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THE SCIENTIFIC AMERICAN SUPPLEMENT

No. 423,

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AN INQUIRY INTO THE ORIGIN OF INVENTION.

In an interesting paper read before the Anthropological Society of Washington, Mr. Franklin A. Seely gave the results of an investigation, the object of which, he stated, was to consider the nature of the first steps in mechanical invention, far back of history, of tradition, and of the revelations of archæological research. He showed by several examples that every invention, however complicated, was the end of a process of evolution starting from the most primitive beginning. He traced thus the evolution of the modern steam engine as well as the bow and arrow of the savage; they could all be traced back to rude types in a few mechanical expedients which man possessed at his earliest origin, and employed, guided by his own selection, and which have been supplemented by other expedients from time to time discovered or invented.

He then asks the question, What were the expedients of primitive man? and replies that the mechanical expedients possessed by the earliest human beings were such, and such only, as they possessed in common with the brutes. The expedients of the latter were then described by the author, who finally led up to the argument that nothing less than *man* with his reasoning powers could have made improvements upon them. Incidentally he remarked that the finished product always precedes the machine or invention which produces it, and no art is known to us that has not grown up from simpler and ruder arts.

THE STANDARD SCREW THREADS.

Our United States, or Sellers, standard of screw threads and diameters has been now many years before the mechanics of the country, and yet it is far from being generally adopted and used. The difficulty of procuring its general adoption has, perhaps unjustly, been attributed to the selfishness of manufacturers, who prefer their own fractional threads in order that repairs and reduplications must come from them. There is a better reason, and possibly a juster cause; it is the dissatisfaction with the system itself. In fact it is hard to establish a uniform, absolute system in screw threads. Every mechanic can readily see how different are the demands on a bolt on which the nut is set up to stay and on one that is to be used for adjustment. It makes a vast difference in "setting up" a nut on a bolt of two inches diameter with the standard pitch of four and a half to the inch, and on another of the same diameter with a thread of six to the inch.

But beyond special needs, the standard is objected to by many mechanics because of the lack of proper relation (so they say) between the diameter and the pitch, particularly on diameters below one inch. The advance in diameters from one-fourth of an inch to the full inch is by sixteenths of an inch, and the pitches, beginning with twenty to the inch and ending with eight to the inch, are ten in number. A three-eighth bolt is cut to a sixteen thread, which greatly weakens the bolt by its depth—much more so than an eight thread can weaken an inch bolt. Complaint is made that a half inch bolt with thirteen threads will twist in two before it will strip, and that a five-eighth bolt is ruined by cutting it eleven threads to the inch.

Our standard is very similar to the English, or Whitworth, standard, having twenty-one pitches for twenty-nine diameters, while the Whitworth has eighteen pitches to the same number of diameters. Up to one inch the relations of pitches and diameters are the same, with the exception of the half inch bolt, which by United States standard has a thirteen thread, but by the Whitworth has twelve. In estimating the relative strength of bolt and pitch of thread, reference must be had to the form of thread. Beyond dispute the Whitworth is the strongest thread yet produced, as much above our modified sharp V-thread, called "standard," as that is above the old V-thread itself, and more. Its rounding, or convex, bottom is never inducive to fracture. If it was not so costly to produce, it would take the place of our square bottom thread for all general purposes. Some of these objections against the standard will appear to have more than prejudice for their foundation, at least for some uses, by a comparison between the threads and diameters and a consideration of the hundreds of differing purposes to which they are to be applied.

U. S. STANDARD.

Diam.	1/4	5/8	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16
Pitch	20	18	16	14	13	12	11	11	10	10
Diam.	7/8	15/16	1	1 1/8	1 1/4	1 3/8	1 1/2	1 5/8	1 3/4	
Pitch	9	9	8	7	7	6	6	5 1/2	5	
Diam.	1 7/8	2	2 1/4	2 1/2	2 3/4	3	3 1/4	3 1/2	3 3/4	4
Pitch	5	4 1/2	4 1/2	4	4	3 1/2	3 1/2	3 1/4	3	3

TO DRILL HOLES IN LINE.

In large castings where holes are to be finished in parallel projections, as the two spindle holes in the uprights of a lathe head, the boring bar, passing through both holes, insures perfect line. But there are many small jobs of a similar form which will not admit of a drilled or cored hole to be afterward bored, but must be finished by the drill. It is difficult to insure perfect line in such cases by ordinary methods. Even the use of the round, twisted drill will not insure accuracy. It is not easy to drill a straight hole, even in a continuous piece of cast iron, owing to the unevenness of the material, and the trouble is increased when there is an interval between two portions to be drilled.

There is, however, a simple method that may not be generally known, which will insure accuracy. Drill one hole in one of the rings, either by chucking the piece or by suspending it on the lathe center. Then fit an arbor nicely to the drilled hole, making a fit sufficient to hold the piece while rotating. Dog the arbor to the live center of the lathe, and support its other end by a center rest close up to the casting, having the arbor, of course, in line with the lathe centers. The casting will revolve with the arbor, and makes a line hole a certainty. If the weight of the overhang is too great to secure even rotation, counterbalance by a weight on the other side.

MANUFACTURE OF SILVER SPOONS.

Probably there is no article of table or of other household use in the production of which so little of machine working is employed. Almost all the work on solid silver spoons is handwork; the exceptions are the rolling of the ingot into plates and the production of spoons with ornamentation in relief, which is produced by recessed patterns on the rolls.

The material for spoons is coin silver obtained from the government mints in ingots, or from trade for old silver, or from the use of current coin. This is melted over a charcoal fire in plumbago crucibles to a certain heat, known to the adept by the appearance of the surface of the molten metal. It is poured into cast iron moulds, forming bars of about seventy ounces weight each.

These bars are heated over a forge fire of charcoal and worked on the anvil by hammer and sledge, precisely as iron or steel is worked, or are rolled into plates or ribbons. Occasional annealings are necessary to prevent cracking, the annealing being heating red hot and quenching in cold water. The ribbon for the ordinary tea spoon is four and a half inches long by three-eighths of an inch wide. When rolled, a blank of two and a quarter inches is lengthened to four and a half inches to thin it down to spoon thickness. Before rolling or hammering, silver is very nearly as soft as lead; but with these mechanical processes it can be made hard and rigid. Good springs, retaining their qualities for years, can be made of silver hammered or rolled.

To form the bowl of the tea spoon the bar, of three-eighths of an inch wide and less than three thirty-seconds of an inch thick, is hammered flat on an anvil with a crowning face until the workman has spread it into an oval, which is much thinner in the middle than at the edges, as the edges are to receive the bulk of the wear. The handles are formed also by the hammer, and a competent workman will so nearly produce the form of the spoon as to leave very little material to be removed by the file to dress it to shape.

The curvature of the bowl is produced by repeated "coaxing" blows by a steel punch and a die of cast composition of lead and tin. No file dressing is employed on the faces of the spoon; only the edges are file-dressed to form. From the anvil and the die the spoons come to hand smoothing with Scotch gray stones and polishing by stiff brushes, generally revolving brushes charged with "grits" and oil.

"Grits" is a peculiar material found in several places, the best in Wallingford, Conn., that has some of the qualities of tripoli, but appears to be an argillaceous deposit with calcareous particles too fine to be palpable. Burnishing is the finish of spoons as of all bright silver goods. All these are hand processes; machinery has little to do in the production of solid silver spoons.

SETTING-UP WITH THE WRENCH.

It is possible that ultimate fracture of otherwise sound bolts is sometimes induced by injudicious setting-up with the wrench. Few mechanics stop to consider the possible power they exert through the medium of the wrench. In a manufacturing establishment recently, a bolt seven-eighths of an inch diameter was cut off as square as if by a cutting-off lathe by the pull on a wrench. The bolt was cut to the standard of nine threads, and the workman was setting up the nut with an ordinary eighteen inch screw wrench; thinking he could do more than feel the nut home, he took a hook wrench made from a seven-eighths inch bar of steel, and bracing his foot against a portion of the frame threw his weight on the lever, cutting the bolt of mild tough steel, as clean as a chisel could have done.

A little consideration would teach the workman that the power exerted through a lever, as a wrench, is enormous for the force applied. Take a nut on a three-quarters of an inch bolt for an example. The bolt has a thread of ten to the inch, and a wrench of twelve inches long is ample to bring the nut to bearing. With this length of lever the wrench will travel about seventy-five inches to move the nut one-tenth of an inch. Let there be a constantly exerted force of fifty pounds on the end of this twelve inch lever, and the strain on the bolt, allowing one-third of the force exerted to be absorbed by the friction of the thread and of the face of the nut, will be not less than 25,000 pounds. The rule in setting up on bolts and nuts should be the "feel" of the absolute contact; straining the bolt or the thread to the limit of tension or of stripping tends to weaken, if it does not actually induce an incipient break.

The Magnetic Balance.

In a paper read recently before the Royal Society, Prof. Hughes gives an account of some experimental researches made with a magnetic balance, from which he concludes that we can find the electric conductivity of iron or steel from a simple reading of its magnetic capacity. Thus, the best Swedish charcoal iron annealed has a magnetic capacity of 525, while that of crucible cast steel annealed is represented by 84. The electric resistance of the same is respectively represented by 192 and 350.