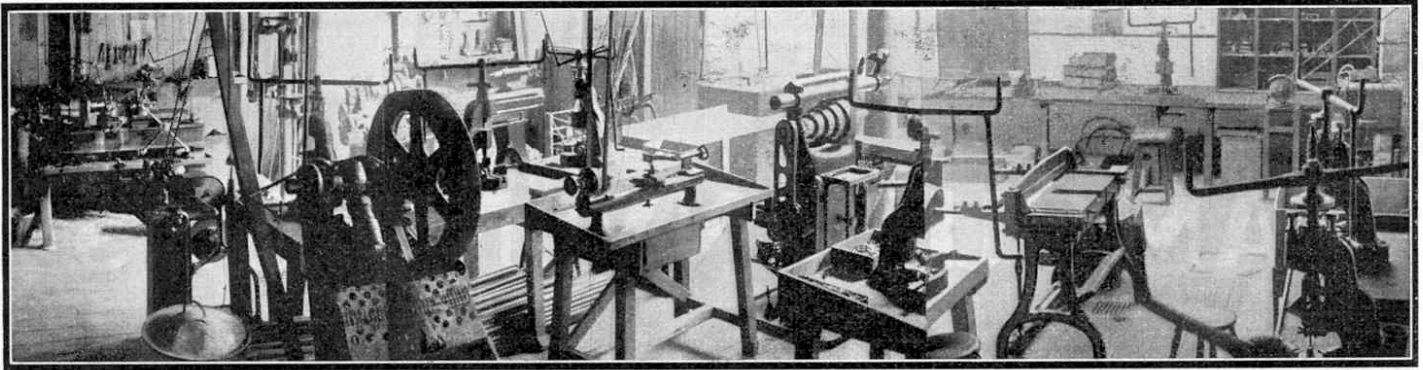
Meccano models from the instructions provided in our Manuals will be able to read intelligently and understand any book on engineering, or a description of any engineering feat that he may come across. I attach the greatest importance to this matter of correct technical description of models, not only because I like everything connected with Meccano to be accurate, but also because technical accuracy is of such great importance to the thoughtful boy who intends later on to take up a career in one of the many branches of engineering.

By this time it had become quite obvious that our tiny factory in Duke Street, Liverpool, was utterly inadequate for dealing with the demand for outfits. Many parts were still made by various manufacturers, but even with this assistance we could not turn out parts in sufficient quantity. We did our best, and worked long hours every day, but the resources of the little factory had reached their limit, and the output could not be increased. There was therefore nothing for it but to move into larger premises and install more machinery. I spent a good deal of time in searching



Truck built with early Meccano Parts.

for a suitable place, and ultimately I decided upon a building that previously had been used as a motor car works, in West Derby Road, Tuebrook. I well remember how impressed I was with the size of the building. It seemed to me more suitable for constructing railway locomotives than Meccano parts, and even after all our machinery and benches were installed the uncovered floor space



that remained gave me a fright!

Before we moved into the new premises at West Derby Road I carefully planned a layout for the various machines and benches, based upon the experience gained in the existing factory; and I was now able to carry out many improvements that previously had been impossible on account of lack of space. First of all I moved in the old machinery and got it working, and then gradually I added one new machine after another. Eventually I had an equipment that, I felt sure, would not only enable me to manufacture practically the whole of the parts myself, but also to produce them in sufficient quantity to meet all possible demands in the future. Never had I made a bigger miscalculation! The popularity of Meccano increased at a rate that I had never contemplated in my wildest imaginings. Dealers who previously had ordered a few outfits, almost in fear and trembling, now began to order on a continually increasing scale and to clamour for immediate delivery. In the effort to grapple with the situation I added machine after machine until the vacant floor space that had worried me earlier on was completely covered; and still the output was not large enough.

During my occupation of this factory I improved my outfits in many important respects. For instance, I abandoned the old tin containers, and the Meccano outfits were now displayed in strong cartons with all the parts looking smart, neat and orderly in their separate compartments. Another far-reaching change was made in regard to the strips. Up to that time these had been made of tin with turned-over edges; but now I began to make them of rolled steel, heavily nickel-plated. This change, as will easily be realised, marked a great step forward in the style and quality of the outfits. I also recognised that the key with which the wheels were fastened on the rods, although satisfactory in most respects, was not sufficiently strong and rigid for use in large working models in which considerable stresses existed. I therefore introduced the more effective set screw which, as will be remembered, I had turned down earlier as being too costly for the purpose. Thus it came about that the key that I formerly manufactured by the million was superseded and gradually disappeared.

In less than two years the position in this factory became similar to that in the old one. I had not sufficient machinery to cope with the demand for parts, and at the same time it was impossible to cram another machine into any part of the building. Thus another move became necessary. At first I thought of looking round for a larger building that might be vacant, but after considering the matter carefully from every point of view I decided against this step. The popularity of Meccano had already increased far beyond my expectations, and I realised that if this growth were to continue on a similar scale it would be foolish to move into a larger building that could only serve the purpose for a comparatively short time, and then have all the trouble and worry of a further change. Finally I decided that the only satisfactory method of meeting the needs of the business was to buy a plot of

land and erect a factory for myself. It was essential that this land should be in a suitable position, and large enough to accommodate not only a factory adequate for present needs, but also any extensions that might become necessary in the future. Finally I purchased a piece of land at Old Swan, a district away from, but within easy reach of the centre of the city, convenient for the principal railway stations and, as far as possibly could be foreseen, large enough to provide for all future requirements.

The designing and planning of the new factory was a long process, demanding the most serious thought. The experience I had already gained was of the utmost value to me at this time in enabling me to decide upon the most effective and economic arrangements, and to avoid features that had proved to be unsatisfactory. Beyond this there was the health and convenience of the workers to be considered, and in this respect I determined to produce an ideal factory. As soon as the plans were completed building was commenced and was pushed forward with the utmost rapidity; and presently there came into being the great Meccano Factory in Binns Road, the name of which is familiar to hundreds of

thousands of boys all over the world. It covers an area of nearly 5 acres of land, with every workshop on the ground floor, glass-roofed and, to a certain extent, glass-sided. Its perfect efficiency is proved beyond doubt by the enormous output that continues steadily week in and week out, and I am confident that there are few factories in which the working conditions are so pleasant.

I take great pride in my factory, and I welcome the thousands of Meccano boys who visit it every year. They are conducted by special guides from shop to shop, every process being thoroughly explained to them; and they leave with eyes shining with excitement and enthusiasm. They have realised a long-cherished ambition—they have seen the home of Meccano!

I wish every boy could see the Meccano Factory, but unfortunately this is impossible. For the benefit of those who, on account of distance or other circumstances, are unable to pay it a visit, I propose in a later article to describe the factory as well as I can, and to explain the many and wonderful processes by which the raw material is converted into the perfectly-finished parts that you all know so well.

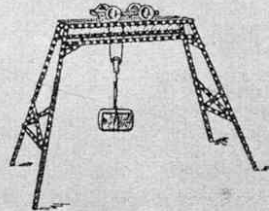
As a rule the transferring of plant and machinery from one factory to another involves an almost complete stoppage of work for a period, and great dislocation of business generally. In this case, however, the machinery was transferred from the old factory to the new one without a stoppage of even a day. Two large new gas engines were first installed, and completely new shafting and belting was set up throughout the works. Then each lathe, press or other machine was carried over separately, fixed in the position that had been prepared for it, and set to work immediately. This involved an immense amount of careful organisation, but the labour was amply repaid, for the whole removal was conducted from start to finish without a hitch.

The working conditions in the new

(Continued on page 238)

MECHANICS MADE EASY.

**A Patent
Adaptable**



**Mechanical
Toy.**

With which boys may
nity in constructing
Waggon, Shafting,
less Variety of Mod

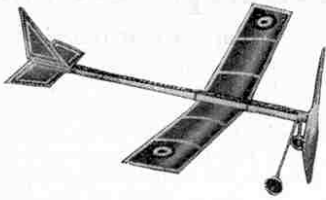
being perforated with holes, equi-distant, enables them to be formed into the shapes (among others) enumerated. No expense for tools. Charming occupation, and Toy indestructible. Price, 7s. 6d Wholesale from—
GEORGE PHILIP & SON, Ltd., 32 Fleet Street, LONDON.
PHILIP, SON & NEPHEW, South Castle Street, LIVERPOOL,
and **STOKE-ON-TRENT.**

MANUFACTURERS—

FRANK HORNBY, 18, James Street, LIVERPOOL.

One of the earliest advertisements issued by Mr. Hornby for "Mechanics Made Easy," under which name Meccano first appeared.

The upper photograph shows the interior of the first Meccano factory.



The "DEMON" Tractor. Price 7/6
Length 25½ in., span 23 in. Fitted 10 in. hand-carved and balanced propeller, patent double-bearing and shock-proof chassis, covered yellow proofed silk with identification discs. Weight and wind resistance are reduced to a minimum in this model, giving the utmost duration of flight.
Weight, 3½ ounces. Distance, 850 feet.
Speed, 16 m.p.h. Ceiling, 80 feet.
Rises from the ground.
Patent No. 296946.

The Warneford "Whippet" Fuselage Model. Price 17/6

Length 20½ in., span 30 in., fitted 11 in. hand-carved and balanced propeller, and covered orange proofed silk. This beautiful Fuselage Model Aeroplane has an excellent performance, is very strong, and has full adjustment of main-plane, tail, and fin. It disassembles and folds so that it fits into a very small box for storage and transport. The finish is in keeping with the usual Warneford high standard.
Weight, 4½ ounces. Distance, 550 feet.
Speed, 17 m.p.h. Ceiling, 50 feet.
Rises from the ground.



THE WORLD'S BEST FLYERS

WARNEFORD

FREE!

JOIN THE W.J.A.L.

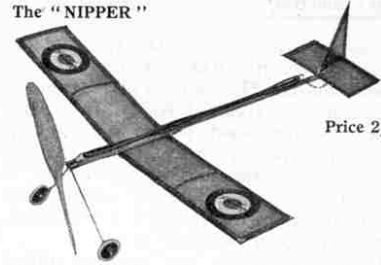
FULL PARTICULARS, WITH FINE ILLUSTRATED FOLDER, POST FREE ON APPLICATION.

MODELS FROM 1/6 TO 35/-

Sole Manufacturer:

F. J. MEE, Warneford Flying Aircraft, GREENWICH, LONDON, S.E.10.

The "NIPPER"



Price 2/6

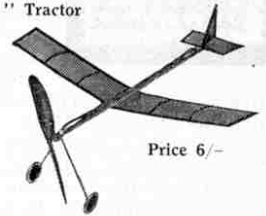
Special Features: A long bearing allowing no movement or wobble on the propeller—therefore a steady flyer. High-tension steel wire tail and rudder—therefore model can be adjusted for stunting. All aluminium wheels, fitted brass bearings, and the model has an amazing performance as the whole aeroplane weighs less than one ounce. The finest machine ever produced at such a price.

Weight, 1 ounce. Distance, 400 feet.
Speed, 12½ m.p.h. Ceiling, 40 feet.
Rises from the ground.
Patent No. 296946.

The Warneford "IMP" Tractor

Length 23 in., span 20½ in., fitted 9 in. hand-carved and balanced propeller. This new model is of all-round increased performance, due to a general reduction in weight. It is fitted with the usual Warneford shock-proof chassis and a 9 in. hand-carved balanced propeller, and also a four-ribbed main-plane. This model having a steel wire tail-plane, is capable of being set for stunting.

Weight, 2½ ounces. Distance, 750 feet.
Speed, 12½ m.p.h. Ceiling, 60 feet.
Rises from the ground.
Patent No. 296946.



Price 6/-

Famous Inventions—(Continued from page 175)

minutes each night. In the wireless room of this powerful French station he listened intently night after night without any result until the 21st October when, just as he was about to retire, he heard the voice of the speaker at Arlington, and caught the words "and now good night." The experiments were continued for many nights before he again heard any of the transmitted speech, and even then it was only occasional words that he could hear.

At that time the necessary power was obtained by grouping together large numbers of transmitting valves, but as valves of greater power were produced the number necessary for wireless telephony was reduced. It was only after years of painstaking experiment, coupled with the gradual development of more powerful apparatus, that wireless telephony became possible on a commercial scale.

The wireless telephone service between New York and London was inaugurated on 7th January, 1927. At the American end a group of officials of the American Telephone and Telegraph Company were seated round a table in the directors' room on the top floor of 195, Broadway, New York City. With the exception of President Gifford, who was seated at the head of the table, each man wore a headpiece provided with a single earphone. At the London end Sir Evelyn Murray sat in his office in London. At this end also was the same operator who in 1915 had caught the first intentional message ever heard across the Atlantic.

President Gifford picked up the telephone in front of him and, as if making an ordinary telephone call, said to the

operator: "Please connect me with Sir Evelyn Murray in London." Instantly the others seated at the table held their headphones more tightly to their ears, and their intense expressions indicated their keen interest and suppressed excitement.

After a few minutes a voice came distinctly over the telephone, "Hello, is that you, Mr. Gifford?"

The voice was that of Sir Evelyn Murray, and as Mr. Gifford heard him he looked up with a triumphant smile at his fellow directors.

"Yes, this is Mr. Gifford," he replied.

Static interferences were troublesome at first, but afterwards the two men then conversed comfortably for some time. Mr. Gifford concluded by congratulating the British officials and extending to them the good wishes of the American Telephone and Telegraph Company. Sir Evelyn Murray replied in suitable terms and declared the service formally opened. It was then turned over to waiting subscribers and on the first day 31 calls were put through.

From that time the use of wireless telephony increased steadily, and in addition to the service between this country and North America wireless telephone services are now in operation between England and Canada; Capetown; many of the countries of South America; Australia and New Zealand; French Indo-China and French Morocco. Wireless telephone communication is available also to and from the "Majestic" and other large liners on the North Atlantic service. It is also possible to converse by wireless telephone with the pilots of the great air liners employed on the Imperial Airways and other important air services.

The Story of Meccano—(Continued from page 173)

factory were almost unbelievably better than those in the previous one. For the first time I found it possible to carry out each process in the most economic manner, without being hampered by restrictions of space, or worried as to whether the floor would stand the strain! This reminds me of one very striking change. In my old building the noise of the big presses was terrific. In the new factory, however, all the floors were specially prepared with concrete beds to receive presses and other heavy machines, with the result that when the workshops were in full swing there was no vibration and very little noise.

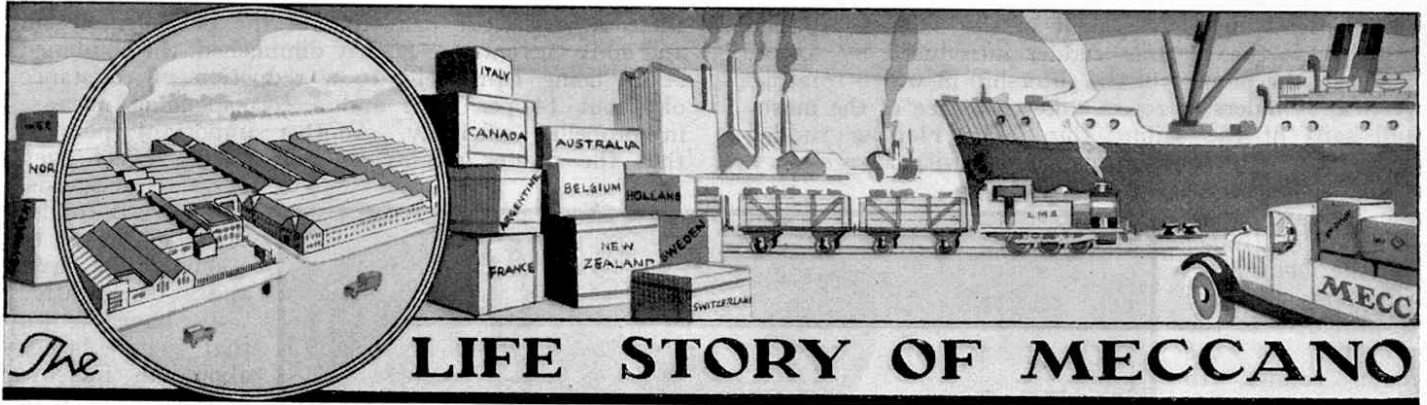
So far I had concentrated entirely on the factory, and my clerical staff still remained in the old building. I now set to work to build ample office accommodation alongside the new factory.

(To be continued)

Scale Model Aeroplanes

Readers who are aeroplane enthusiasts will be interested in the Aeromodels outfits for home construction. The component parts are printed in correct colours on wood and cartridge board, ready for cutting up and assembling. The outfits include an excellent set of instruction sheets and blue prints that make the task of constructing the models perfectly straightforward for any boy possessing normal skill with his fingers. The present series of models are not constructed to fly, but their accurate presentation makes them of exceptional interest, and in photographs it would be difficult to distinguish between the models and the real machines.

The first model in the Aeromodels series is that of a D.H. Gipsy "Moth." It is designed to a scale of 1 in. to 1 ft., and has a wing span of 15 in. Other outfits will be issued shortly, including one to build the Comper "Swift" machine on which Mr. C. A. Butler made his record-breaking flight to Australia. The price of each outfit is 3/-, or 3/6 post free from Aeromodels, Hooton Road, Willaston, Cheshire.



THE LIFE STORY OF MECCANO

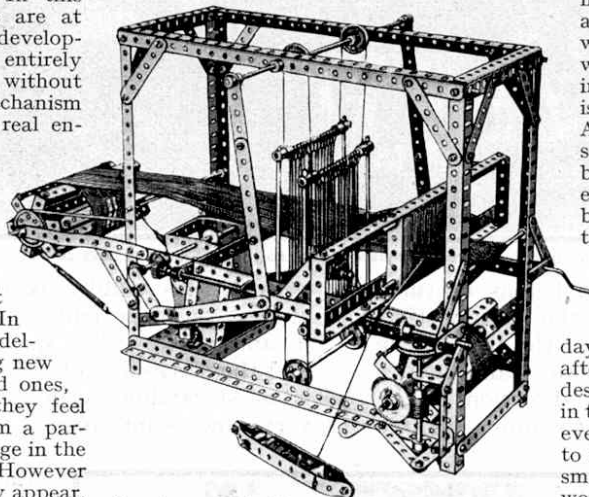
By Frank Hornby

LAST month I stated that I was postponing until later in this series of articles a full description of the Meccano factory, but I feel that I must mention here one of its most highly specialised and fascinating departments—that in which Meccano models are designed and built. In this great room expert model-builders are at work all day long in improving and developing existing models, or designing entirely new ones. Scarcely a month passes without some notable new machine or mechanism being introduced to the world of real engineering, and immediately sufficient details are available our designers set to work to reproduce these inventions in Meccano. In this manner Meccano keeps pace with developments in all branches of engineering.

It is in this department also that proposed new parts are tried out. In the course of their work the model-designers are continually producing new movements, or modifications of old ones, and it frequently happens that they feel the need of a new part to perform a particular function, or for a slight change in the shape or size of an existing part. However attractive a proposed new part may appear, it is not adopted without the fullest consideration. First of all a dimensioned drawing of it is made, and from this a sufficient number of samples are prepared. These samples are then built into a variety of models and tested in every possible way to make certain that the part fulfils the two essential conditions for inclusion in the Meccano System—first, that it is a miniature reproduction of a real engineering part; and second, that it has a wide range of utility, and is not just a "stunt" part for building one spectacular model. If these conditions are fulfilled, the part is added to the Meccano System, which thus extends steadily in all directions without ever abandoning its aim and ideal of being "Engineering in Miniature." In addition to the new parts that are evolved in this manner, suggestions for new parts are received every day from Meccano enthusiasts, and each one is submitted to the searching tests that I have just described.

Another interesting part of the work of our model-experts consists in building, improving and perfecting the models that win prizes in our various competitions. The splendid quality of these prize-winning models has always been a source of the keenest interest to me. The great £500 world contest that has just closed seems likely to surpass all earlier contests in the quality of the entries, and I shall be very busy during the next two or three weeks in supervising the judging of the large number of entries. This contest provides another indication of the remarkable manner in which Meccano is seized upon with the utmost eagerness by the boys of succeeding generations in all parts of the world. As I look at the models submitted, I feel that the engineering of the future is in safe hands.

It is a large part of our business to provide models for dealers to give practical demonstrations of the possibilities of Meccano. These models vary in size according to the window space available, but most of them are very large, and all are fitted with electric motors, so that they are capable of working away for hours on end without any attention whatever. Some of them also are fitted up with electric lights, and at night these lights, in combination with rapidly moving mechanism, form an irresistibly attractive picture. At certain times of the year we have a large staff of model-makers busily engaged in building these models, carefully adjusting the electrical fittings, and testing the mechanism before they are despatched to their destinations.

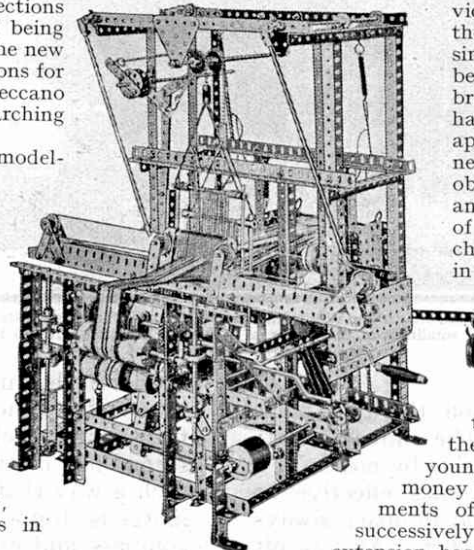


The two models illustrated here afford another striking example of the development of Meccano. Above is the first Meccano Loom, in which all movements had to be made separately by hand. Below is a later model, in which the movements are carried out automatically by turning the handle.

engineering principles. I have always attached the utmost importance to this accuracy, and as a result Meccano to-day plays a unique part in the development of sound engineering knowledge.

In 1926 occurred the 25th anniversary of the introduction of Meccano, and it was distinguished by an outstanding event, namely the introduction of Meccano in colour. Previously all parts of the Meccano System, except those made of brass, were finished in nickel; since that time plates and pulley wheels have been enamelled red, and strips, girders and brackets green. The use of these coloured parts has brought about a great improvement in the appearance of models by introducing a brightness and realism that previously could not be obtained. This step was taken only after long and careful consideration, but the popularity of the decision was shown by an immediate chorus of approval from Meccano enthusiasts in all parts of the world.

Meccano is made up for sale in a number of outfits of various sizes, which have been developed year by year from the single outfit in which my invention first appeared. Gradually the number of outfits grew until they ranged from No. 1, the smallest, to No. 7, the largest. Then there arose a demand for smaller outfits for young boys who had the Meccano spirit but little money to spend; and in order to meet the requirements of these boys there have been introduced successively a No. 0, a No. 00 and a No. 000 Outfit. No extension has been made at the other end of the scale,



for the No. 7 Outfit contains a complete miniature engineering equipment, capable of reproducing practically every type of structure and mechanism.

In planning these outfits my guiding principle has been that of steady and gradual progress from small things to great, without any gaps, overlappings or difficulties of any kind occurring between the various stages. For instance, a boy may purchase a No. 1 Outfit. He takes this home and gradually works his way through the models shown in the Manual of Instructions contained in the Outfit. Presently he turns his attention to the more elaborate and more interesting models that he sees grouped together on two pages at the end of the Manual, and he becomes eager to build these. He is unable to do this at present, however, because he lacks various parts; these larger models require larger outfits. In the ordinary way the purchase of a No. 2 Outfit, the next larger, would involve this boy in acquiring a number of parts that he already possesses. Therefore, in order to avoid the unnecessary cost thus incurred, what are known as "Accessory" or "A" outfits have been prepared to provide bridges leading from one standard outfit to the next higher. Thus a boy who has a No. 1 Outfit, and wishes to convert it into a No. 2, may do so by purchasing a 1A Accessory Outfit, and thus acquiring all the new parts he needs without any useless expenditure on parts that he already possesses.

A boy who contents himself with building the models that are illustrated and described in the Meccano Manuals of Instructions inevitably gains a sound general knowledge of engineering design and principles, but very few boys stop there! From the time when a boy first commences to use Meccano he has before him a constant encouragement and stimulus to make slight changes in the construction of the various models. From this he is led on almost imperceptibly to build models entirely from his own ideas, and then he has become, in the true sense of the word, an inventor.

The educational value of Meccano does not end here, however; it extends to every boy, even those who have no special aptitude for engineering, and who certainly have no intention of taking up engineering as a career. Every boy is interested in knowing "how things work," and why they work in their own particular manner. Until recent years boys who wished to understand how the world's giant engines and machines work had to be content with book descriptions; but Meccano has brought about a revolution in this respect. By means of Meccano a boy can build miniature models of an almost endless variety of engines and machines; and these models actually work on the same principles as the originals. The result is that, instead of a vague and often inaccurate idea of the most important mechanisms, the Meccano boy has a real and definite knowledge of how these work—a knowledge that, once gained, is never lost.

A very striking illustration of the practical nature of the

education provided by Meccano is to be found in schools for the blind. It is naturally an extremely difficult matter to convey by description, to a boy who has been blind from birth, a true conception of, say, a motor car. If, however, Meccano models of a gear-box, differential gear, steering mechanism, etc., are placed before him, so that he can handle each unit separately and follow by the sense of touch its incorporation in the chassis, he can gradually build up a mental picture of the complete car.

He can actually feel the difference in the drive obtained by changing the gears in the gear-box; he can feel the clutch gradually take up the drive from the engine; and he can note exactly what happens in the differential as a car turns a corner. Then, when next he hears a motor car start up, or change gear to negotiate a steep hill, he can visualise exactly what is happening. In a similar manner a blind boy may acquire exact knowledge of a wide variety of engines and machinery.

Quite apart from all these advantages Meccano plays a wonderful part in training the hand and the eye to work together efficiently.

This is the case from the very first. Even the smallest boy who sets out to build a simple model has to think and make decisions at every step. When, in the course of building, another part is required, he has to decide which part it is, where it is to be placed, and how it is to be fitted and fixed in position. This mental process continues throughout the building of every model, and quite unconsciously the Meccano boy acquires a habit of first thinking out a problem and then coming to a definite decision—a habit that is of the greatest possible value to him in later life.

While he is acquiring this habit the Meccano boy is learning the value of form and design, and that the different members of a crane or a bridge are not inserted haphazard or merely for the sake of ornament, but to serve a definite purpose in resisting some stress or strain, and in adding to the combined strength of the whole structure.

Further proof of the fact that Meccano is real "Engineering in Miniature" is afforded by the extensive and increasing use that is made of it by inventors, many of whom write to express their high appreciation of the assistance it affords them in making models and mechanisms of all kinds, and thus translating their ideas into practice. The same appreciation is expressed also by engineers and engineering firms who make use of Meccano regularly in their every-day work.

Other letters come from science masters and masters in technical colleges, who find that their ever-changing requirements in models and apparatus are fulfilled by Meccano in a unique manner.

I am very proud of these testimonials to the efficiency of Meccano. They show that, although it is primarily a constructional toy, it is based on such sound principles that there are practically no limits to its possible extension. Next month I hope to refer to a few of the most notable instances in which Meccano has proved itself of service.



The room in which "Mechanics Made Easy" parts were assembled for packing into Outfits.

BEST OF ALL PRESENTS.

MECCANO - 1910 SERIES -

Makes CRANES, WINDMILLS, FIRE ESCAPES, TOWER BRIDGE, EIFFEL TOWER, BIG WHEELS, TRUCKS, WAGGONS, &c.

ALL MECCANO models are built on correct mechanical principles, and work like the real thing. The parts are interchangeable, and each model can be taken to pieces and set up for another model from the same parts.

All the struts are screw-plated, and the heavy wheels and rollers, metal galleys, and every MECCANO model presents a beautiful attractive appearance.

Everything provided. Nothing extra to buy.

MECCANO

EVERY BOY is given an opportunity of exercising his ingenuity and creative faculties. The beautifully illustrated book of instructions containing 44 models, gives only an idea of what can be accomplished with

MECCANO—
A Fascinating Hobby for Young or Old.

ANYONE WITH 2 HANDS CAN MAKE MECCANO MODELS.

THE FAMOUS WRIGHT AEROPLANE
in Miniature. MADE ENTIRELY OF MECCANO PARTS.

MECCANO has caused and distributed many thousands of boys and youths.

The interest does not die out or wear out, but keeps up until year by year.

OUTSHINES ALL OTHER HOBBIES.

MECCANO

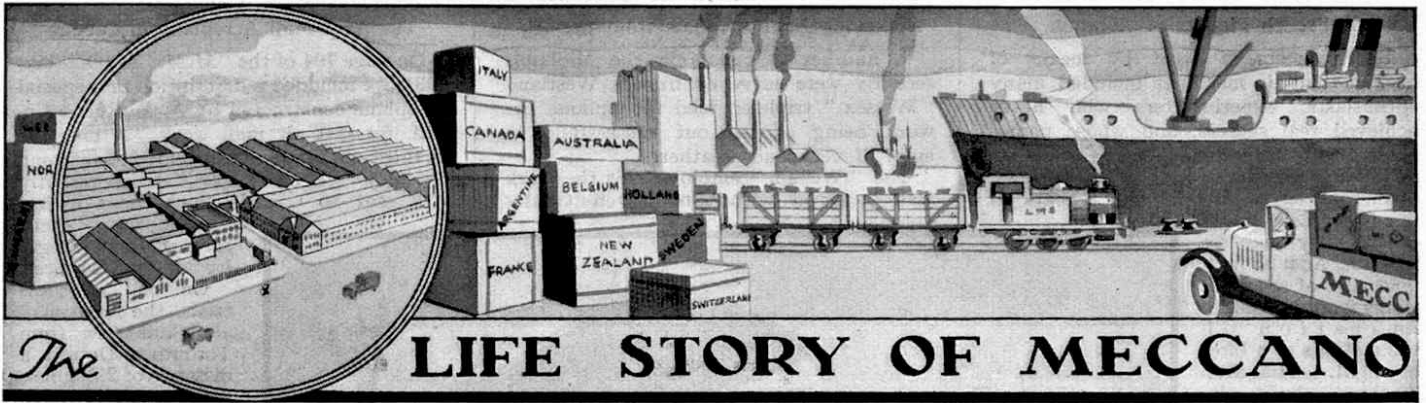
PRICES.

KINDERGARTEN OUTFIT	3/6
MECCANO No 1	6/0
MECCANO No 2	10/0
MECCANO No 3	15/0
MECCANO No 4	22/0

MECCANO PRESENTATION OUTFIT packed in Walnut box—No. 120; 22s. 6d.

A Beautifully Illustrated Manual of Instructions with each Outfit.

Reproduction of a Meccano advertisement that appeared in Gamages Catalogue, 1910.



The LIFE STORY OF MECCANO

By Frank Hornby

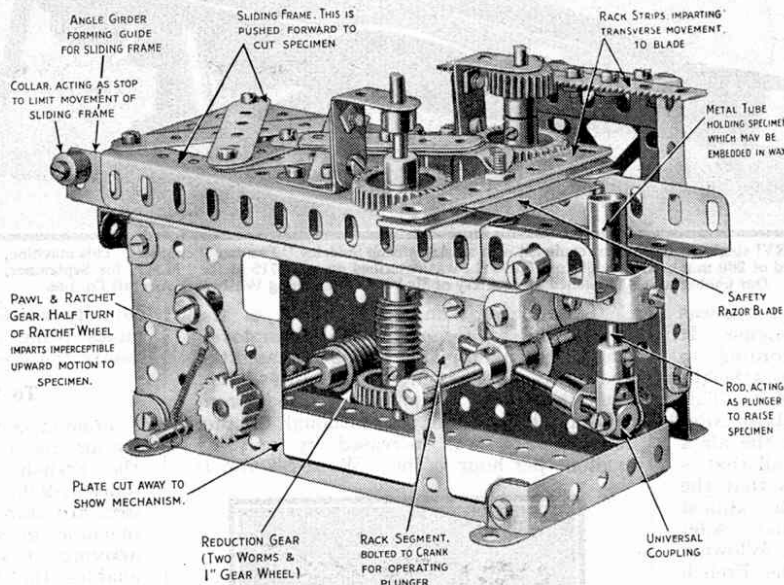
LAST month I referred to the increasing use that is being made of Meccano by inventors, engineers and engineering firms, scientists and schoolmasters, and I promised to refer to a few notable instances in which Meccano had proved of service. There are so many of these, and they are so varied in character, that I find it difficult to know which to select for the purpose. In one respect all are alike—they show how rapidly and effectively Meccano is replacing the older methods of model-making.

Formerly an inventor or an engineer who wished to try out in miniature form a new idea had only two possible courses open to him. He must himself go through the laborious process of making special parts in wood or metal, as I had to do before I invented Meccano; or he must have these parts made for him, which necessarily involved considerable expense. In very few cases was the model thus built quite satisfactory. Almost always many changes had to be made, involving the preparation of new parts, for it was seldom that the existing parts could be modified to suit the purpose. Frequently, too, the idea ultimately turned out to be impracticable, and then all the time and money spent on the model were wasted. Meccano has opened up entirely new possibilities in this direction. In the first place it provides ready-made parts with which any mechanical movement can be reproduced. Then, if the result is not at first satisfactory, almost endless modifications may be made by substituting here and there larger or smaller parts, or parts of a different type. In the end, if the scheme is sound Meccano will enable it to be demonstrated in practical working form; or if it proves unsound, the parts all remain available for further experiments, nothing being lost or wasted.

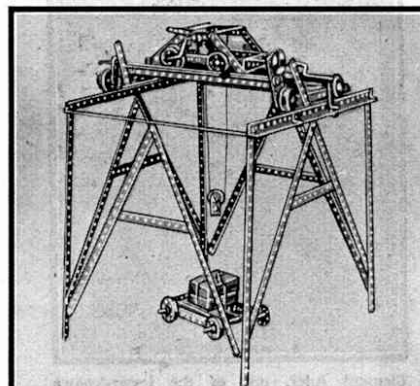
More than this, inventors have told me how Meccano has actually given them new ideas when they were at a loss as to how to produce certain results. While pondering over the problem they have suddenly caught sight of a part that immediately suggested the solution, and very soon the desired end was achieved. This is not in the least surprising, for with a large Meccano outfit an inventor has spread out before him in miniature almost all the resources of modern engineering.

One of the most recent uses of Meccano by engineers has already been described in the

"M.M." This occurred in connection with the design by M.R.S. Ltd., of Liverpool, of a giant lorry capable of carrying across London the huge girders required in the erection of the Cumberland Palace Hotel now being built near the Marble Arch. Among these girders was one weighing 99½ tons, and measuring 68 ft. in length, 10 ft. 4 in. in depth, and 2 ft. 4 in. in thickness. The designing of a lorry capable of handling such a load presented great difficulties, and the problem was solved only after many experiments with models built from Meccano parts, which ultimately led to the discovery of a new principle of steering. In addition, a Meccano scale model of the lorry and its trailer was used to work out in Liverpool on a miniature course the details of the journey through London streets. Illustrations and details of the remarkable Meccano model of this huge lorry appear elsewhere in this issue.



A wonderful microtome built in Meccano by Dr. Ernest Bade, a United States scientist. This remarkable instrument cuts sections of tissue as thin as two thousandths of an inch.



"MECHANICS MADE EASY."
 A Constructural Mechanical Toy. No expense of tools. Simplicity of construction. Absence of dirt. Interesting occupation. Parts interchangeable. Educative. Embodying the principles of Mechanics. Price:— Box A (to construct 10 Models), 3/6. Box A1 (accessories), 6/-. Box B (A & A1), 14/6. Box B1 (accessories), 10/-. Box C (A, A1 & B1), 24/6. Box C1 (accessories), 10/6.— PHILIP & TACEY, Ltd., East Harding Street, London; PHILIP, SON & NEPHEW, South Castle Street, Liverpool. ELLIOTT & HORNBY 18, James St., LIVERPOOL.

An early advertisement of "Mechanics Made Easy."

Going back a few years, Meccano enthusiasts who visited the Amusement Park at the British Empire Exhibition at Wembley, will remember the wonderful "Golden Glide" constructed by A. & F. Pears Ltd., the famous soap manufacturers. This Glide consisted of a journey of nearly a quarter-of-a-mile through alternate scenes of beauty and of horror, and at speeds varying from a gentle glide to a swift downward rush. The apparatus, which has been described as a masterpiece in engineering, was designed by Mr. C. E. Cannon, and the original model of it was worked out entirely with Meccano.

Mr. F. Dutton, Superintendent of Signals and Motor Transport of the South African Railways, developed the Stronach-Dutton locomotive tractor from models in Meccano. This tractor was designed specially for use in thinly-populated countries like South Africa, the idea being to utilise the low tractive resistance of vehicles running on rails and the high tractive effort of solid rubber tyres on roads. In a letter expressing his appreciation of the Meccano parts Mr. Dutton says: "I think their adaptability and accuracy are astonishing. They furnish not only 'Engineering for Boys,' but apparatus of the most useful description for designers, inventors and experimenters. I think that the Meccano System is simply wonderful, and the interchangeability and precision of the various items are indeed extraordinary."

By way of contrast to this I may mention

that Mr. W. R. Dunlop, the inventor of an egg-grading machine for use in connection with the Ministry of Agriculture Egg Marketing Scheme, worked out his ideas with the aid of Meccano parts.

I was particularly interested some time ago to learn that the Mersey Docks and Harbour Board, of Liverpool, had worked out in Meccano, with complete success, a new type of bale-lifter, and had found Meccano of such value in developing machines in model form that they had purchased a large outfit for the use of their engineers.

Bridges have always played an important part in Meccano model-building, owing to the fact that they lend themselves to a wide variety of designs, and can be produced with remarkable accuracy even with small Meccano outfits. Not long ago the capability of Meccano in this respect was put to practical use in the United States. On this occasion large-scale models built from standard parts were used to demonstrate the possibilities of proposed bridges in New York, for which the sanction of the United States War Department had to be obtained. The point that was in dispute was whether or not some of the piers of the proposed two bridges, one at Elizabeth and the other at Perth Amboy, across the "Arthur Kill" channel, might prove to be serious obstructions to river traffic.

At the request of a committee formed by authorities in favour of the scheme, scale Meccano models were built and placed on exhibition during the hearing of the case before the War Department. The models, one of which was 21 ft. in length, were placed on wooden bases covered with plate glass to represent water, and the depths of the river at various points were plainly marked. In addition, scale models representing various types of vessels were placed on the glass river. These models proved of great assistance in demonstrating that the objections to the bridges were not well founded, and ultimately construction was sanctioned by the War Department, the engineers of which commented very favourably on the models and the purpose they had served. After the hearing, one of the model bridges was displayed at the Staten Island Ferry House, where it was inspected by many thousands of people.

Turning now to scientific applications, Professor C. V. Boys, F.R.S., has used Meccano in making apparatus and instruments. In a paper read before the Society of Gas Engineers he described the particular application of Meccano to his work, and in the course of his remarks said: "This is the third time recently within my knowledge where the admirable fittings of the Meccano firm, made and sold for toys, have found a place in a highly-refined scientific instrument."

A series of models of quite unusual interest were specially designed and constructed for Professor E. N. da C. Andrade, D.Sc., for use in connection with the Christmas Lectures that he delivered at the Royal Institution of Great Britain, London, in December, 1927, and January, 1928. These models included a "Baltic" tank locomotive with Walschaerts valve gear, and demonstration models of Stephenson's link motion and Joy's valve gear. In referring to these models Professor Andrade wrote: "The locomotive model is magnificent, and will certainly ensure the success of my third lecture." On another occasion Professor Andrade wrote: "Meccano is the finest toy not only that I know, but that I can imagine, and fully deserves all the success it has had."

Further afield, Dr. Ernest Bade, the well-known United States expert in microscopical work, has constructed in Meccano, with perfect success, a variety of devices for use in scientific work in

connection with the microscope. Some of these devices have been described in past issues of the "M.M.," and among them one of the most interesting is a microtome, an instrument for cutting extremely thin slices of plant and animal tissue, a view of which I illustrate here. Instruments of this type are costly to buy on account of the great precision they must possess; yet the Meccano model not only cuts with perfect accuracy sections as thin as two thousandths of an inch, but also is entirely automatic in action, whereas many of the manufactured instruments require manipulation of the blade. The only non-Meccano parts in the whole model are an ordinary safety razor blade and a small tube for holding the specimen to be cut.

Among the many letters from schoolmasters that I have received I will only mention the following two from masters at London County Council Schools. Mr. Percy L. Blackman, Surrey Square School, S.E.17, writes: "It may interest you to know that I often make use of Meccano in the ordinary science lessons in which I specialise. I am sure that far too

little time is given in present-day elementary science teaching to mechanical principles; and in the teaching of these I find Meccano an unrivalled assistant. The last hour on Friday afternoons I often use in allowing boys to bring their Meccano sets and make models, and display the working to the less fortunate boys."

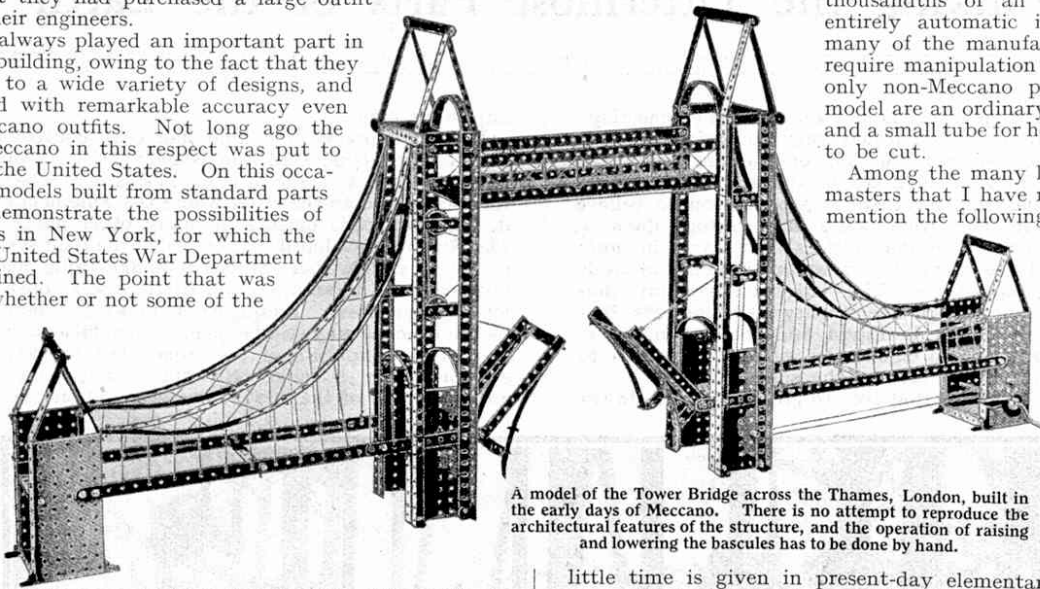
The other interesting letter comes from Mr. W. F. Abrahams, science teacher, Boys Department, Mawbey Road School, S.E.1, who says: "You will perhaps be interested in the photograph enclosed illustrating a turbine wheel constructed by the older boys in order to encourage the younger boys in the study of science. The smaller boys are encouraged to construct simple models with their Meccano parts, and at periods a little competition is held at school, when all their constructed models are seen by them working for an hour or so on the home-made shafting. The older boys find Meccano parts most useful in constructing their own models to illustrate scientific principles; indeed, there are few of our lessons in which some Meccano parts cannot be utilised."

I have already referred to the value of Meccano to the blind. Mr. R. Elton Laing, L.C.P., Headmaster, Yorkshire School for the Blind, who employs Meccano systematically in his teaching, says: "One afternoon per week is now set aside for the use of Meccano and the making of models to be employed in

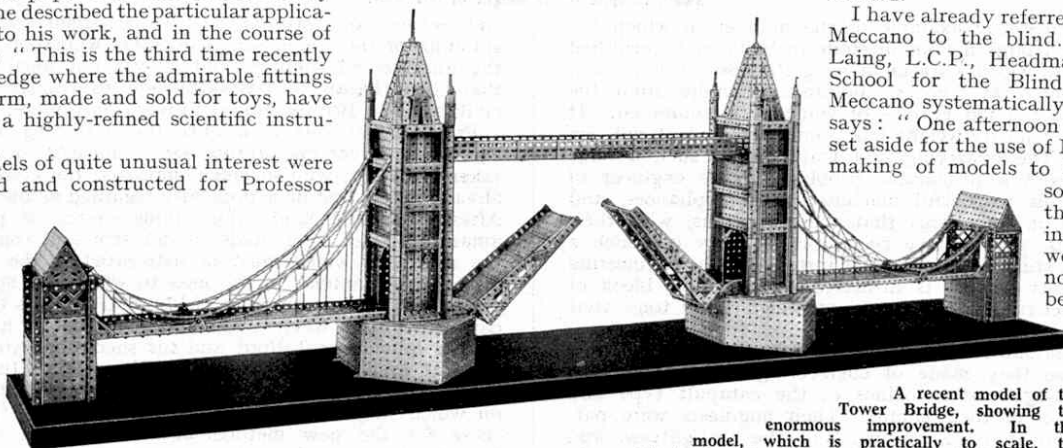
some of the lessons that will fall due in the following week. This afternoon has come to be called 'Meccano afternoon,' and I think I am right in saying that it is the busiest and happiest afternoon of the whole week.

A recent model of the Tower Bridge, showing the enormous improvement. In this model, which is practically to scale, the architectural style of the original is closely followed, and the bascules are raised and lowered continuously by an electric motor concealed in one of the towers.

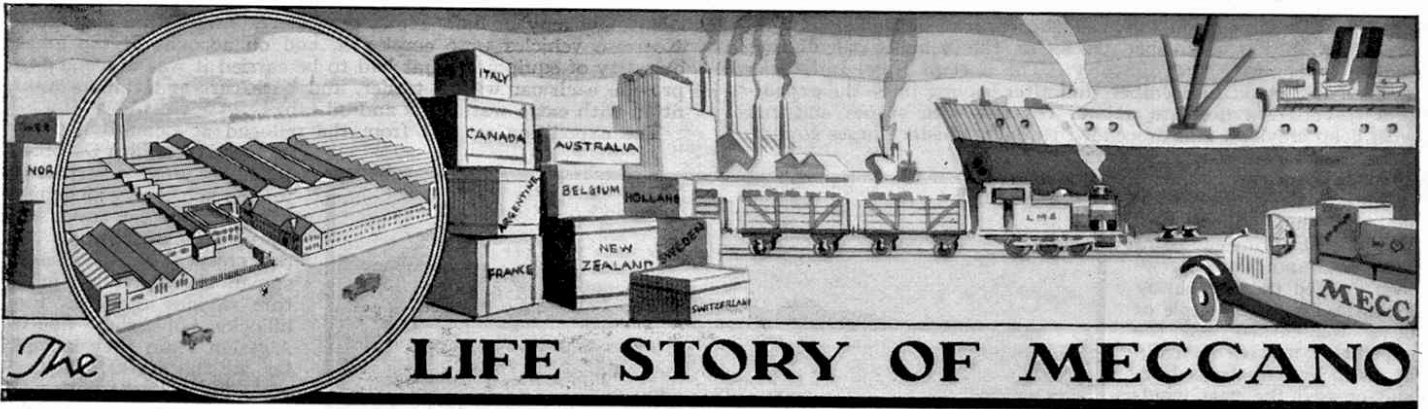
The whir of the motor is a never-ending source of delight to the younger boys, and excitement runs high when the eager hands have brought a model to completion and, by means of the motor, set it to work just like the real thing. I am now thoroughly convinced that Meccano is indispensable for the teaching of the blind along practical and at the same time interesting lines. Nowadays when our school prize day comes round and I ask what sort of prize the winner would like, the answer in very many cases is certain to be—"A Meccano outfit, please, sir."



A model of the Tower Bridge across the Thames, London, built in the early days of Meccano. There is no attempt to reproduce the architectural features of the structure, and the operation of raising and lowering the bascules has to be done by hand.



A recent model of the Tower Bridge, showing the enormous improvement. In this model, which is practically to scale, the architectural style of the original is closely followed, and the bascules are raised and lowered continuously by an electric motor concealed in one of the towers.



VI.—By Frank Hornby

THE early history of Hornby Trains is as fascinating as that of Meccano. To begin at the beginning I must take you back to the time of the Great War, a bygone age to most of you but a vivid memory to those of us who survived that stormy period. Among the new parts added to the Meccano System somewhere about this time was Part No. 108, Architrave, and when samples of this part were being examined someone drew attention to its resemblance to the side of a locomotive cab. It was evident that it would be a useful part in the construction of Meccano locomotives, as we had not previously been able to satisfactorily model an engine-cab.

To see exactly how the part would build up we had a model constructed, using another special part for the boiler. The model looked very realistic and, as someone pointed out, its only drawback was the fact that it would not run under its own power. From the construction of this little model was but a step to the idea of marketing a constructional locomotive having a specially-designed clockwork motor, but the idea had to be shelved until such time as our machines were released from the War work on which they were engaged.

The idea, as originated in this little Meccano locomotive, which is illustrated on this page, was one that was to bear abundant fruit in the later years. More particularly so because during the later years of the War there was a scarcity of mechanical toys of all kinds. Prior to 1914 most toys of this nature had been imported from the Continent, and of course when hostilities commenced this source of supply had come to an end. The greatest grievance of the youngsters of that period was the impossibility of obtaining toy trains.

For some time after the Armistice we were fully occupied in making up for lost time in the production of Meccano. We did not lose sight of the possibility of clockwork trains, however, and carried out numerous experiments to develop the earlier ideas on sound practical lines. In 1920 we decided to commence the manufacture of clockwork trains, and in that year the first "Hornby Train" was placed on the market.

These trains were unique in that they applied the Meccano constructional idea. Engines, tenders and trucks were built up from standard units, and could be taken to pieces and rebuilt in a similar manner to Meccano models.

In addition, new parts could be purchased at any time to replace any that might be damaged or lost. The clockwork mechanism was of first-class quality, and we paid particular attention to the accurate cutting of the gears in order to ensure the smooth running that is so desirable in miniature trains. We decided to

build our trains to the standard miniature Gauge "0," in which the distance from inside to inside of the heads of the rails is $1\frac{1}{4}$ in. We also decided upon two standard curves, forming respectively circles of 2 ft. and 4 ft. diameter. The success of these first Hornby Trains was immediate, and indeed it surpassed all expectations. The reason for this was that the army of Meccano boys had complete faith in anything turned out by the Meccano factory, and consequently Hornby Trains were purchased without hesitation.

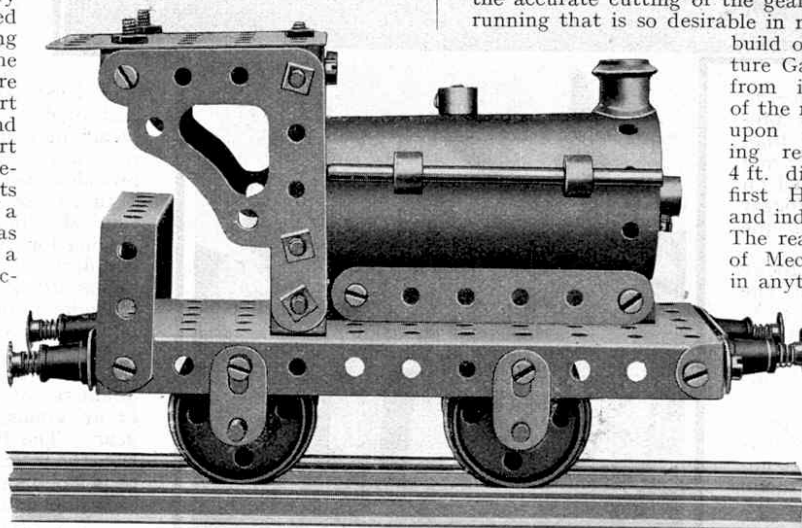
From the outset we determined that the Hornby miniature railway system should be just as perfect in its way as Meccano, and the ideal that we kept in mind was that of a gradually growing and developing system that ultimately would be capable of reproducing in miniature practically all the everyday

operations of actual railways. Before long we found that the building of locomotives and rolling stock on the Meccano constructional plan was proving a handicap to the development of more realistic and true-to-type models. After careful consideration, therefore, we decided to abandon the constructional plan, and since 1925 all Hornby locomotives and rolling stock have been built from specially-made components, assembled into a complete unit.

In order to provide as great a variety as possible the first Hornby Trains were made available in five colours to represent the London and North Western, Midland, Great Northern, Caledonian, and London, Brighton and South Coast railway systems.

Our first locomotives were well designed and constructed, and we received an astonishing number of letters expressing the keenest enthusiasm in regard to their smooth running and excellent hauling powers. We were not satisfied, however, and a section of our technical staff was set to work to study further the problems involved in the construction of clockwork engines, and to introduce every possible improvement that would make for greater efficiency. This development work has gone on ever since, and as a result Hornby locomotives have been improved steadily year by year until we can fairly claim that they are superior to all rivals.

Along with the development of



The little Meccano locomotive from which a great industry grew—the production of Hornby Trains. The earliest Hornby locomotives, tenders and trucks were built up from standard units and could be taken to pieces and re-built in a similar manner to Meccano models.



The first Hornby Train Set. The engine, tender and truck were built up from standard parts.

locomotives there has proceeded a steady increase in the number of types of rolling stock and of accessories of all kinds. Many of these items were introduced as the direct result of requests from boys. The suggestions put forward in the letters arriving day by day in large numbers from all parts of the world are carefully tabulated, and when it is seen that there is a widespread demand for a particular item, the production of this is carefully considered. If the idea proves practicable, designs are got out, and before long the new accessory or piece of rolling stock is being turned out by the thousand, to the great joy of the boys who suggested it.

Soon after the introduction of the Hornby System we began to receive requests for electrically-propelled locomotives. We postponed development in this direction until our clockwork trains were thoroughly established, and then in 1925 introduced an electric train set modelled on the lines of the London Metropolitan Railway. The locomotives of these first Metropolitan sets were operated by high-voltage motors, but before long we abandoned these motors in

favour of low-voltage motors, first of four volts and afterwards of six volts. These motors had the great advantage that they could be used either with an alternating current mains supply through a transformer, or from an accumulator. They were thus available for every boy, whether his home had electric light installed or not.

The starting and stopping of these locomotives, and their running speed, are controlled by a special resistance controller situated outside the track, but reversing has to be done by the movement of a lever in the locomotive cab. In response to many requests we introduced some time ago a tank locomotive to be run from a six-volt accumulator, not from the mains, which can be reversed as well as started, stopped and controlled for speed from a controller outside the track. This fast and powerful little locomotive can thus be made to do anything without the necessity of touching it, and it has become a great favourite with Hornby railway enthusiasts.

Electric locomotives have the advantage that they do not require to be wound up. They keep on running as long as the current remains switched on, and the un-railway-like spectacle of a train stopping half-way between stations, owing to the clockwork having run down, is avoided. Long continuous runs are possible—one Hornby Train ran continuously for over 800 miles—and at the same time stops may be made as required. In addition there is sufficient power available to enable gradients to be incorporated in a layout, so that an actual descent to and ascent from an underground section of line is possible.

In 1926 the Hornby Control System was introduced, and this has enabled miniature railways to be operated on lines closely following actual practice. By means of a special lever frame and connecting wires, the points and signals of a layout can be controlled from a signal cabin just as is done on a real railway. The application of the Control System to a model railway thus increases its realism and interest to an enormous extent. Another introduction that has tended towards greater realism, especially in shunting operations, is that of automatic couplings. These are now fitted to all Hornby locomotives and rolling stock. They couple on impact, so that an engine may be backed on to its train in the correct manner—a piece of model railway working that is always interesting to watch—and the couplings will engage of their own accord. All that then remains to be done is to reverse the engine, and the train is ready to depart. The speed of operations, particularly in a busy terminal station, is thus considerably

increased as compared with the ordinary method of coupling.

The latest additions to the Hornby Railway System have been introduced for the special purpose of giving "life" to a model railway, and providing it with suitable surroundings. The bare and desolate appearance that characterises the station platforms of so many model railways has always seemed to us to be a serious defect, and we determined to do what we could to improve matters in this respect. We therefore introduced first of all a series of miniature platform accessories, including luggage and a porter's barrow, milk cans with a suitable truck, and such items as seats, a letter-box, and automatic machines. To these accessories we have recently added a series of miniature figures—stationmaster, guard, porters, ticket collector, engine driver, hotel porters, etc.—and a station platform provided with a selection of these miniatures immediately takes on an appearance of life and realism that is quite remarkable. The trains must have a reason for running, and a series of miniature passengers is to be added to the existing operating staff. To increase still more the lifelike appearance of the station, miniature posters are available. These are small-scale reproductions in the original colours of the most famous posters that cover the hoardings of our towns and cities. They are gummed on the back, so that they may be readily attached to the miniature station hoarding. As an alternative the posters may be mounted on special poster boards fitted with two lugs that can be attached easily to fencing and to bridges.

The Hornby System is particularly well equipped with accessories in the shape of lineside structures of various kinds. There is the signal cabin, which can be arranged to accommodate the lever frame, or in the case of electric layouts, the controller; there are stations and goods platforms, where heavy traffic can be dealt with; and there are the imposing Engine Sheds for the housing of the locomotives. Among the smaller accessories, the watchman's hut and the platelayer's hut are particularly effective, and have proved extremely popular on account of their realistic appearance.

Another notable introduction is a series of train name boards and destination boards. By means of these boards the various expresses of the Hornby Series may be appropriately named, the most famous trains of the four groups being represented. The improvement

in the appearance of miniature trains brought about by the use of these boards is quite remarkable.

Many of the Hornby accessories, such as the engine sheds, goods platform, signal cabins, signals and buffer stops, have recently been suitably wired and fitted for electric lighting. It thus becomes possible to illuminate a miniature layout on realistic lines, the signals in particular having a most fascinating appearance.

As the result of widespread requests we have recently extended our range of tunnels, with the special object of assisting the owners of railways that have to be taken up and stowed away each time after use. These tunnels are made in various lengths, and special features are the curved tunnels in the form of a small hill through which the track runs obliquely. These may be obtained either with a right-hand or a left-hand curve, so that they are suitable for any layout.

Still another innovation that will add enormously to the appearance of any model railway is a series of cuttings. These also are made in a variety of sections. There are end sections, sloping down realistically to ground level, and centre sections to be inserted between these end sections, thus enabling a cutting to be extended to any desired length. The centre sections are also made in curved form.



Hornby Trains in the making. (Top) Enamelling a locomotive by means of a compressed air spray. (Centre) Hand finishing locomotives. (Right) Testing locomotives for hauling power and length of run.

