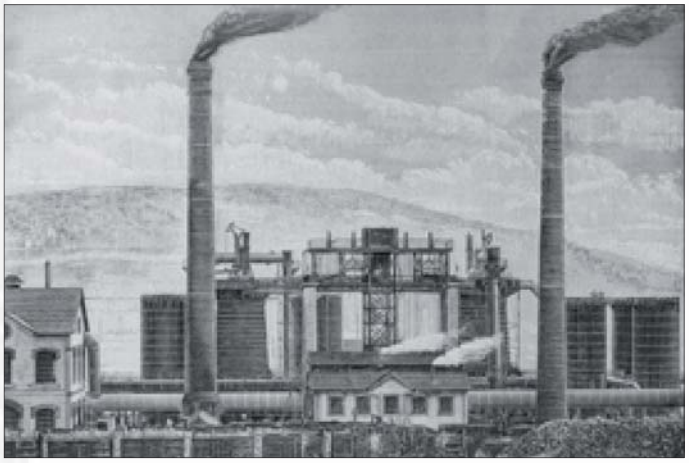
5 The Tower... made of iron and rivets

Industrialization

During the 19th century progress made in the world of metallurgy brought along industrial development.
Manufacturing iron and steel enabled to build railways (railway tracks and engines), factories, stations, bridges, markets, department stores. From the second half of this century, engineers such as Eiffel became very knowledgeable in the use of metallic frameworks and structures that are lighter than stone or concrete.

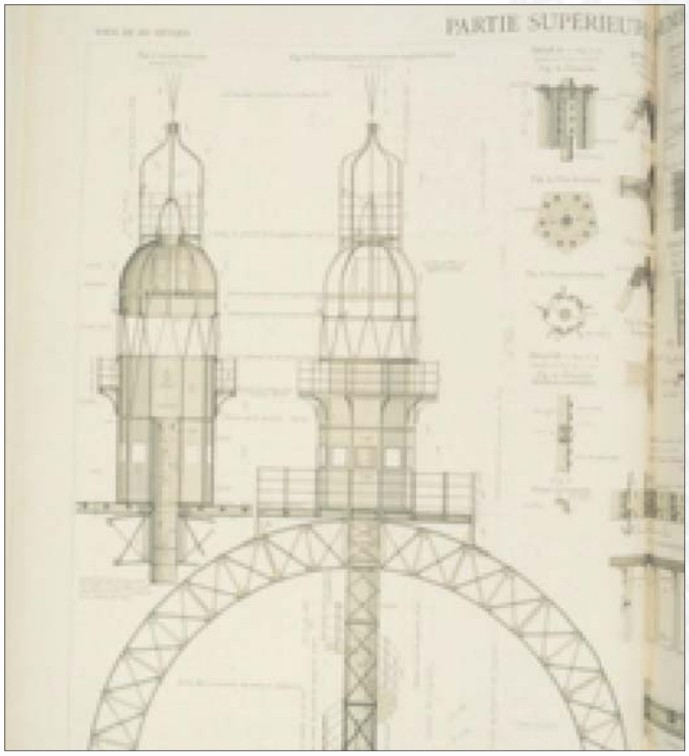
1803: Construction of the Pont des Arts in Paris, in cast iron.
1853: Construction of the Paris covered market with a metallic structure that adds beauty to the building.



The Pompey factory

An iron Tower

The Eiffel Tower is made of puddled iron. This type of iron is obtained by mixing liquid hot iron and the result is iron of a fibrous texture obtained through the dissociation of carbon and impurities from the cristallographic structure. Hammering and rolling complete the preparation of this highly resistant iron. All of these operations were carried out in factories set up near the iron mines, especially in the Lorraine region.



Map of the upper part of the Tower

The project is accurate to the millimetre

In Eiffel's workshops, some twenty engineers and thirty designers made 5,329 drawings that enabled about one hundred workers to assemble the various metallic parts in the workshops located in Levallois-Peret (West of Paris) as early as June 1887. These metallic parts measured between just a few millimetres for the rivets and various metres for the puddled iron beams manufactured in the steelworks of Pompey, in the Lorraine department. The 18,038 parts it took to build the Eiffel Tower were then partly assembled and transported to the site of the Tower.

The Tower... made of iron and rivets

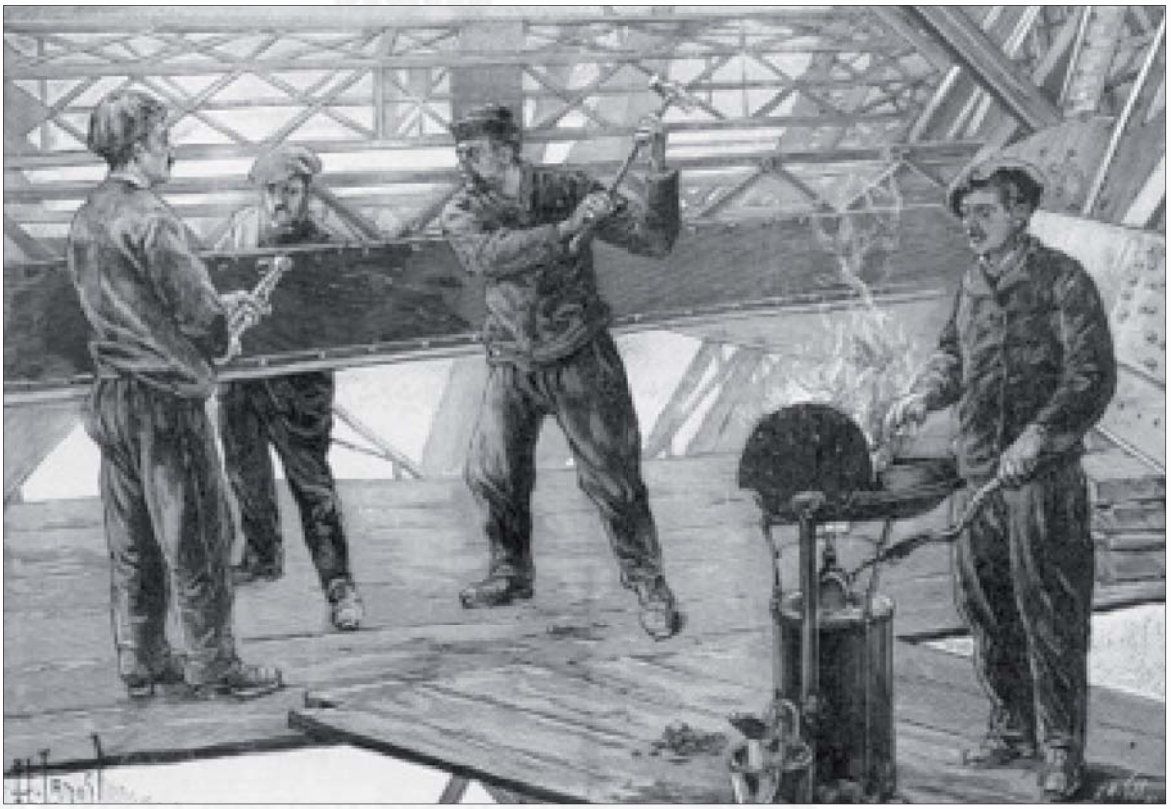
A gigantic « mecano »

On the building site, 120 workmen and highly experienced supervising staff who had participated in the construction of bridges, finished assembling the various parts using rivets that were driven in with a hammer, by hand.

The assembly works were done using rivets driven hot as soon as their final location had been secured. As they cooled, the rivets would contract and it would guarantee tightening of the parts to one another.

It is interesting to point out that only one third of the 2,500,000 rivets were fitted on the spot and that all the others were set in Levallois-Peret where the assembly works were carried out.The rivets were supplied by a company located in Paris called Letroyeur et Bouvard. The rivets used were of the same quality as those used for the boilers of steam engines, which guaranteed their high resistance.

Four men were required to fit a rivet, one who would heat it (see the picture below), one to hold it in and one to shape its head (on either side of the beam) and the last one who would flatten it with a hammer.



Riveters at work

Workers in the building site

On the site of the Tower, the workers worked 9 hours a day in winter and 12 hours a day in summer so that the works could be completed on time. Despite a few days of strike in September and December 1888, for salary claims, the work was completed on time. Despite the fact that the men were working hundreds of metres above the ground, only one man died and the accident occurred outside the working hours (he went up the Tower on a Sunday).

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Exercises

CP - CE1

French / Reading / Spelling

EDUCATIONAL OBJECTIVE

In a simple sentence, in which the subject-verb syntactical order is complied with, learning about the subject and the verb (with a proper noun, a pronoun or a nominal group).

La Tour Eiffel repose sur quatre piliers.
Un pylône monte vers le ciel.
Les ouvriers assemblent les pièces.
Ils posent les rivets.
On compte plusieurs milliers de rivets.
Eiffel visite le chantier.

• Have the pupils underline the subjects, frame the verbs contained in the above sentences and work out subject-verb relationships, and point out the agreement. Identify the nature of the subjects: proper noun, nominal group or pronoun (tell the pupils to ask themselves the question « qui est-ce qui » (« who? ») after the verb so as to identify the subject).

• Then, the verbs can be conjugated using the different personal pronouns.

Mathematics / Numbers and calculations

EDUCATIONAL OBJECTIVE

Learning to write and read the numbers up to 100 or 1,000.

• Have the pupils write the following numbers.

14:
50:
120:
865:
792:

• Writing the numbers using both letters and figures is a key stage of the learning process. These numbers can also be used as basis for mental arithmetic.

14 + 10 + 2 – 1 = 25
14 + 5 + 6 + 7 = 32
50 + 9 + 9 +9 = 77
120 + 100 = 220

• Have the pupils write the following numbers using letters.

quatre:
cinquante-neuf:
soixante-quinze:
quatre-vingts:
cent vingt-quatre:

Art and art history / Visual arts (CP to CM2)

EDUCATIONAL OBJECTIVE

Teaching the pupils to express what they see and to imagine and express present their projects and works using adequate vocabulary.

• Tell the pupils to build « their own monument » using two types of drawings to be duplicated (the teacher of younger pupils should do this) and stuck on a sheet of paper.

• The pupils can describe their work either orally or in writing according to their level.

The Tower... made of iron and rivets

Exercises

CE2 - CM1 - CM2

French / Reading / Spelling

EDUCATIONAL OBJECTIVE

Respecting the value of letters according to the following consonant (« n » before « m » before « m », « b », « p »).

• Using the last sentence, have the pupils find all the words where the « n » is changed into an « m » according to the following consonant.

La Tour a représenté un véritable défi, car c'était la première fois que l'on osait construire aussi haut ! Elle est constituée d'une base qui repose sur quatre piliers appuyés chacun sur un bloc de béton. Ces piliers sont reliés au niveau des premier et deuxième étages. Au-dessus de ce socle, un pylône s'élève verticalement pour former le troisième étage et le sommet de la Tour. Les pièces, montées sur place, sont assemblées au moyen de rivets. Et on n'en compte pas moins de... 2 500 000 !

• Explain the rule by asking the pupils to find other words to which this rule applies (concombre, embrasser, impossible, emporter...) and complete by explaining the alteration before an « m »: emmener.

• Dictate the following sentences to the pupils.

Les ouvriers qui montent sur la Tour pour tout assembler n'ont pas peur de tomber.
Il est impossible de compter tous les rivets, même en restant immobile.
Le tampon sur cette enveloppe représente la Tour.

Mathematics / Numbers and calculations

EDUCATIONAL OBJECTIVE

Learning how to read and write the numbers up to a million (CE2) or up to a billion (CM1-CM2).

• Write the following numbers using letters.

50 - 120 - 1 887 - 5 300 - 18 038 - 2 500 000

• This can also be done by alternating letters and figures and by breaking down the numbers.

120 : (1 x 100) + (2 x 10)
(1 x 1 000) + (8 x 100) + (8 x 10) + 7 = ...
5 300 = (..... x 1 000) + (3 x .....)
18 038 = (..... x .....) + (..... x .....) + (..... x .....) + 8
(2 x 1 000 000) + (5 x 100 000) =

• Write the following numbers using figures.

- Trois cents:
- Mille huit cent quatre-vingt-neuf:
- Quatre-vingt-treize mille huit cent sept:
- Deux cent millions six cent vingt mille dix-sept:

History

EDUCATIONAL OBJECTIVE

Identifying and teaching the characteristics of the 19th century: France in the age of industrial and urban developments; legal working hours in factories, technical developments.

• Have the pupils study the two iconographical documents: the Pompey factory and riveters at work.
Here are some of the laws related to working hours so that the pupils become aware of what the working conditions were like over a century ago.

- 1841: a maximum of 12 hours a day for children (12 to 16 years old) and 8 hours for children 8 to 12 years old)
- 1848: a maximum of 12 hours a day for adults
- 1874: a maximum of 6 hours for children under 12 years old
- 1892: a maximum of 11 hours for women and children aged between 16 and 18
- 1900: a maximum of 10 hours a day with gradual implementation
- 1906: beginning of the 6 day a week work working days week (one weekly day off)

• Reading of excerpts from novels such as Zola's *Germinal*, Hector Malot's *Sans Famille* to complete information concerning the workers' life.