REPORT OF THE COMMITTEE OF THE FRANKLIN INSTITUTE ON SCREW THREADS.

The Special Committee on a Uniform System of Screw Threads, Etc., presented the following report:—

That in the course of their investigations they have become more deeply impressed with the necessity of some acknowledged standard, the varieties of threads in use being much greater than they had supposed possible; in fact the difficulty of obtaining the exact pitch of a thread not a multiple or sub-multiple of the inch measure is sometimes a matter of extreme embarrassment.

Such a state of things must evidently be prejudicial to the best interests of the whole country, a great and unnecessary waste is its certain consequence, for, not only must the various parts of new machinery be adjusted to each other in place of being interchangeable, but no adequate provision can be made for repairs, and a costly variety of screwing apparatus becomes a necessity. It may reasonably be hoped that should a uniformity of practice result from the efforts and investigations now undertaken, the advantages flowing from it will be so manifest as to induce reform in other particulars of scarcely less importance.

Your Committee have held numerous meetings for the purpose of considering the various conditions required in any system which they could recommend for adoption. Strength, durability, with reference to wear from constant use and ease of construction, would seem to be the principal requisites in any general system, for, although in many cases, as, for instance, when a square thread is used, the strength of the thread or bolt are both sacrificed for the sake of securing some other advantage, yet all such have been considered as special cases, not affecting the general inquiry. With this in view, your Committee decided that threads having their sides at an angle to each other must necessarily more nearly fulfil the first condition than any other form; but what this angle should be must be governed by a variety of considerations, for it is clear that if the two sides start from the same point at the top, the greater the angle contained between them the greater will be the strength of the bolt; on the other hand, the greater this angle, supposing the apex of the thread to be over the center of its base, the greater will be the tendency to burst the nut, and the greater the friction between the nut and the bolt, so that if carried to excess the bolt would be broken by torsional strain rather than by a strain in the direction of its length. If, however, we should make one side of the thread perpendicular to the axis of the bolt, and the other at an angle to the first, we should obtain the greatest amount of strength, together with the least frictional resistance; but we should have a thread only suitable for supporting strains in one direction, and constant care would be requisite to cut the thread in the nut in the proper direction to correspond with the bolt; we have consequently classed this form as exceptional, and decided that the two sides should be set at an angle to each other and form equal angles with the base.

The general form of the thread having been determined upon the above considerations, the angles which the sides should bear to each other has been fixed at 60°, not only because this seems to fulfil the conditions of least frictional resistance, combined with the greatest strength, but because it is an angle more readily obtained than any other, and it is also in more general use. As this form is in common use almost to the exclusion of any other, your Committee have carefully weighed its advantages and disadvantages before deciding to recommend any modification of it. It cannot be doubted that the soft thread offers us the simplest form, and that its general adoption would require no special tools for its construction, but its liability to accident, always great, becomes a serious matter upon large bolts, while the small amount of strength at the sharp top is a strong inducement to sacrifice some of it for the sake of better protection to the remainder; when this conclusion is reached, it is at once evident a corresponding space may be filled up in the bottom of the thread, and thus give an increased strength to the bolt, which may compensate for the reduction in strength and wearing surface upon the thread. It is also clear that such a modification, by avoiding the fine points and angles in the tools of construction, will increase their durability; all of which being admitted, the question comes up what form shall be given to the top and bottom of the thread? for it is evident one should be the converse of the other. It being admitted that the sharp thread can be made interchangeable more readily than any other, it is clear that this advantage would not be impaired if we should stop cutting out the space before we had made the thread full or sharp, but to give the same shape at the bottom of the thread would require that a similar quantity should be taken off the point of the cutting tool, thus necessitating the use of some instrument capable of measuring the required amount, but when this is done the thread having a flat top and bottom can be quite as readily formed as if it was sharp. A very slight examination sufficed to satisfy us that in point of construction, the rounded top and bottom presents much greater difficulties, in fact all taps and screws that are chased or cut in a lathe required to be finished or rounded by a second process. As the radius of the curve to form this must vary for every thread, it will be impossible to make one gage to answer for all sizes and very difficult, in fact impossible, without special tools to shape it correctly for one.

Your Committee are of opinion that the introduction of a uniform system would be greatly facilitated by the adoption of such a form of thread as would enable any intelligent mechanic to construct it without any special tools, or if any are necessary, that they shall be as few and as simple as possible, so that although the round top and bottom presents some advantages when it is perfectly made, as increased strength to the thread and the best form to the cutting tools, yet we have considered that these are more than compensated by ease of construction, the certainty of fit and increased wearing surface offered by the flat top and bottom, and therefore recommend its adoption. The amount of flat to be taken off should be as small as possible, and only sufficient to protect the thread; for this purpose one-eighth of the pitch would seem to be ample, and this will leave three-fourths of the pitch for bearing surface. The considerations governing the pitch are so various that their discussion has consumed much time.

As in every instance the threads now in use are stronger than their bolts, it became a question whether a finer scale would not be an advantage, it is possible that if the use of the screw thread was confined to wrought iron or brass, such a conclusion might have been reached, but as cast iron enters so largely into all engineering work, it was believed finer threads than those in general use might not be found an improvement, particularly when it was considered that so far as the vertical hight of thread and strength of bolt are concerned, the adoption of a flat top and bottom thread was equivalent to decreasing the pitch of a sharp thread 25 per cent, or, what is the same thing, increasing the number of threads per inch 33 per cent. If finer threads were adopted they would require also greater exactitude than at present exists in the machinery of construction, to avoid the liability of overriding, and the wearing surface would be diminished; moreover, we are of opinion that the average practice of the mechanical world would probably be found better adapted to the general want than any proportions founded upon theory alone.

We have taken some pains to ascertain what the proportions in use are, and submit the following, as being in our judgment a fair average, viz:—

Diam. of Bolt...	¼	5-16	⅜	7-16	½	9-16	⅝	¾	⅞	1	1⅛	1¼
Threads per in...	20	18	16	14	13	12	11	10	9	8	7	7
Diam. of Bolt...	1⅜	1½	1⅝	1¾	1⅞	2	2¼	2½	2¾	3	3¼	3½
Threads per in...	6	6	5½	5	5	4½	4½	4	4	3½	3½	3¼
Diam. of Bolt...	3¾	4	4¼	4½	4¾	5	5¼	5½	5¾	6	...	...
Threads per in...	3	3	2⅞	2¾	2⅝	2½	2½	2⅜	2⅜	2¼	...	...

The proportions for bolt-heads and nuts, as given in most of our books of reference, are believed to be larger than necessary, and all are tabulated, necessitating constant reference, a simple formula would probably induce a uniform practice, but as most of the sizes in common use are made by machinery and also by hand, it is believed the bolt-head and nut for finished work should be made somewhat smaller than for rough, to avoid the confusion that would ensue if the necessary allowance for dressing should be made upon work intended for finishing.

In conclusion, therefore, your Committee offer the following:—

Resolved, That the Franklin Institute of the State of Pennsylvania recommend for general adoption by American Engineers, the following forms and proportions for screw threads, bolt-heads and nuts, viz.—

That screw threads shall be formed with straight sides at an angle to each other of 60°, having a flat surface at the top and bottom equal to one-eighth of the pitch. The pitch shall be as in the preceding table.

The dis ance between the parallel sides of a bolt-head and nut for a rough bolt shall be equal to one-and-a-half diameters of the bolt, plus one-eighth of an inch. The thickness of the heads for a rough bolt shall be equal to one-half the distance between its parallel sides. The thickness of the nut shall be equal to the diameter of the bolt. The thickness of the head for a finished bolt shall be equal to the thickness of the nut. The distance between the parallel sides of a bolt-head and nut, and the thickness of the nut shall be one-sixteenth of an inch less for finished work than for rough.

Resolved, That a copy of these resolutions be forwarded to the Quarter Master General, Chief of the B reau of Steam Engineering of the Navy, and the Chief of the Bureau of Ordnance for the Army and Navy, and Chiefs of the Engineer and Military R.R. Corps, and the Supt. and M.M. of R.R. Co.'s, requesting them to use their influence to promote the adoption of a uniform system of screw threads, bolt-heads and nuts, by requiring all builders on new contracts to conform to the proportions recommended.

Resolved, That a copy of these resolutions be also sent to all Mechanical and Engineering Associations or Institutes, and the principal Machine and Engine Shops in the country, with a request that they will use their influence in the proposed system.

Resolved, That this Committee be now discharged.

WM. B. BEMENT, firm of Bement & Dougherty.
C. T. PARRY, supt. Baldwin's Locomotive Works.
J. VAUGHAN MERRICK, firm of Merrick & Sons.
JOHN A. TOWNE, firm of I. P. Morris, Towne & Co.
COLEMAN SELLERS, Eng. Wm. Sellers & Co.
B. H. BARTOL, supt. Southwark Foundery.
EDVARD LONGSTRETH, foreman Baldwin's Loc. Works.
JAMES MOORE, firm of Matthews & Moore.
WM. SELLERS, firm of Wm. Sellers & Co.
ALGERNON ROBERTS, of the Pencoyd Iron Works.

Letter from Mr. Mushet.

We find the following in the London *Engineer* :—

THE BESSEMER PROCESS.

SIR:—When Mr. Bessemer read his celebrated paper at the meeting of the British Association at Cheltenham, in 1856, I saw clearly where his difficulties would arise, and that he could not, by his process, produce either iron or steel of commercial value. A few days after the reading of the paper, I received specimens of Bessemer metal. Some of these were cold short and some were cold tough; but all were alike red short at any heat under the welding heat. They were ductile enough when worked at a high welding heat; but as soon as the temperature was lowered, the bars broke off or crumbled like heated cast iron. I at once saw that, by melting them again with manganesic pig iron, or spiegeleisen, they would form good steel or iron, according to the dose of manganesic pig added to them. Late that night it occurred to me that, by mixing the already melted Bessemer metal with melted spiegeleisen, the process could at once and simply be rendered successful.

I immediately lighted a fire in a small steel melting furnace, and placed in the furnace two crucibles, one containing eight ounces of Bessemer metal, and the other one ounce of spiegeleisen. When the contents of the crucibles were melted I withdrew the crucibles, and poured the melted spiegeleisen into the melted Bessemer metal; I then emptied the mixture into a small ingot mold; the ingot was piped, and had all the characteristics of an ingot of excellent cast steel. I next heated the ingot to a fair cast-steel heat. Mrs. Mushet held it in a pair of tongs, and I drew it out with a sledgehammer into a flat bar. I heated this bar, and then twisted it in a vise, at a white heat, red heat, and black red heat; and it remained perfectly clear and sound in the edges, without a trace of red shortness. I now doubled and welded the bar, and forged it into a chisel, which I tempered and tried severely for a flat chisel and diamond point, upon hard cast iron. The chisel stood the test well, and was, in fact, welding cast steel, worth, at the least, 42s. per cwt. I saw now that I had made a discovery even more valuable than that of the Bessemer process; for, although the Bessemer process was not of any value apart from my invention, on the other hand, my invention could be applied extensively in the manufacture of pot-melted steel. Less conversant with the world than with matters relating to iron and steel, I confided in certain parties of great wealth and influence in the iron trade, believing that I had to deal with men of honor and integrity, incapable of a mean and base action. On this score I gained experience, which cost me my patents, but taught me a lesson not easily forgotten. I placed my patents in the hands of parties who promised to carry them out, and see justice done to me. I now proceeded to extend the scale of operations as follows:—

I charged sixteen melting pots with 44 lb. each of Bessemer metal, and when this was melted I poured into each pot 3 lb. of melted spiegeleisen. I then poured the contents of the sixteen melting pots into a large ingot mold, and the ingot thus made was sent to the Ebbw Vale Ironworks, and then rolled at one heat into a double-headed rail. This rail was sent to me for inspection, and to be by me forwarded to Mr. Ellis at Derby station, to be laid down there at a place where iron rails had to be changed once in three months.

When the rail, which was very perfect, came to me, it was so thickly studded with the words "Ebbw Vale Iron Co ," that no space remained to squeeze in the words "Robert Mushet."

I sent the rail to Derby, and I read a public statement made by Mr. Adams of the Ebbw Vale, some time ago, to the effect that this rail remained as perfect as ever, after six years wear and tear from the passage over it of 700 trains daily. That was the first Bessemer rail.

I next charged twenty melting pots with 46 lb. each of Bessemer metal, and when melted I poured into each pot 2 lb. of melted spiegeleisen, and then emptied the contents of all the melting pots into one ingot mold. The ingot was rolled at two heats, at Ebbw Vale Ironworks, into a bridge rail, which would have been about thirty feet long, but the engine was overpowered when the rail was in the last groove and stopped, so that the rail had to be cut in two. One piece, sixteen feet long, was exhibited in the office of an influential Iron Company in London, as the produce of the Uchatius or atomic process of steel making.

Let us charitably suppose that the gentlemen who exhibited this rail were at the time laboring under some mental hallucination. To enable me to specify my patent, I was very generously furnished by Mr. S. H. Blackwell of Dudley with a blowing machine capable of sustaining a pillar of blast of 10 lb. per square inch. With this blowing apparatus and some small furnaces operating upon from 60 lb. to 600 lb. melted cast iron, I experimented for six months, and satisfied myself that the whole affair was as simple, and, indeed, far more simple, than the ordinary foundery process for melting and casting iron. I made cast steel direct from the Bessemer, of a quality fairly valued at £56 per tun, but which apparently has not been accomplished subsequently by others who have adopted the process. I am well aware of the cause of the failure and of many difficulties that beset, and will still continue to beset, this process, until it is reduced to the simple first principles which govern it. I do not in the least grudge to Mr. Bessemer the £100,000 per annum which my invention is enabling him to realize. It was not by any fault of his that my patent was lost; but I wish, for his own sake, that he had manfully acknowledged the source of his success, and had been content with the amply sufficient merit of his own inventions and perseverance, without endeavoring tacitly to monopolize the credit due to me and to himself jointly. R. Mushet.

Cheltenham, Jan. 23, 1865.

COUNT RUMFORD.

Professor Youmans, in the introduction to his collection of treatises on the Correlation of Forces gives this sketch of Count Rumford:—

"Benjamin Thompson was born at Woburn, Mass., in 1753. He received the rudiments of a common school education, became a merchant's apprentice at twelve, and subsequently taught school. Having a strong taste for mechanical and chemical studies, he cultivated them assiduously during his leisure time. At seventeen he took charge of an academy in the village of Rumford, (now Concord), N. H., and in 1772 married a wealthy widow, by whom he had one daughter. At the outbreak of revolutionary hostilities he applied for a commission in the American service, was charged with toryism, left the country in disgust and went to England. His talents were there appreciated, and he took a responsible position under the government, which he held for some years.

"After receiving the honor of knighthood he left England and entered the service of the Elector of Bavaria. He settled in Munich in 1784, and was appointed aide-de-camp and chamberlain to the Prince. The labors which he now undertook were of the most extensive and laborious character, and could never have been accomplished but for the rigorous habits of order which he carried into all his pursuits. He reorganized the entire military establishment of Bavaria, introduced not only a simpler code of tactics, and a new system of order, discipline and economy among the troops and industrial schools for the soldiers' children, but greatly improved the construction and modes of manufacture of arms and ordnance. He suppressed the system of beggary which had grown into a recognized profession in Bavaria, and become an enormous public evil—one of the most remarkable social reforms on record. He also devoted himself to various ameliorations, such as improving the construction and arrangement of the dwellings of the working classes, providing for them a better education, organizing houses of industry, introducing superior breeds of horses and cattle, and promoting landscape gardening, which he did by converting an old abandoned hunting-ground near Munich into a park, where after his departure, the inhabitants erected a monument to his honor. For these services Sir Benjamin Thompson received many distinctions, and among others was made count of the holy Roman Empire. On receiving this dignity he chose a title in remembrance of the country of his nativity, and was thenceforth known as Count of Rumford.

"His health failing from excessive labor and what he considered the unfavorable climate, he came back to England in 1798, and had serious thoughts of returning to the United States. Having received from the American government the compliment of a formal invitation to revisit his native land, he wrote to an old friend requesting him to look out for a 'little quiet retreat' for himself and daughter in the vicinity of Boston. This intention, however, failed, as he shortly after became involved in the enterprise of founding the Royal Institution of England.

"There was in Rumford's character a happy combination of philanthropic impulses, executive power in carrying out great projects, and versatility of talent in physical research. His scientific investigations were largely guided and determined by his philanthropic plans and public duties. His interest in the more needy classes led him to the assiduous study of the physical wants of mankind, and the best methods of relieving them; the laws and domestic management of heat accordingly engaged a large share of his attention. He determined the amount of heat arising from the combustion of different kinds of fuel, by means of a calorimeter of his own invention. He reconstructed the fireplace, and so improved the methods of heating apartments and cooking food as to produce a saving in the precious element, varying from one-half to seven-eights of the fuel previously consumed. He improved the construction of stoves, cooking ranges, coal grates and chimneys; showed that the non-conducting power of cloth is due to the air enclosed among its fibers, and first pointed out that mode of action of heat called *convection;* indeed he was the first clearly to discriminate between the three modes of propagating heat—radiation, conduction and convection. He determined the almost perfect non-conducting properties of liquids, investigated the production of light, and invented a mode of measuring it. He was the first to apply steam generally to the warming of fluids and the culinary art; he experimented upon the use of gunpowder, the strength of materials, and the maximum density of water, and made many valuable and original observations upon an extensive range of subjects.

"Prof. James D. Forbes, in his able Dissertation on the recent Progress of the Mathematical and Physical Sciences, in the last edition of the 'Encyclopedia Britannica,' gives a full account of Rumford's contributions to science, and remarks:—

"'All Rumford's experiments were made with admirable precision, and recorded with elaborate fidelity, and in the plainest language. Every thing with him was reduced to weight and measure, and no pains were spared to attain the best results.

"'Rumford's name will ever be connected with the progress of science in England by two circumstances: first, by the foundation of a perpetual medal and prize in the gift of the council of the Royal Society of London, for the reward of discoveries connected with heat and light; and, secondly, by the establishment in 1800 of the Royal Institution in London, destined, primarily, for the promotion of original discovery, and, secondarily, for the diffusion of a taste for science among the educated classes. The plan was conceived with the sagacity which characterized Rumford, and its success has been greater than could have been anticipated. Davy was there brought into notice by Rumford himself, and furnished with the means of prosecuting his admirable experiments. He and Mr. Faraday have given to that institution its just celebrity with little intermission for half a century.'

"Leaving England, Rumford took up his residence in France, and the estimation in which he was held may be judged of by the fact that he was elected one of the eight foreign associates of the Academy of Sciences.

"Count Rumford bequeathed to Harvard University the funds for endowing its professorship of the Application of Science to the Art of Living, and instituted a prize to be awarded by the American Academy of Sciences, for the most important discoveries and improvements relating to heat and light. In 1804 he married the widow of the celebrated chemist Lavoisier, and with her retired to the villa of Auteuil, the residence of her former husband, where he died in 1814."

A New Electro-Magnet.

Is it possible that our present electro-magnet is to what it might be, what the cog wheel of the early railway engineers was to the present smooth one? For after our electricians have for so many years been exhausting their ingenuity to accomplish a certain object, M. Du Moncel—no mean authority in such matters—comes forward and declares that the object gained by that ingenuity is worse than useless. An electro-magnet may be briefly defined to be a cylinder of iron covered with a helix of wire; very powerless is the iron if no current is passing through the wire; very powerful is it—witness the Royal Institution magnet, and the one in Paris which is covered with 20,000 ft. of wire and lifts a weight of three tuns—while a current passes. We may say, therefore, that the power of the magnet depends on the wire; and it has always been considered necessary that the wire, thin or thick, according to the work to be done or the strength of the current used, must be most carefully covered with an insulated substance. So we have wires covered with silk, with cotton, india-rubber, and varnishes of different kinds. And this equally in the electro-magnets used for experiments as in those used for the ten thousand purposes in which electricity is now being daily employed; indeed, we may almost say that electricity works by electro-magnets. Some time ago, M. Carlier, an electrician in Paris, asked himself the question—Is this covering necessary? And he very properly set to work to make an electro-magnet with uncovered wire to answer the question. M. Du Moncel, in a communication to the Paris Academy, on the 9th inst., declares that the answer thus given is so extraordinary, and the power of the uncovered electro-magnet so great, that he can scarcely believe his own experiments. Not only can these new magnets produce all the effects of attraction of the covered ones, but the effects in some cases are more than doubled. Let us produce M. Du Moncel's figures. A bar of iron 4½ centimeters long, and 7 millimeters in diameter, covered with a single spiral of wire 0.277 millimeters in diameter, with two small Bunsen's elements, sustained a weight of 3·9 kilogrammes; covered, it could only support 2·4 kilogrammes. A larger magnet, covered with twelve coats of wire, held up 940 grammes; with covered wire it could only support 540 grammes. The effects of distant attraction were even more favorable. At a distance of one millimeter, and with a Daniell's pile of twenty-eight elements, the weights attracted were as follows:—

Circuit.	New Magnet.	Old Magnet.
0 kilometres	83	12
10 ,,	12	3
20 ,,	4	0

The requisite condition to obtain these effects is that the different "coats" of wire shall be separated from each other by a piece of paper, and that the interior of the bobbins, whether in wood or copper, should be