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PRODUCTION OF EDUCATIONAL TOYS APPROPRIATE FOR  
DEVELOPING COUNTRIES \*

by

P. Schült\*\*

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### Introduction

During the first six years of a child's life it plays about 15 000 hours and nobody is preventing this activity. What are they doing in 7 to 9 hours every day? What is or is not considered as play? In observing children, one will notice that everything can become a game in their hands: washing, dressing, eating, etc.

What we call "playing" is an exploration of the children within their own environment, covering human beings, objects, matters, events followed by the, besides listening, smelling, tasting and touching.

Children have their own point of view. They are able to realize the significance of people, objects, matters and growing to be able to co-ordinate things properly in their life.

Learning by playing is learning by practical experience. These considering the play of children will also deal with their environment in another light, trying to extend the scope of experience within the world of the adult.

Although all types of toys in earlier times for children are known for their importance in training, in this modern world continues to influence children with appropriate toys. In former times, the toy material was offered by nature and by the different workshops, not separated from the dwellings where children grow up. They could live with the activities of the adult and the nature of subjects was comprehensible.

Many things were imitated in play and with this activity experience was gained. Pulling a loaded hand-cart gives an idea of the efficiency of a horse pulling a milk trolley. The efficiency of a truck is not understandable this way.

The more convenient and easy the world is developed for adults, the more tedious and boring it becomes for children. Thus, one has to recover the lost world of experience ingeniously by toys. The independent play is really essential for a child. Generating abilities, overcomes its aggressions and solitude, creates its own world and is developing the ground for intelligence, initiative, self-reliance, and imagination, which is also the starting-point for learning-activities within the pre-school period. What children formerly could see and understand day by day as an unplanned matter of course is available today by means of beginner's teaching aids.

Unfortunately this development has also its by way. The knowledge that playing facilitates the learning process lead to recommendation to increase playing by using toys as learning and training aids. The toy industry logically reacted and developed the so-called "educational toy", but this terminology does not include the toy quality. Many of these toys are completely unsuitable. As often they have little or nothing to do with playing.

A real play can develop itself towards independence when spontaneous activities can be enrolled and the playing child can decide on its own about progress and finalisation of its action. Activities based on ones own choice, the playing child follows its ideas, creates abilities on the track of mistakes or errors. Aimed, methodical learning is entirely different. 15 000 hours play-time of the infant and 10 000 hours of the juvenile-age are certainly worth giving some serious thought to on, how, where, when and with what a child is playing.

#### 1. Evaluation of production equipment

Wood is an original and living material. Unfortunately, it is not as much appreciated in this modern world as it should still be. Therefore, it is important to realize the value of this beautiful material. Wood is used in all countries for many different products. The wooden toy has a history of long tradition. In former times it had been produced exclusively in cottage industries, home workshops where the knowledge of handicraft was handed down from one generation to another. There are still family workshops manufacturing special toys based on tradition.

The machinery and equipment of the woodworking toy industry consists mainly of light duty to medium machines, with some being of the heavy duty type. The same machines are installed in joinery and cabinet manufacturing plants. By adding turning machines, these operations produce specialty items used in the manufacture of toys. For sanding operations drum-belt, edges, and disc-sanding machines are used. Printing is done on simple screen printing jigs. The staining and varnishing is done by dip and spray coating equipment.

In machining wooden toys it is advisable to have several machines of the same type. These should be of a standardized range so that the same tools fit several machines. Besides the stationary machines it is necessary to have a selected range of hand-operated machines. Both machine types should be available in developing countries, where they can be maintained in a small maintenance and repair workshop adjacent or joined to the factory. Before purchasing the machines for toy production one has to know the toy range. For each toy drawings have to be prepared. Based on these drawings, the lay-out and the work flow within the factory should be scheduled, following which in-plant material handling systems need to be programmed. In the planning stage, a factory for the manufacture of various designs of toys, the arrangement of the working tables and assembly lines have to be prepared to accommodate for teamwork operation. The same is true for the packing and shipping sectors.

Two aspects of a well organized toy production plant are:

- A production flow without return flow;
- Conveying distances have to be as short as possible and the transportation equipment must be appropriate to the manufacturing facilities.

## 2. Minimum capacity

The purchase of machines to facilitate the work which also could be done manually is justified only if the production costs decrease, quality is improved and production is increased.

Supposing the annual profit of a toy factory is in the area of E: 40 000 on annual costs of E: 1 000 000 - this corresponds to a capital requirement of E: 500 000 which produces the following results:

$$\text{Profitableness (P)} = \frac{\text{profit}}{\text{capital}} \times 100$$

$$P = \frac{40\,000}{500\,000} \times 100 = 8\%$$

In comparison with E: 320 000 capital

$$P = \frac{40\,000}{320\,000} \times 100 = 12.5\%$$

The minimum capacity of a factory depends on a number of factors. Not only normal operating factors are decisive but also marketing. The more the market can absorb, the more the purchasing power exists the easier - without much expenditure for advertisement - one can sell the product. One can produce by large batches. If the competition is strong and the market is small, the assortment has to be increased. This means one has to produce in small batches. The batch size itself does not give any evidence on the economy and profitableness of the factory.

### 3. Jigs and Fixtures for production of toys

In other industry requires the manufacture of such a variety of jigs as the wooden toy industry. As this industry services a limited market, no special machines have been developed. But to manufacture in the most rational way, the toy industry developed very special jigs manufactured specially for its range of toy products. The toy industry also developed special machines for itself based on power driven units or portable fire machines. Jig production and design is a development technique. At first a rough pattern made from off-cuts has to be screw assembled which can be corrected in its shape before finishing the accurate jig. Either mechanical or pneumatic clamps are used as a means of positioning. There are often small parts required to form the jig, much larger than the work piece, to be machined to avoid accidents.

As far as possible a jig should be applied machining various parts e.g. for parts which vary in length only. This is possible by folding jigs. Also by applying screw heads one can easily convert a jig for different parts.

The quality of the jig depends on the skill of the operator as well as on the material used. To a large extent jig and templates are manufactured from laminated densified wood. For less stressed jigs high grade plywood can be used. To hold boring, accurate metal bushings should be counter sunk.

The life of a jig depends on the quality of the material, as well as on its handling. As mentioned above, the construction of

jigs and fixtures is a development technique. One should always start with simple jigs and later on manufacture more complicated ones.

In developing countries a factory should not only be a place of production but also a place of training to improve skills necessary to step into intermediate machine technologies. Just the jig and fixture design enables one sooner or later to easier understand new techniques.

#### 1. Jigger form - Simple to manufacture

Toys and toy elements shown on the following pages can be manufactured with a minimum of material and tools. The parts consist of four rods (wood slats) with a square cross section. Some toy elements are made of round rods with a diameter of 8 mm and 20 mm.

#### The U-element

Composed of two long and one short piece. The U is also the basis for various animals, eg. the horse and the ape.

#### The black cross-element

The symmetry of this element renders possible an annex or complementary assembly. The end-on-formation offers many possibilities.

#### The L-element and the angle element

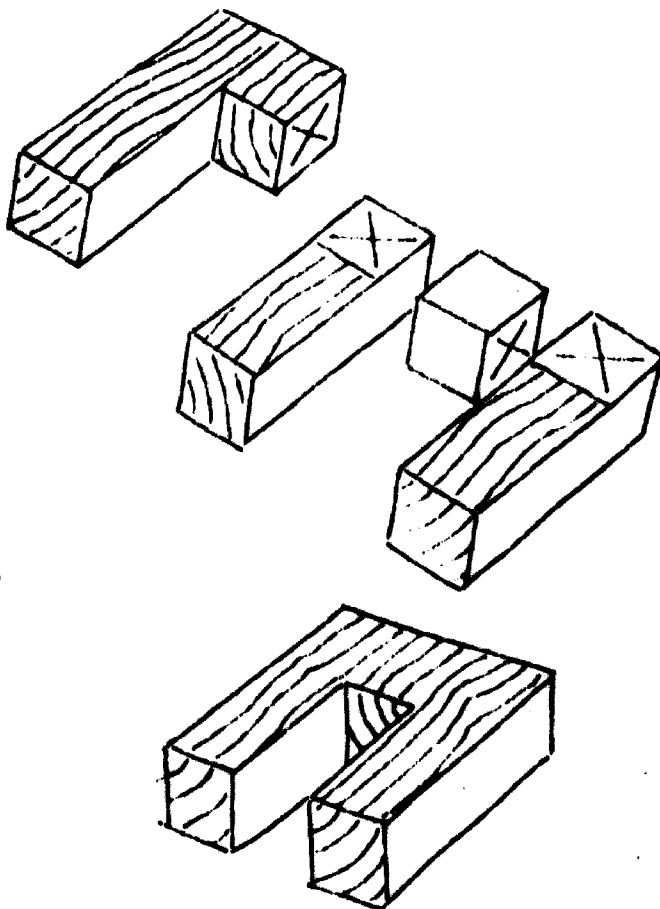
Both are typifying trees and bushes compared to a ladder or a fir-tree, consequently one can realize the various angle constructions.

#### Stick cross-element (without sketch)

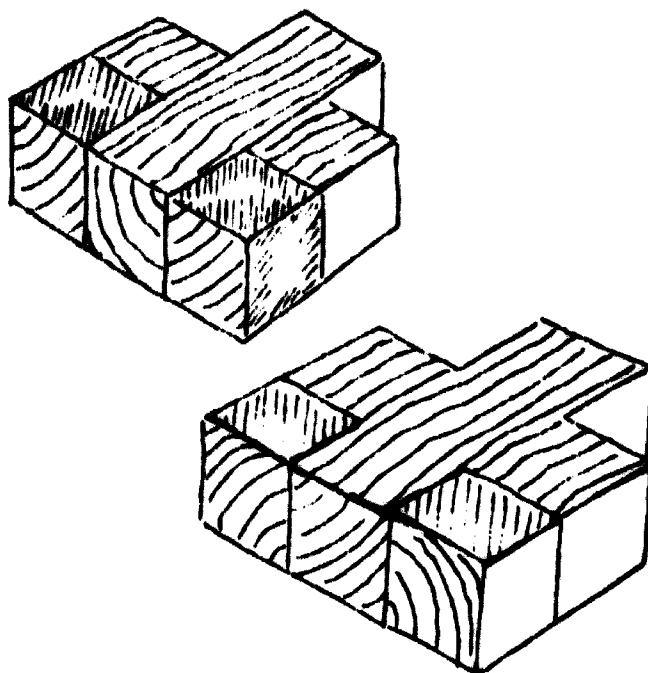
Another cross-element made of sticks glued one transposed upon the other. By arrangements of two parts in the levels, the elements are not only built up one on top of the other but they also interlock - similar to a weaving structure.



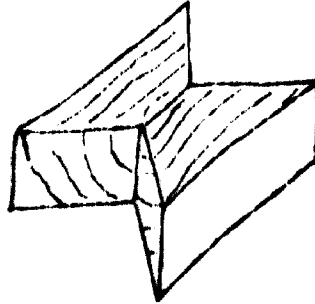
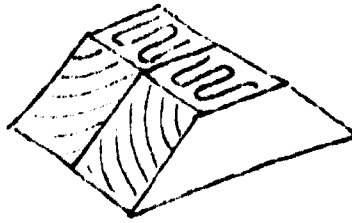
**The U-element**



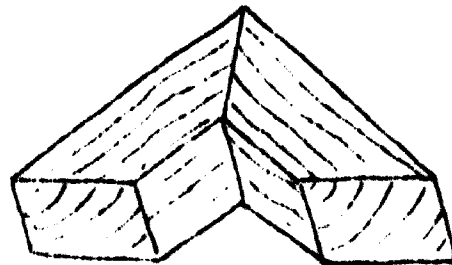
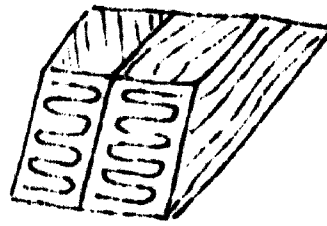
**The cross-element**



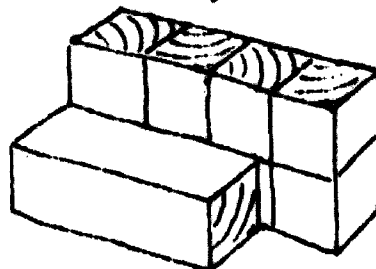
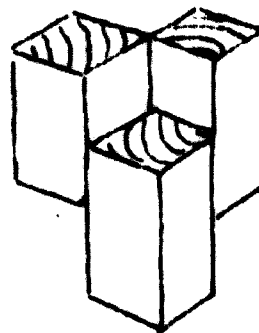
The X-element



The angle



The red pinning element to be joined



**The transposed cross-element (without sketch)**

Made of three long sticks glued and transposed. It is the most popular element when considering construction properties.

**The H-element (without sketch)**

This element consists of four medium-sized sticks. They can be joined only in one direction and produce some very interesting shapes.

**The T-element**

This element is composed of one long and two short reglets. Apart from the T, one can also build up other letters. The single letters are interesting in their varying assembly possibilities. While the T-element is preferably used for piling up, the H-element joined in different directions.

**5. Wooden building blocks**

Wooden building blocks are considered to be the most favoured of old toys. With this plain toy the child has many possibilities in forming and building. Thus it is one of the best educational toys.

The basic element is the cube sized 40 x 40 mm or 25 x 25 mm. All the measures of the other pieces are determined by those of the cube.

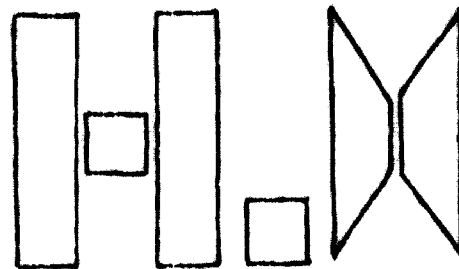
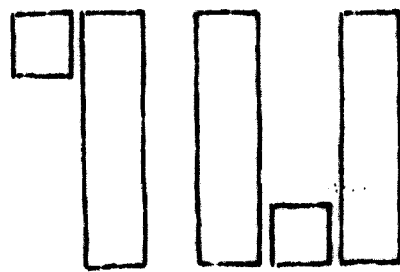
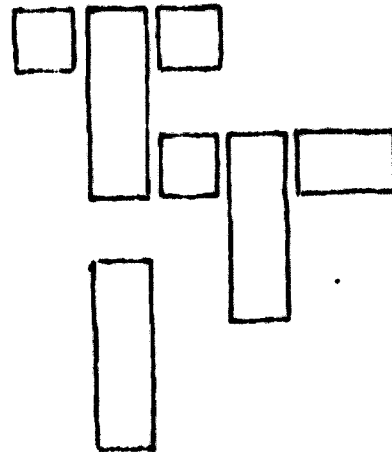
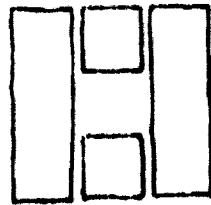
Blocks with different volume setting different requirements will familiarize the child with basic elements. If the child takes interest in building one should enlarge the basic range by an extension box to encourage building activities.

The building blocks are mostly made of material from timber of broad leaf species tree, finished by sanding with all edges smoothly rounded. It is better to leave them raw - i.e. without surface coating - because the varnished surface makes the blocks slippery which renders the building and constructing rather difficult.

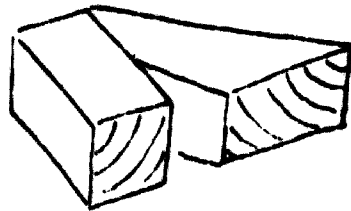
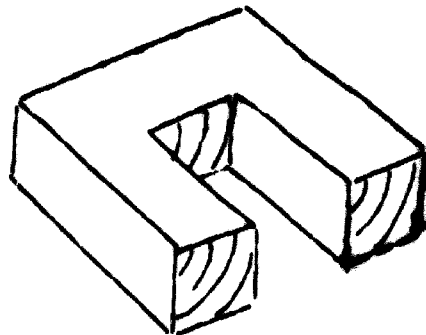
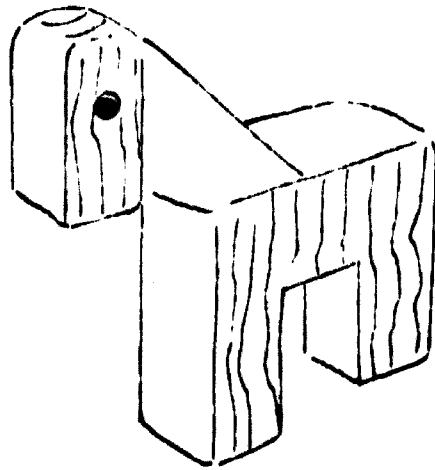
**Contents of the basic boxes:**

Small basic box:	24 pieces
Medium basic box:	48 pieces
Large basic box:	96 pieces

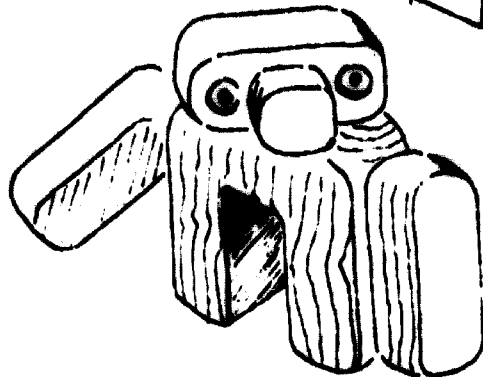
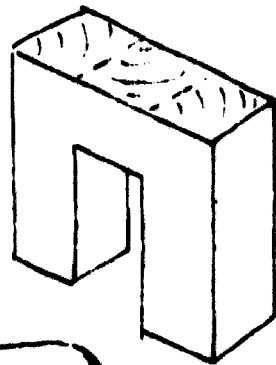
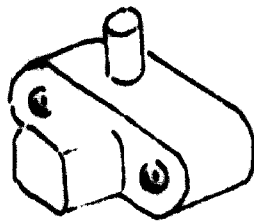
The T-element



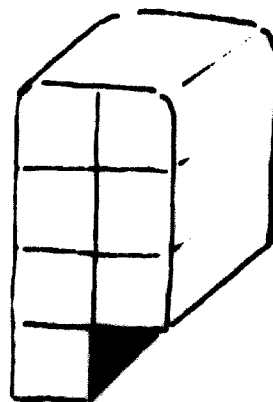
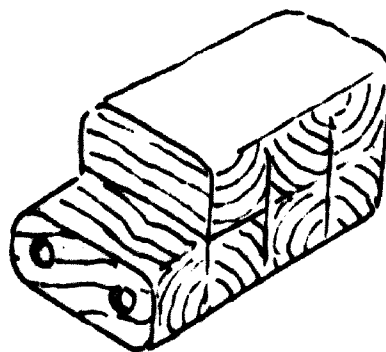
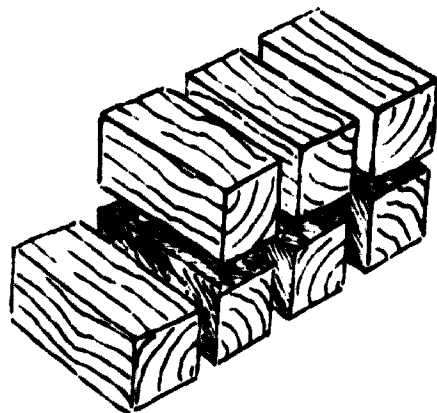
The horse



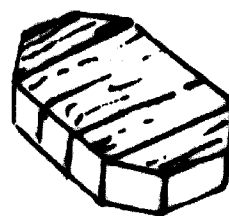
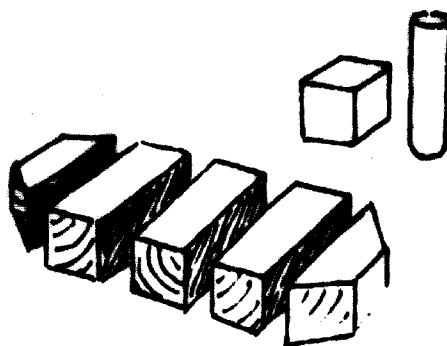
The ape



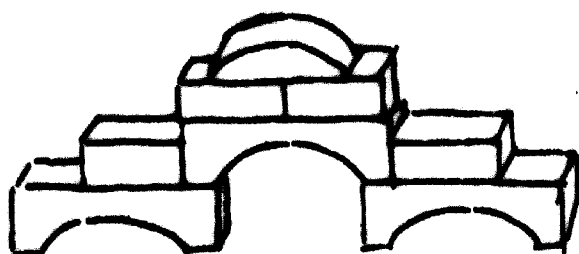
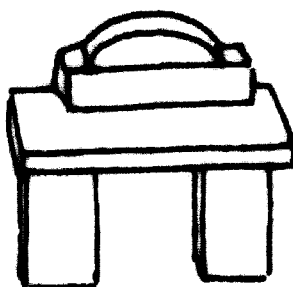
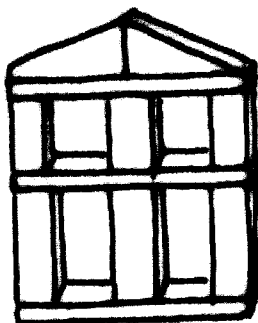
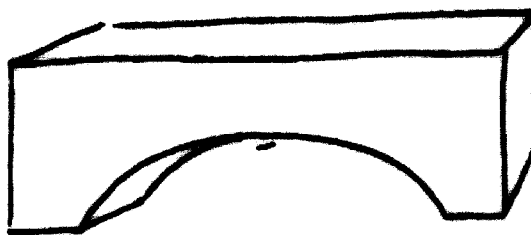
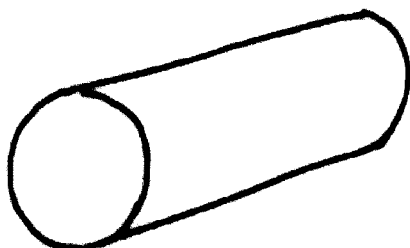
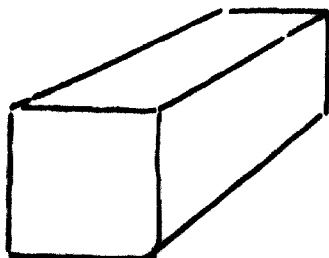
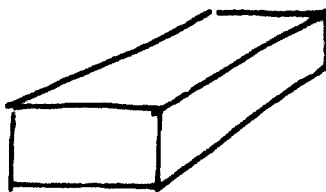
The motor-car



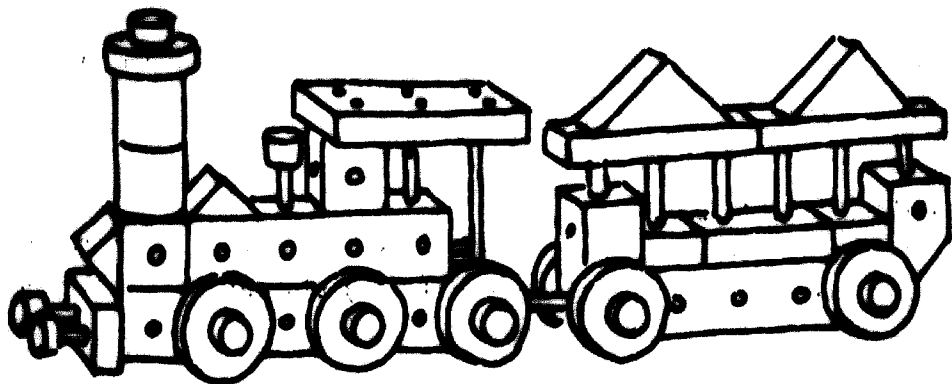
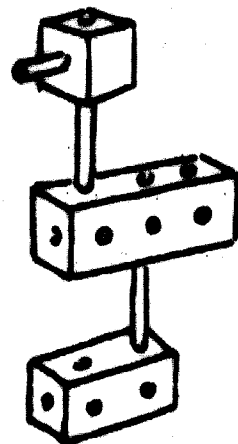
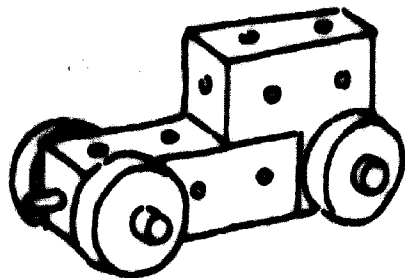
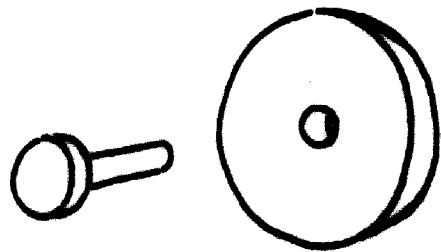
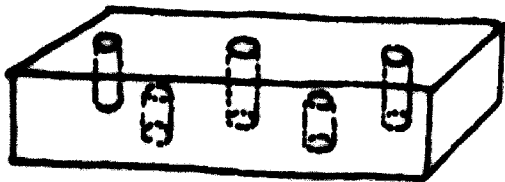
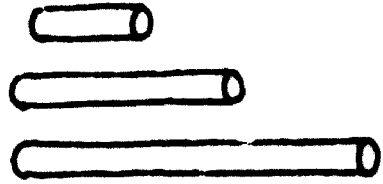
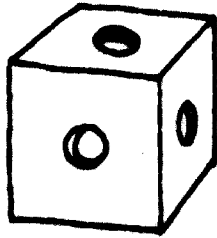
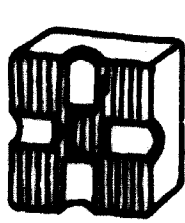
The boat



Wooden blocks



Wooden blocks with holes

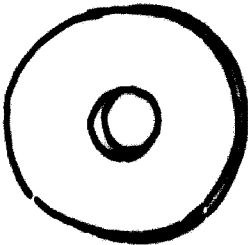




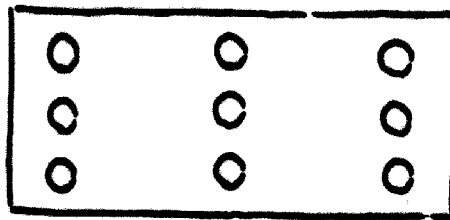


Wooden construction material - Boltin system

Boards (floor slats)



washer  
or shim



assembly plates



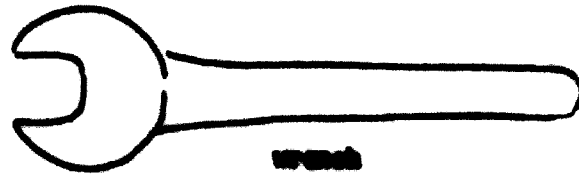
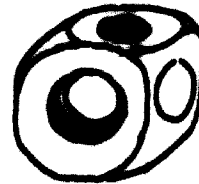
slotted bolt



hexagon bolts



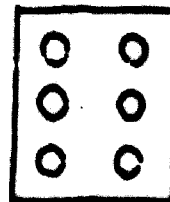
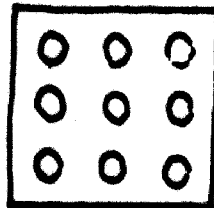
four way nut



wrench



screw driver



These reglets of different lengths have bores in a distance of about 60 mm and they have to be joined by bolts and nuts. Besides the different lengths of the bolts (screws) there should also be manufactured two different types of bolts: the slotted head and the hexagon head so the child learns to handle both, the screw driver and the wrench. The nuts should have the form of a rhombus for easier tightening by hand.

Cubes 30 mm by 30 mm bored are taped with the edges being smoothly rounded. This system also includes the wheel.

This wooden construction set is certainly one of the most ideal toys as it guarantees a lasting tight fit by the bolts. The child must already be 3 - 4 years of age when starting structural play.

The smallest basic box of this construction material should contain about 100 pieces. Larger boxes should contain - besides the mentioned elements - base plates, which offer increased construction possibilities. The size of the plates have to correspond with the size of the reglets.

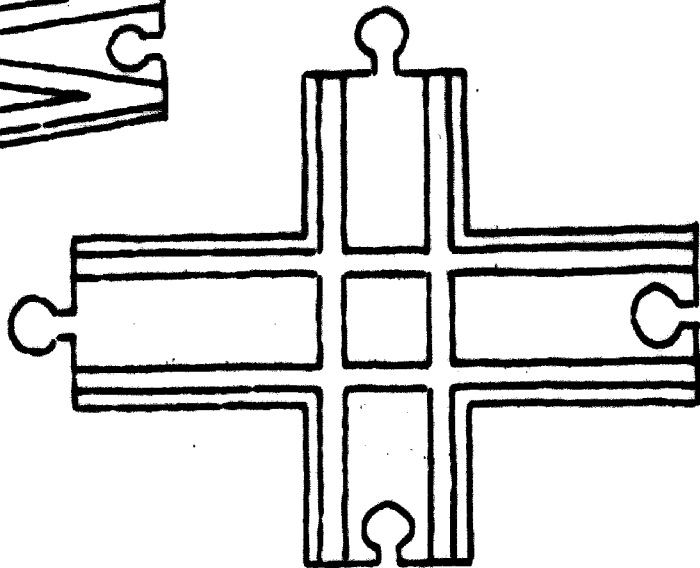
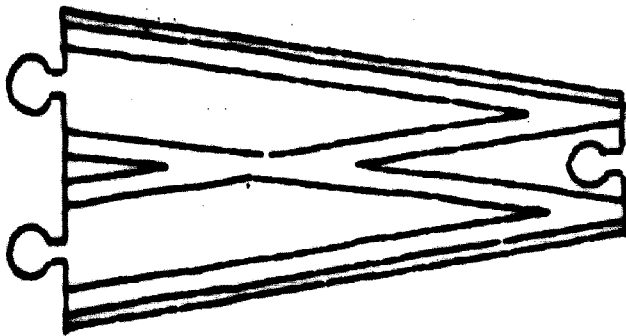
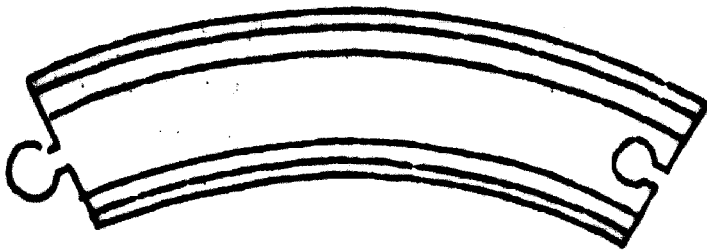
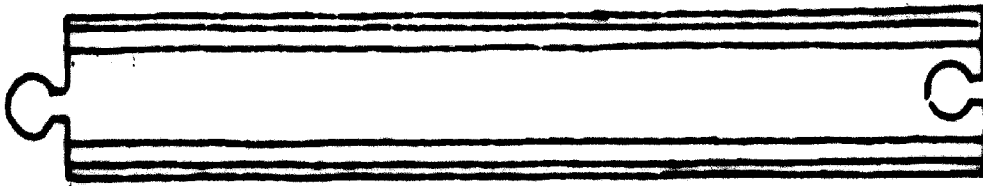
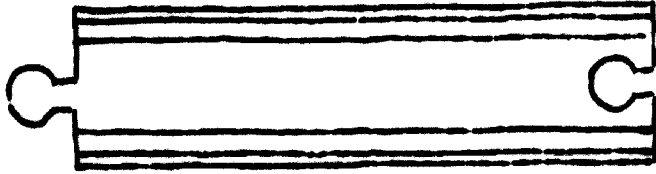
#### 7. Wooden railways

Other favoured and educational wooden toys are railways and speedways. This is the most simple model toy for a child. The rail elements are assembled for railway cars or for speed way cars. With the wooden model toys, the child is introduced to motion elements vis.: train or car to be moved by hand. The manufacture of this toy needs more machines than the production of construction toys but as an educational toy it is a very important element.

The smallest basic box must contain at least 8 curved tracks as well as a train with two wagons.

Here also extension boxes with straight and curved tracks and crossing tracks should be available. Signal, barrier, bridge head, crane, container transport, small cars, etc. should be offered as single packages.

Wooden railway or speedways



### 8. Summary

Each of the described construction toys and the railway tracks are educational toys which stimulate the child's imagination and enables it to imitate what it finds in reality. With these toys the child becomes familiar with the different functions of engineering.

All toys can be varied appropriate to the inclination of each individual child.

There is no difficulty in the production of these wooden toys. The most important prerequisite for an acceptable toy is the material which is wood. On account of its characteristic feature to shrink and or swell it is possible that after some time the stick connections do no longer fit tightly, but when kiln dried, there will be no problem derived from moisture content. Decision for this is the selection of the wood which should be plain (not heartwood). It must be absolutely free of tensile strength. The toy must be worked out very accurately because all parts must fit precisely.

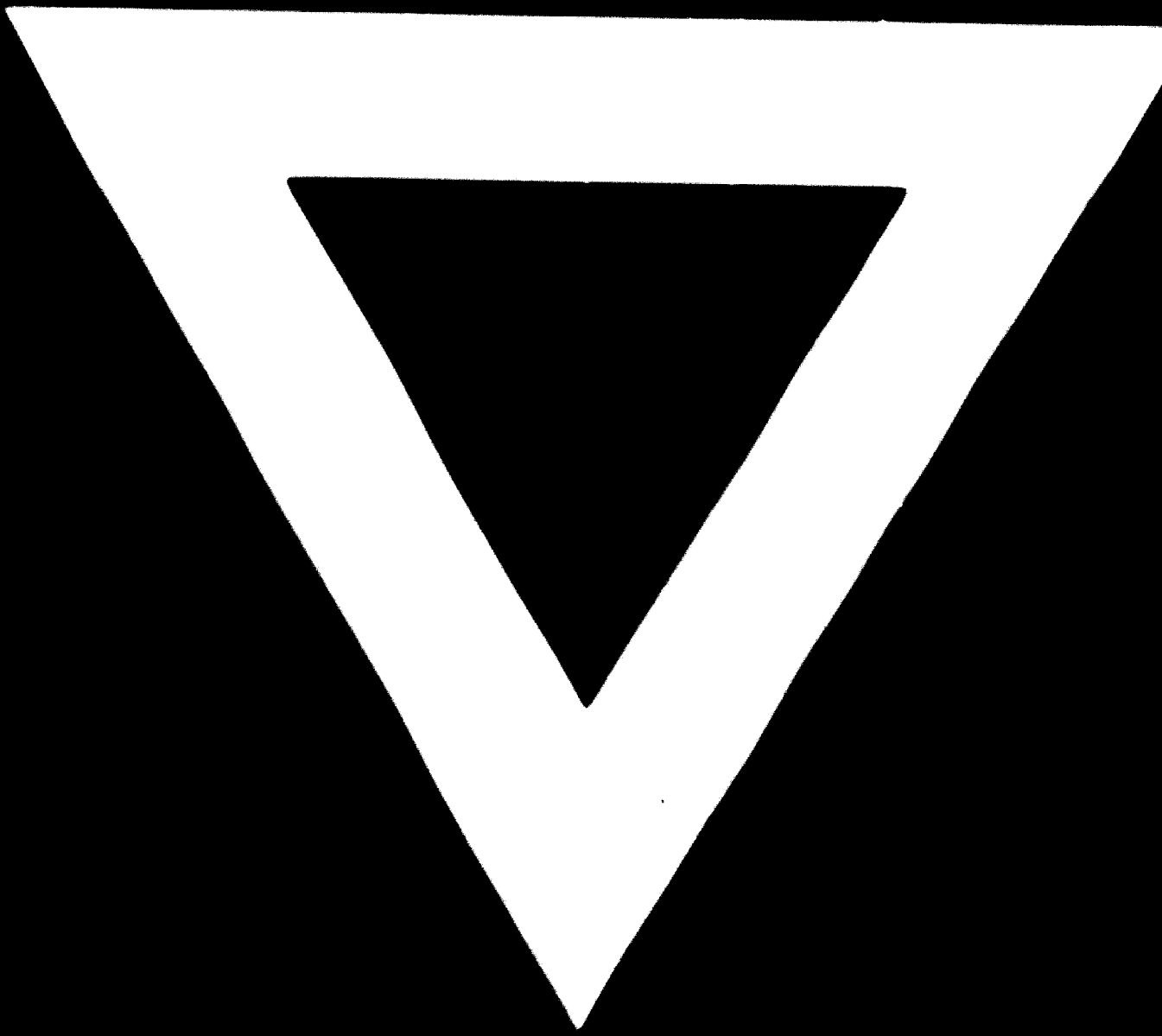
As to the production, it should be considered that the assembly of the trains and wagons as well as the mini cars can be done in cottage workshops as no machines are required for assembly.

### 9. Machinery list for a small scale toy workshop

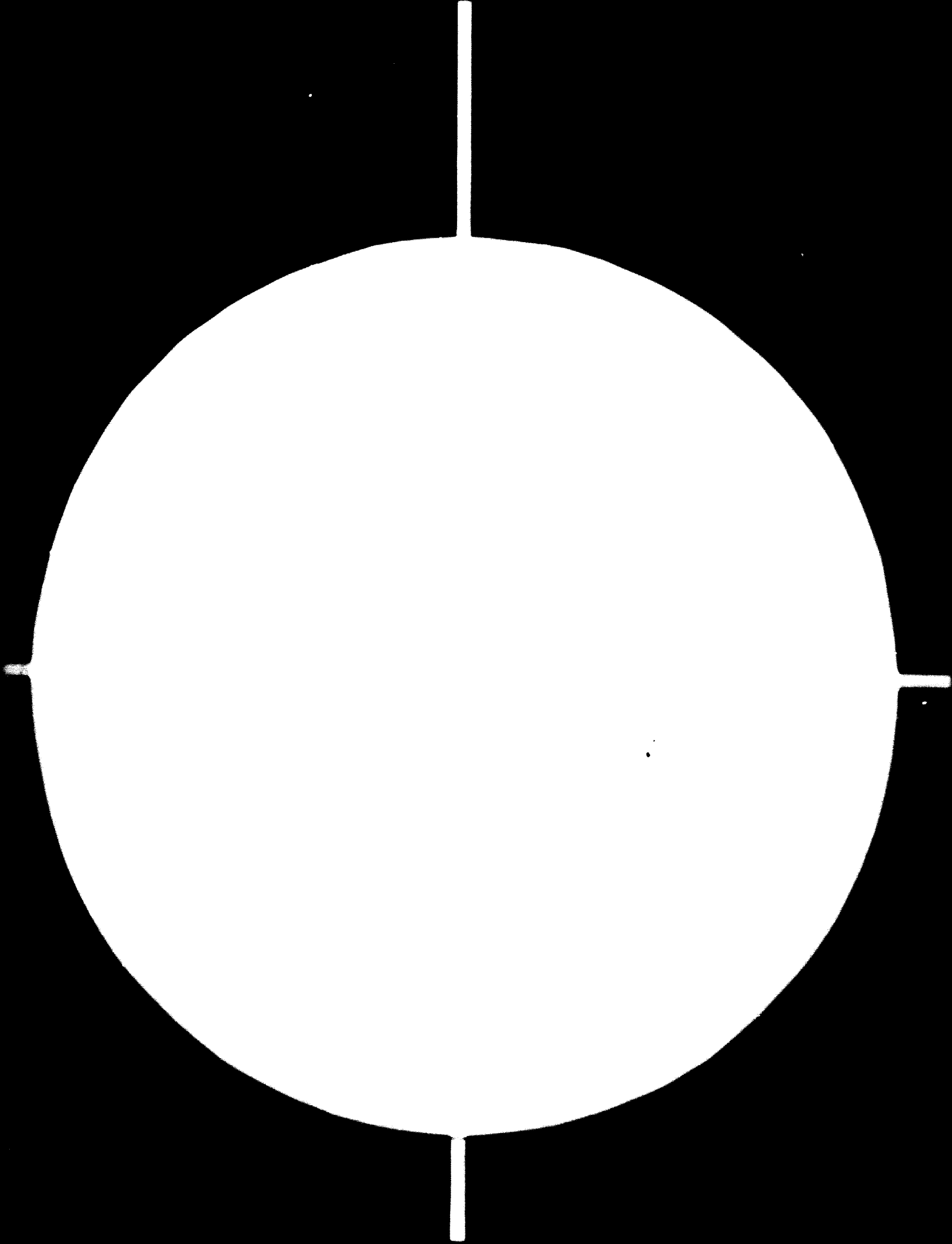
- Kiln drying chamber (condensation drying could be applied)
- Cut off saw
- Circular saw (with extended spindle for rip sawing reglets)
- Surface planing machine
- Thicknessing machine (alternatively: four-side planing machine)
- Spindle moulder
- Routing machine
- Bench drill
- Multi-spindle drilling machine
- Turning lathes with screwing attachment
- Four-side moulding machine
- Bowl milling machine
- Bowl-out-off and chamfering machine

- Band saw
- Contour sanding machine
- Band sanding machine
- Drum sanding machine
- Belt sanding machine
- Edge sanding machine
- Sanding stand (brush sanding machine)
- Various power driven manual operated machines

**C-149**



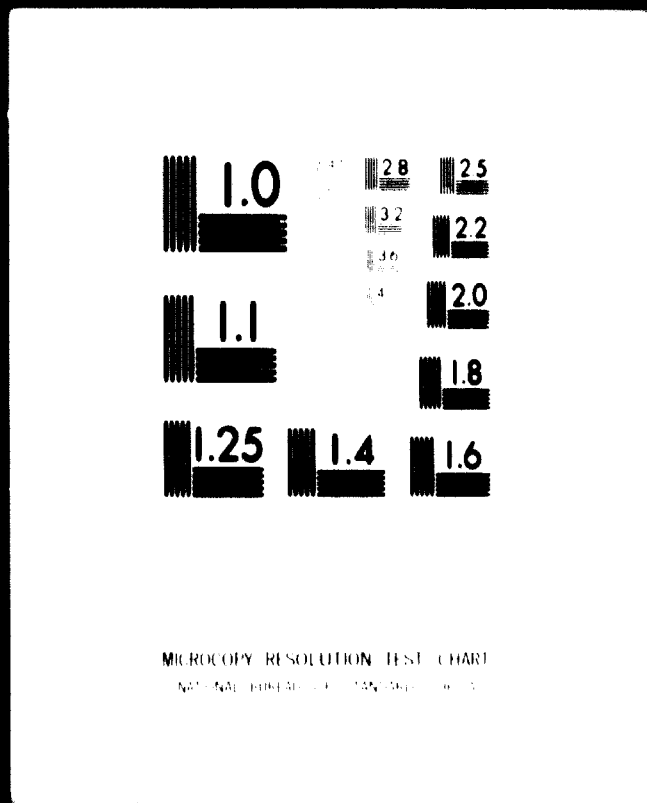
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Seminar on Wood Processing Industries  
Cologne and Hannover, FRG, 16 - 30 May 1979

**PRODUCTION OF EDUCATIONAL TOYS APPROPRIATE FOR  
DEVELOPING COUNTRIES \***

by

**P. Schulz\*\***

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### Introduction

During the first six years of a child's life it plays about 15 000 hours and nobody is preventing this activity. What are they doing in 7 to 9 hours every day? What is or is not considered as play? In observing children, one will notice that everything can become a game in their hands: washing, dressing, eating, etc.

What we call "playing" is an exploration of the children within their own environment, covering human beings, objects, matters, events followed by the, besides listening, smelling, tasting and touching.

Children have their own point of view. They are able to realize the significance of people, objects, matters and growing to be able to co-ordinate things properly in their life.

Learning by playing is learning by practical experience. These considering the play of children will also deal with their environment in another light, trying to extend the scope of experience within the world of the adult.

Although all types of toys in earlier times for children are known for their importance in training, in this modern world continues to influence children with appropriate toys. In former times, the toy material was offered by nature and by the different workshops, not separated from the dwellings where children grow up. They could live with the activities of the adult and the nature of subjects was comprehensible.

Many things were imitated in play and with this activity experience was gained. Pulling a loaded hand-cart gives an idea of the efficiency of a horse pulling a milk trolley. The efficiency of a truck is not understandable this way.

The more convenient and easy the world is developed for adults, the more tedious and boring it becomes for children. Thus, one has to recover the lost world of experience ingeniously by toys. The independent play is really essential for a child. Generating abilities, overcomes its aggressions and solitude, creates its own world and is developing the ground for intelligence, initiative, self-reliance, and imagination, which is also the starting-point for learning-activities within the pre-school period. What children formerly could see and understand day by day as an unplanned matter of course is available today by means of beginner's teaching aids.

Unfortunately this development has also its by way. The knowledge that playing facilitates the learning process lead to recommendation to increase playing by using toys as learning and training aids. The toy industry logically reacted and developed the so-called "educational toy", but this terminology does not include the toy quality. Many of these toys are completely unsuitable. As often they have little or nothing to do with playing.

A real play can develop itself towards independence when spontaneous activities can be enrolled and the playing child can decide on its own about progress and finalization of its action. Activities based on one's own choice, the playing child follows its ideas, creates abilities on the track of mistakes or errors. Aimed, methodical learning is entirely different. 15 000 hours play-time of the infant and 10 000 hours of the juvenile-age are certainly worth giving some serious thought to on, how, where, when and with what a child is playing.

#### 1. Evaluation of production equipment

Wood is an original and living material. Unfortunately, it is not as much appreciated in this modern world as it should still be. Therefore, it is important to realize the value of this beautiful material. Wood is used in all countries for many different products. The wooden toy has a history of long tradition. In former times it had been produced exclusively in cottage industries, home workshops where the knowledge of handicraft was handed down from one generation to another. There are still family workshops manufacturing special toys based on tradition.

The machinery and equipment of the woodworking toy industry consists mainly of light duty to medium machines, with some being of the heavy duty type. The same machines are installed in joinery and cabinet manufacturing plants. By adding turning machines, these operations produce specialty items used in the manufacture of toys. For sanding operations drum-belt, edges, and disc-sanding machines are used. Printing is done on simple screen printing jigs. The staining and varnishing is done by dip and spray coating equipment.

In machining wooden toys it is advisable to have several machines of the same type. These should be of a standardized range so that the same tools fit several machines. Besides the stationary machines it is necessary to have a selected range of hand-operated machines. Both machine types should be available in developing countries, where they can be maintained in a small maintenance and repair workshop adjacent or joined to the factory. Before purchasing the machines for toy production one has to know the toy range. For each toy drawings have to be prepared. Based on those drawings, the lay-out and the work flow within the factory should be scheduled, following which in-plant material handling systems need to be programmed. In the planning stage, a factory for the manufacture of various designs of toys, the arrangement of the working tables and assembly lines have to be prepared to accommodate for teamwork operation. The same is true for the packing and shipping sectors.

The aspects of a well organized toy production plant are:

- A production flow without return flow;
- Conveying distances have to be as short as possible and the transportation equipment must be appropriate to the manufacturing facilities.

## 2. Minimum capacity

The purchase of machines to facilitate the work which also could be done manually is justified only if the production costs decrease, quality is improved and production is increased.

Supposing the annual profit of a toy factory is in the area of E: 40 000 on annual costs of E: 1 000 000 - this corresponds to a capital requirement of E: 500 000 which produces the following results:

$$\text{Profitableness (P)} = \frac{\text{Profit}}{\text{capital}} \times 100$$

$$P = \frac{40\,000}{500\,000} \times 100 = 8\%$$

In comparison with E: 320 000 capital

$$P = \frac{40\,000}{320\,000} \times 100 = 12.5\%$$

The minimum capacity of a factory depends on a number of factors. Not only normal operating factors are decisive but also marketing. The more the market can absorb, the more the purchasing power exists the easier - without much expenditure for advertisement - one can sell the product. One can produce by large batches. If the competition is strong and the market is small, the assortment has to be increased. This means one has to produce in small batches. The batch size itself does not give any evidence on the economy and profitability of the factory.

### 3. Jigs and fixtures for production of toys

In other industry requires the manufacture of such a variety of jigs as the wooden toy industry. As this industry services a limited market, no special machines have been developed. But to manufacture in the most rational way, the toy industry developed very special jigs manufactured specially for its range of toy products. The toy industry also developed special machines for itself based on power driven units or portable firm machines. Jig production and design is a development technique. At first a rough pattern made from off-cuts has to be screw assembled which can be corrected in its shape before finishing the accurate jig. Either mechanical or pneumatic clamps are used as a means of positioning. There are often small parts required to form the jig, much larger than the work piece, to be machined to avoid accidents.

As far as possible a jig should be applied machining various parts e.g. for parts which vary in length only. This is possible by folding jigs. Also by applying screw heads one can easily convert a jig for different parts.

The quality of the jig depends on the skill of the operator as well as on the material used. To a large extent jig and templates are manufactured from laminated densified wood. For less stressed jigs high grade plywood can be used. To hold boring, accurate metal bushings should be counter sunk.

The life of a jig depends on the quality of the material, as well as on its handling. As mentioned above, the construction of

jigs and fixtures is a development technique. One should always start with simple jigs and later on manufacture more complicated ones.

In developing countries a factory should not only be a place of production but also a place of training to improve skills necessary to step into intermediate machine technologies. Just the jig and fixture design enables one sooner or later to easier understand new techniques.

#### 1. Wooden toys - Simple to manufacture

Toys and toy elements shown on the following pages can be manufactured with a minimum of material and tools. The parts consist of four rods (wood slats) with a square cross section. Some toy elements are made of round rods with a diameter of 8 mm and 20 mm.

##### The U-element

Composed of two long and one short piece. The U is also the basis for various animals, eg. the horse and the ape.

##### The black cross-element

The symmetry of this element renders possible an inner or complementary assembly. The add-on-formation offers many possibilities.

##### The L-element and the angle element

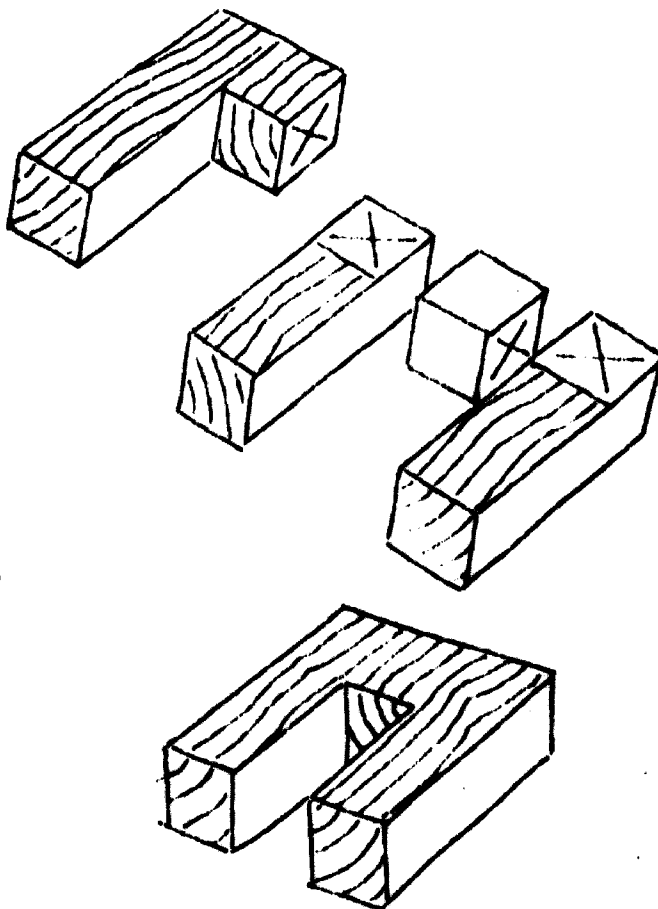
Both are typifying trees and bushes compared to a ladder or a fir-tree, consequently one can realize the various angle constructions.

##### Stick cross-element (without sketch)

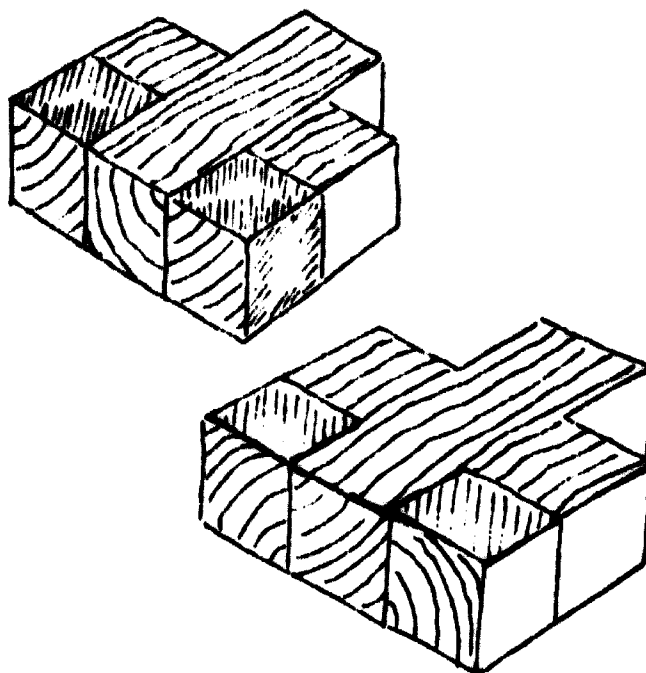
Another cross-element made of sticks glued one transposed upon the other. By arrangements of the parts in the levels, the elements are not only built up one on top of the other but they also interlock - similar to a weaving structure.



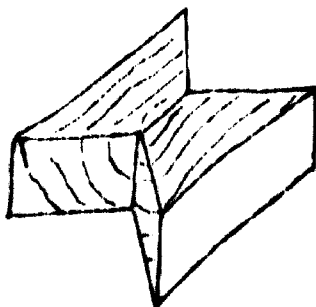
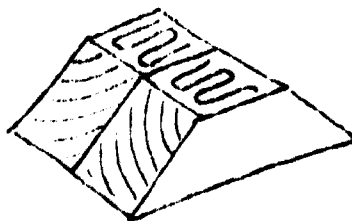
**The U-element**



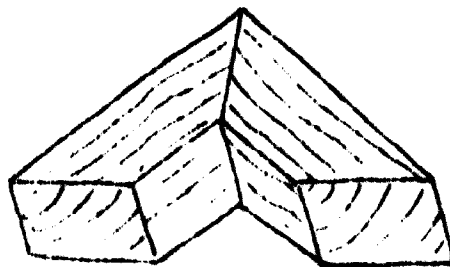
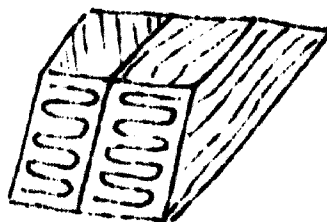
**The cross-element**



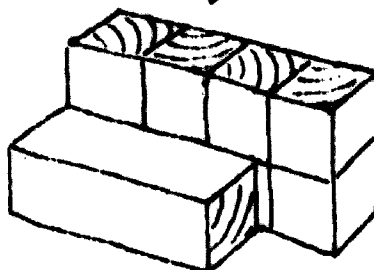
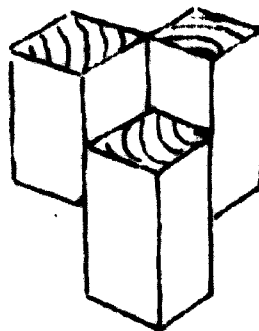
The X-element



The angle



The red pinning element to be joined



**The transposed cross-element (without sketch)**

Made of three long sticks glued and transposed. It is the most popular element when considering construction properties.

**The H-element (without sketch)**

This element consists of four medium-sized sticks. They can be joined only in one direction and produce some very interesting shapes.

**The T-element**

This element is composed of one long and two short reglets. Apart from the T, one can also build up other letters. The single letters are interesting in their varying assembly possibilities. While the T-element is preferably used for piling up, the H-element joined in different directions.

**5. Wooden building blocks**

Wooden building blocks are considered to be the most favoured of old toys. With this plain toy the child has many possibilities in forming and building. Thus it is one of the best educational toys.

The basic element is the cube sized 40 x 40 mm or 25 x 25 mm. All the measures of the other pieces are determined by those of the cube.

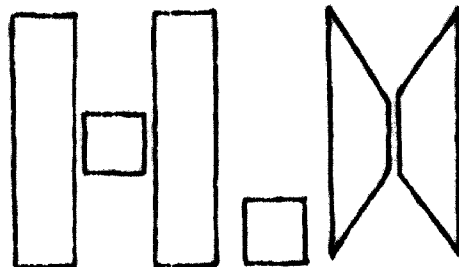
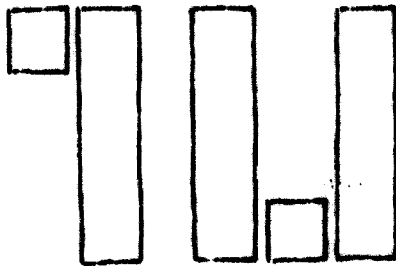
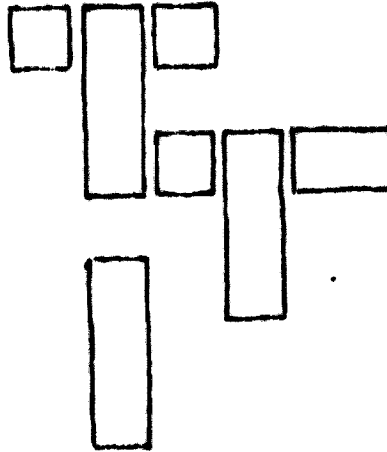
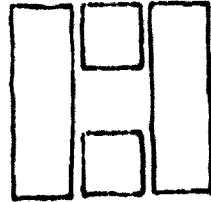
Blocks with different volume setting different requirements will familiarize the child with basic elements. If the child takes interest in building one should enlarge the basic range by an extension box to encourage building activities.

The building blocks are mostly made of material from timber of broad leaf species tree, finished by sanding with all edges smoothly rounded. It is better to leave them raw - i.e. without surface coating - because the varnished surface makes the blocks slippery which renders the building and constructing rather difficult.

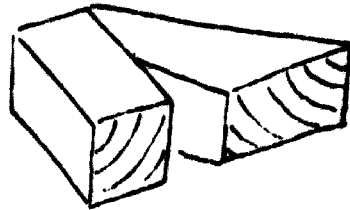
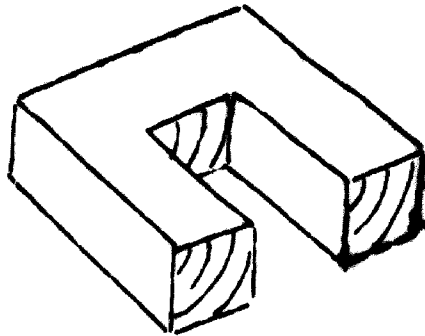
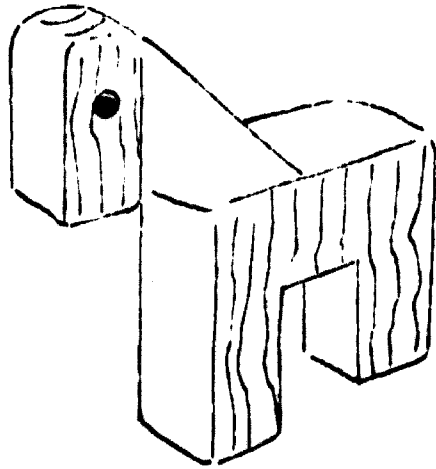
**Contents of the basic boxes:**

Small basic box:	24 pieces
Medium basic box:	48 pieces
Large basic box:	96 pieces

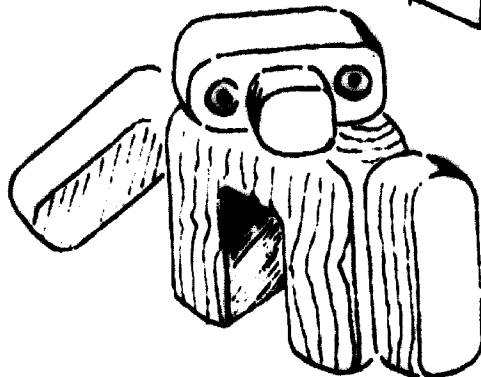
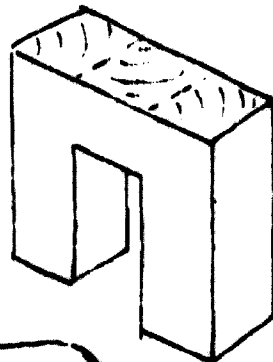
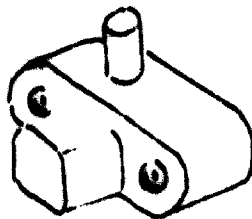
The T-element



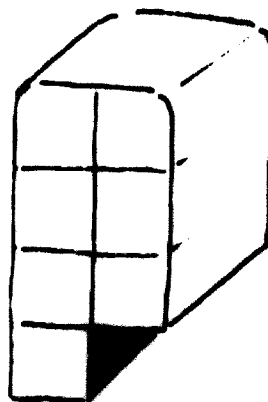
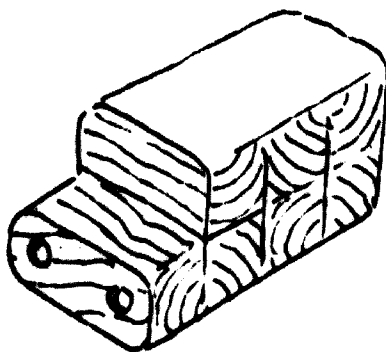
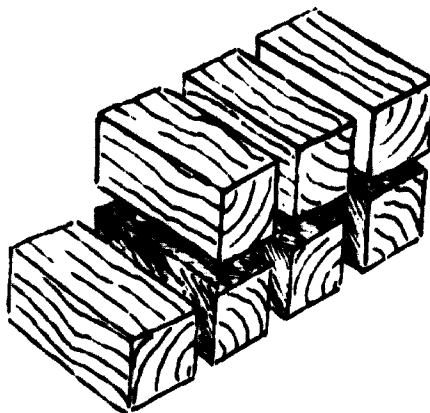
The horse



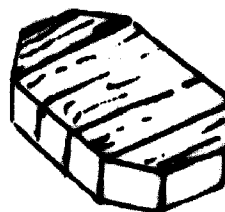
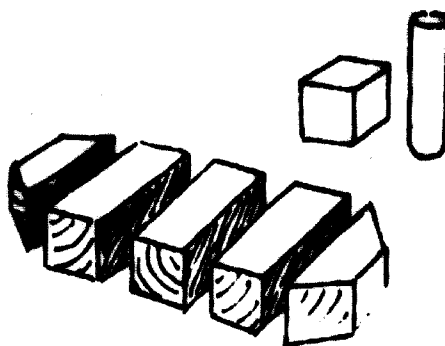
The ape



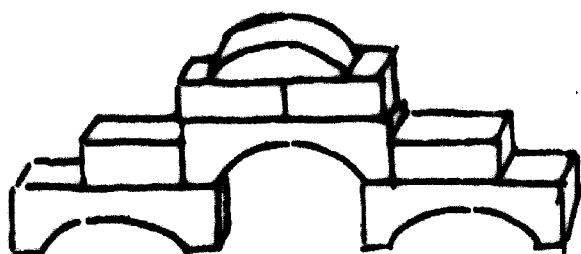
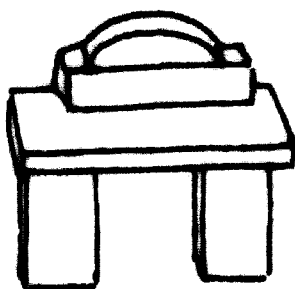
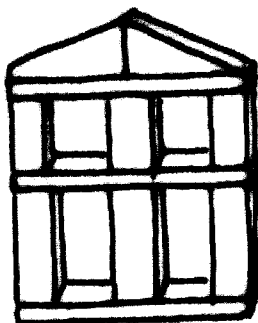
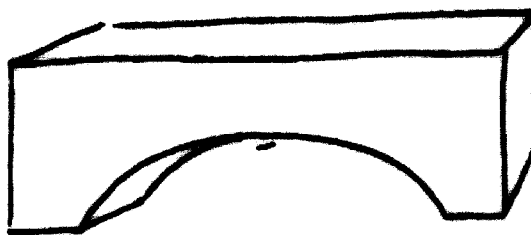
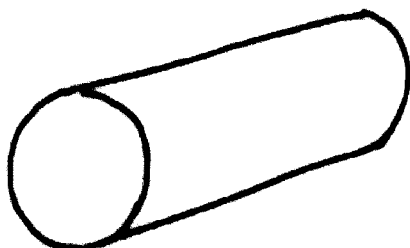
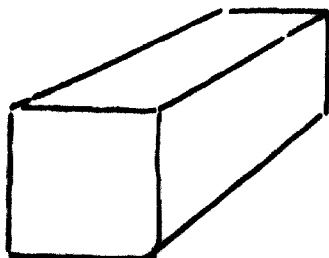
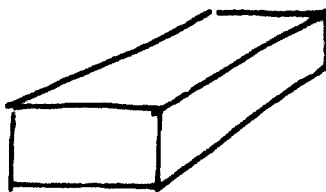
The motor-car



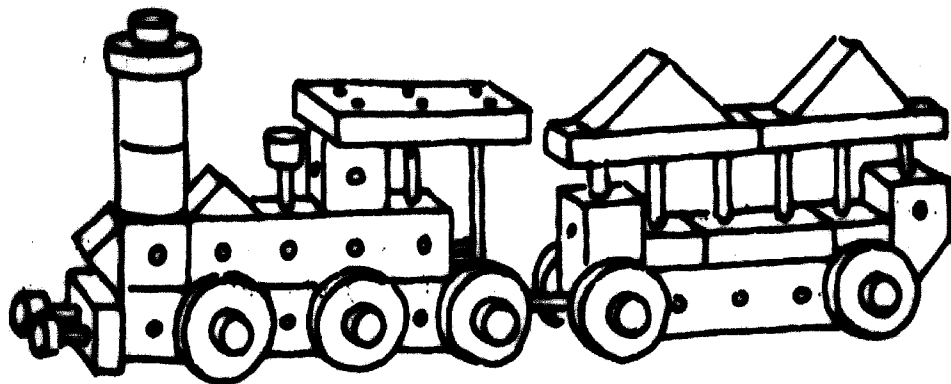
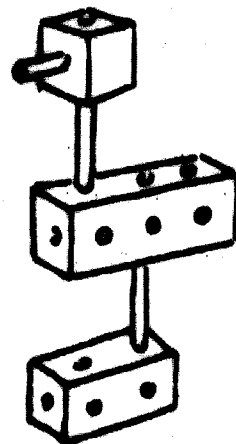
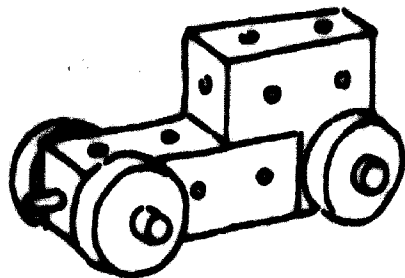
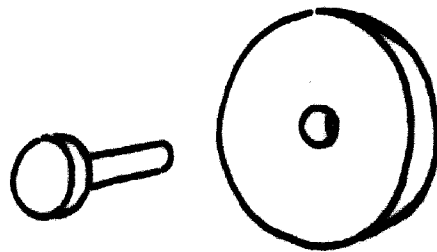
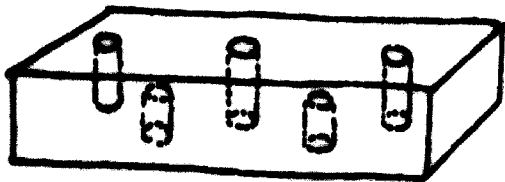
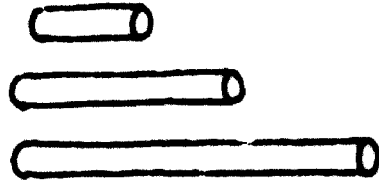
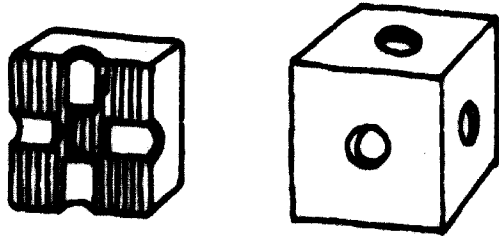
The boat



Wooden blocks



Wooden blocks with holes





Each basic box should include different shapes of building blocks (See drawings).

Extension boxes: Boxes with laths, boxes with arches, boxes with cubes, boxes with pillars.

The extension boxes could be manufactured with a content of only six pieces to keep the price low.

The manufacture of a variety of wooden building blocks which are joined together are those which consist of bores in the blocks and dowels, which join them. This kind of construction for children of two years is best suited for their age. A new element is added: the wheel. So the child becomes familiar with the function of the wheel.

The composition of the contents of these boxes is the same as for the other building blocks.

The advantage of these boxes of construction material is that the basic boxes require considerable less material than the basic boxes of wooden blocks.

The smallest basic box contains only three types of blocks:

One cube                                    40 x 40 mm square

One slit                                    80 x 40 x 40 mm

One slit                                    120 x 40 x 40 mm

Four wheels

Five top pieces to fasten the wheels and round sticks of different lengths.

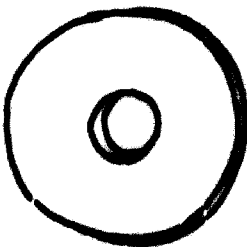
Of course each basic box includes a wooden hammer and a pair of wooden pliers. With these few elements one can readily assemble cars, carriages, small persons and animals. In addition, one should manufacture extension material. An extension box should contain the different parts.

#### 6. Building assembly toys

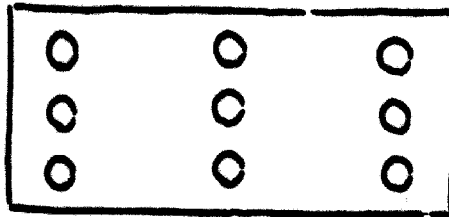
Another variation which differs a little from the preceding wooden structural toys is based on the reglet (slit) element 24 mm wide and 4 mm thick.

Wooden construction material - *Table*

Boards (floor plates)



washer  
or flange



assembly plates



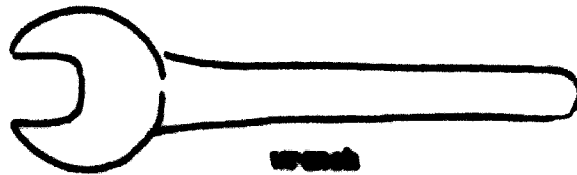
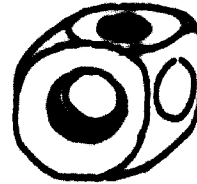
slotted bolt



hexagon bolts



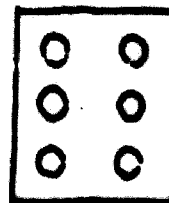
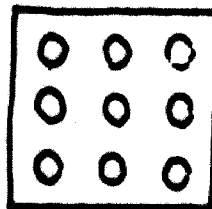
four way nut



wrench



screw driver



These reglets of different lengths have bores in a distance of about 60 mm and they have to be joined by bolts and nuts. Besides the different lengths of the bolts (screws) there should also be manufactured two different types of bolts: the slotted head and the hexagon head so the child learns to handle both, the screw driver and the wrench. The nuts should have the form of a rhombus for easier tightening by hand.

Cubes 30 mm by 30 mm bored are taped with the edges being smoothly rounded. This system also includes the wheel.

This wooden construction set is certainly one of the most ideal toys as it guarantees a lasting tight fit by the bolts. The child must already be 3 - 4 years of age when starting structural play.

The smallest basic box of this construction material should contain about 100 pieces. Larger boxes should contain - besides the mentioned elements - base plates, which offer increased construction possibilities. The size of the plates have to correspond with the size of the reglets.

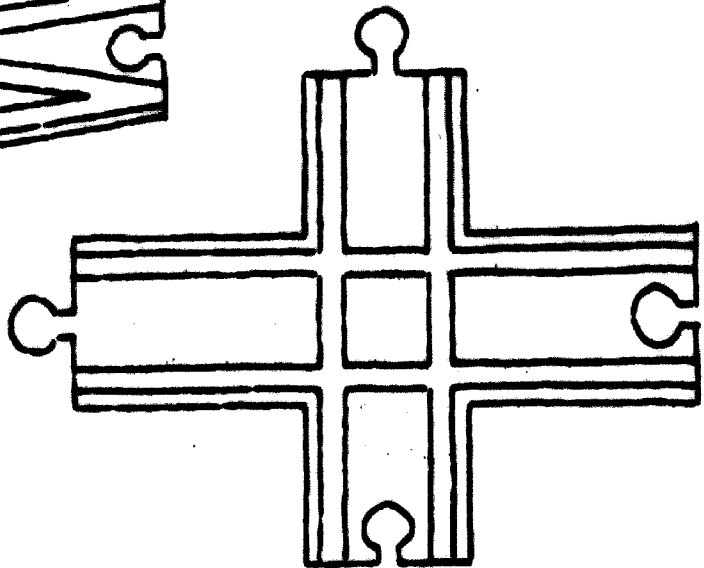
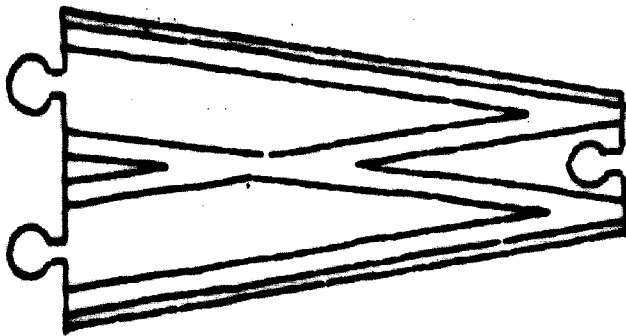
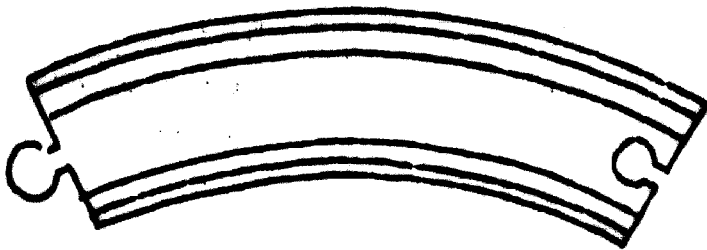
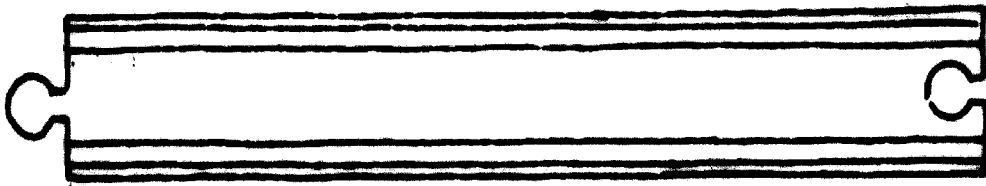
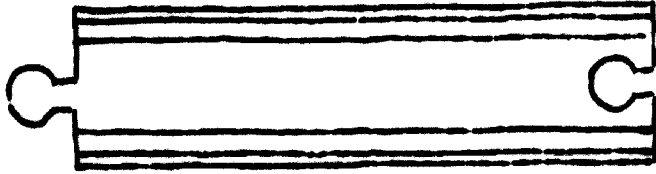
#### 7. Wooden railways

Other favoured and educational wooden toys are railways and speedways. This is the most simple model toy for a child. The rail elements are assembled for railway cars or for speed way cars. With the wooden model toys, the child is introduced to motion elements vis.: train or car to be moved by hand. The manufacture of this toy needs more machines than the production of construction toys but as an educational toy it is a very important element.

The smallest basic box must contain at least 8 curved tracks as well as a train with two wagons.

Here also extension boxes with straight and curved tracks and crossing tracks should be available. Signal, barrier, bridge head, crane, container transport, small cars, etc. should be offered as single packages.

Wooden railway or speedways



### 8. Summary

Each of the described construction toys and the railway tracks are educational toys which stimulate the child's imagination and enable it to imitate what it finds in reality. With these toys the child becomes familiar with the different functions of engineering.

All toys can be varied appropriate to the inclination of each individual child.

There is no difficulty in the production of these wooden toys. The most important prerequisite for an acceptable toy is the material which is wood. On account of its characteristic feature to shrink and or swell it is possible that after some time the stick connections do no longer fit tightly, but when kiln dried, there will be no problem derived from moisture content. Decision for this is the selection of the wood which should be plain (not heartwood). It must be absolutely free of tensile strength. The toy must be worked out very accurately because all parts must fit precisely.

As to the production, it should be considered that the assembly of the trains and wagons as well as the mini cars can be done in cottage workshops as no machines are required for assembly.

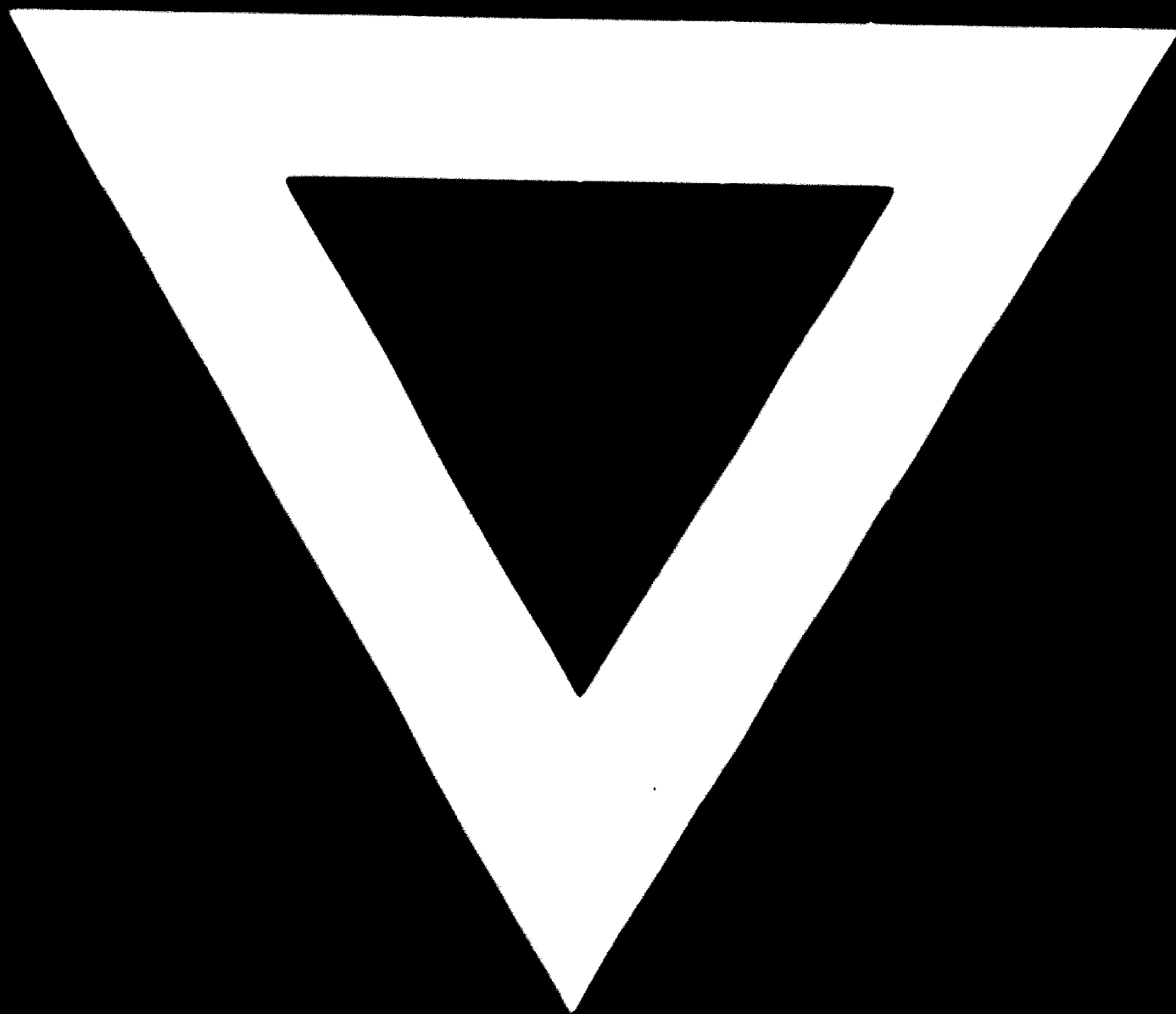
### 9. Machinery list for a small scale toy workshop

- Kiln drying chamber (condensation drying could be applied)
- Cut off saw
- Circular saw (with extended spindle for rip sawing reglets)
- Surface planing machine
- Thicknessing machine (alternatively: four-side planing machine)
- Spindle moulder
- Routing machine
- Bench drill
- Multi-spindle drilling machine
- Turning lathee with screwing attachment
- Four-side moulding machine
- Bowl milling machine
- Bowl-out-off and chamfering machine

- Hand saw
- Contour sanding machine
- Band sanding machine
- Drum sanding machine
- Belt sanding machine
- Edge sanding machine
- Sanding stand (brush sanding machine)
- Various power driven manual operated machines

1. The first part of the document is a list of names and addresses of the members of the committee. The names are listed in alphabetical order, and the addresses are given in full. The list includes the names of the members of the committee, the names of the members of the sub-committee, and the names of the members of the advisory committee. The addresses are given in full, including the street, city, and state.

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**80.04.16**