Discussion.

Sir BENJAMIN BAKER, K.C.M.G., Vice-President, said, in these days of keen international competition, the trade of the country could only be maintained by close attention to detail in multitudinous things. Nothing of a mechanical nature was beneath the consideration of the Institution, to which the country at large looked as the leader amongst engineering bodies, to see that Great Britain did not lag behind its competitors in any mechanical detail which might make for the benefit of trade. No doubt members had noticed the statement that ten million casks were required annually for the cement trade. The competition between Germany and England in the supply of cement, even to British Colonies, was well known, and an item such as the cost of the cask would really determine the direction in which the trade would go. Apart from considerations of that kind, members would remember the well-known definition of a "well-informed man"—one who knew a great deal about one subject and a little about most subjects. The thanks of the Institution were therefore due to the Author for enabling a step to be made by its members towards the desirable position of well-informed men, by letting them learn a little about casks. Until he heard the Paper, he must confess to having been rather ignorant on that subject, which had been associated in his mind chiefly with some absurd regulations on the part of Trade Unionists, that if casks were made by machinery, manufacturers should be compelled to have some workmen present to make zigzag marks in chalk round the casks at intervals, for no useful purpose, but that the men so engaged should draw a salary. He had great pleasure in proposing a vote of thanks to the Author for his interesting Paper.

Mr. ALLEN RANSOME thought no person who had not gone through the painful experience of scheming cask-making machinery could have the faintest idea of the immense amount of difficulty which had to be encountered at every step. Looking at a cask, an outsider would say it was the simplest thing in the world; that it consisted simply of a certain number of staves, more or less flat and equal in size; of two heads, which were always supposed to be round; and of six or eight iron hoops. The difficulties commenced at the very first step. The jointing of the staves,

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apparently the simplest thing in the world, depended upon the nature of the wood, the class of casks to be made, the amount of bilge the cask was to have, and whether the staves were to be uniform in width or wider at one end than at the other. The two designs of jointing-machines shown in the Figs. represented probably hardly 2 per cent. of those which were either actually in use or had gone out of use. As the Author had mentioned, those which had survived were probably the fittest. Others were to be seen in some more or less perfect works on the Continent, and some were still to be found at work in old-fashioned establishments in England. Another great difficulty was, that it was necessary to pander in every possible way, not only to the prejudices of the trade and the hand-cooper, but also to those of the men who used the cask. If, for instance, a supply of cognac-casks were sent into the Bordeaux districts, there would be no demand for them. Each locality required its own type of cask, having some different peculiarities which the maker of machinery must exactly follow, otherwise the casks would meet with no sale. Take, for instance, the simple claret-cask used in Bordeaux, one of the cheapest casks that could be made for wine. It might be said that anything would do for cheap claret, that any good sound cask would serve this purpose. But that was not so. Claret casks had several peculiarities, which were distinct weaknesses. First, the bilge of the cask was extremely pronounced, the whole of the bend in the barrel being given in about 6 inches length of the stave, which, of course, had the effect, especially with thick staves or when the wood was not very sound, of causing an undue amount of breakage in bending. To remedy that, the staves of Bordeaux casks were usually steamed and pressed before they were jointed. That again necessitated a different class of machines from those exhibited. The claret cask was made with a very long chime, the ends of the staves projecting considerably beyond the heads. The staves were reduced by being shaved off with a long chime, the result of which was to render them weak. If, however, machinery were provided which would produce casks without those weaknesses, there would be no sale for it, on the ground that if claret were supplied in casks which did not look like those to which people had been accustomed, it would be said that the wine contained in them was not genuine. There was a certain amount of truth in this, but it made it difficult for those who had to design machines to meet all these peculiar requirements. Of course, it was known that for years past there had been great troubles in the trade; the strikes, especially

among the London coopers who manufactured barrels and casks for the London breweries, had been notoriously vexatious. Quite recently there had been a strike for an increase of wages. For years past the London coopers had been working on a regular scale, being paid so much for each operation. The Union thought it was necessary to demand a rise of wages, and the masters conceded an advance of 10 per cent. without the slightest demur. No sooner had the men received that, which was supposed at the time to be final, than they formed a new list which was apparently prepared in a very arbitrary way. Instead of being paid about 1s. 8d. for re-making a hogshead, the price was raised to between 4s. and 5s., and other prices were advanced in the same way. One regulation was that every cask was to be stamped with the date at which it was made, and after it had been at work for a certain number of years, whether it was good or bad, it was to be thrown on one side. The masters objected, and a struggle ensued which continued for about four months, and then, as was usually the case, some of the masters began to give way, and virtually the men gained the day. That sort of thing had made coopers and brewers look round to see whether they could not shield themselves from such inconveniences; and some of them had adopted machinery, with the results shown by some of the casks exhibited—two of which, made entirely by machinery, he believed, would take a prize before almost any hand-made cask. The great difficulty in the introduction of machinery in London, was that the brewing trade was so good that the brewers looked upon the cost of the casks as quite a secondary matter; and, although many of them paid extravagant prices for their casks, they did not attach sufficient importance to that, to risk difficulties with their workmen by erecting machinery. That sort of feeling was gradually giving way, and it might be hoped that cask-making machinery would be in future more generally introduced for that purpose.

Mr. SIDNEY STRAKER requested the Author to furnish further information as to whether the wire rope tended to slip off the top of the staves, when the windlass was worked, and whether the cask required to be held back. It would be also interesting to know the speed of the machines. It had been stated by the Author that the operation in the ovalling and bevilling machine was performed in one turn of the head. If that was so, he imagined that it would tend to tear the wood in cutting. No doubt that was not the case, but some explanation might be given. Then, with regard to the capacity, he imagined it would be a

Mr. Allen
Ransome.

Mr. Straker.

Mr. Straker. varying quantity, and that, even though gauged accurately before being steamed, the barrel would tend to warp, and so the capacity would vary. Were the barrels always made by gauge, or were they sent out ungauged as to contents? The construction of machinery for cask-making was the result of very many years' application, and no doubt the results were very satisfactory and practical.

Mr. Lewis. **Mr. W. B. LEWIS** observed that whilst the Author had stated that several operations could be performed much more rapidly by machinery than by hand work, he had not given any idea as to the relative cost of machine-made and hand-made casks. A very large brewery firm had been, within recent years, in difficulties, and one could not help thinking that, if there was saving from making casks by machinery, that firm would face trouble with their men, in order to provide a dividend for their shareholders.

Mr. Ward. **Mr. HENRY WARD** found it difficult to understand how the joints could be equally good whether the staves were sawn or planed. The explanation seemed to be that very great pressure was put upon the staves when they were trussed together. Another difficulty was that, in the endeavour to give the proper bend to each one of the staves, it was necessary to steam them, and, apparently, while under the influence of steam or heat the joint was formed. In that case, probably, when the stave became dry again the joint would be somewhat out of truth. He would ask whether that was the fact and whether it gave rise to any trouble. It had been stated by coopers that one reason why hand-made casks would always exist, was that there were no pieces of timber exactly alike, and that a cooper, on noticing the varying qualities of different pieces of timber, could put different bevils upon them, according to their nature. The skill of the coopers in that respect must be great indeed, when it was realised how the whole length of the stave must differ at every point of its length in order to make a tight joint. It rarely occurred that two pieces of timber could be got exactly alike; and of course when dressed by the machines, every piece of timber would be finished to exactly the same shape independent of quality.

Mr. Wynne. **Mr. FRANK WYNNE** requested the Author to describe the process of backing and hollowing the staves. Perhaps he would explain the difference between a stave that was backed and hollowed and one to which that operation had not been applied.

Mr. Rigby. **Mr. JOHN RIGBY** wished to call attention to one very important

feature of a cask, namely, the hoop. The cask was nothing without the hoop, which was its backbone. It was evident that, as the cask was made of dry wood, and remembering the purpose to which it was always applied, the hoop of the cask must be submitted to considerable longitudinal stress. He therefore wished to know something about the materials used for cask-hoops, and how they were manufactured; whether in that respect the manufacturer of machine-made casks was entirely dependent upon the manufacturer of hand-made hoops; whether there was any machine which would make the hoops out of sheet-steel by compression and punching; or whether they were welded up from hoop-iron in the good old way formerly practised. It was, of course, important that the hoops should be very firm in order to stand the tension to which they were subjected. Long ago hoop-guns had been made very much in the same way as casks were now made. Some of the earliest of the great ordnances made in the middle ages were designed much on the principle of a cask with a great number of staves held together by hoops.

Mr. E. R. DOLBY, referring to the setting-up apparatus, supposed it was improbable that the whole of the staves were made exactly of the same width. He asked, therefore, whether the last one or two staves in a cask were selected so as to fit perfectly tight in the setting-up apparatus. He also asked how the price of barrels made with separate staves would compare with the price of those made all in one piece. There was a process by which barrels were made from one sheet. The trunk of a tree was steamed, and a sheet was taken from the trunk spirally and then nicked out. It would be interesting to know if much had been done in that way. It would seem that very large trunks must be necessary for the purpose, but he believed the plan had been adopted for cement-casks to a considerable extent.

Mr. HENRY G. RAWSON was connected with a company which was manufacturing in Belgium casks of one piece of wood on the plan which had been alluded to by Mr. Dolby. It was important that the V's or gores in the sheet should not be opposite one another, but as alternate spaces, so as not to split and run together. A log, averaging as a rule 15 or 16 inches in diameter, was taken, and after being boiled three to six hours according to the wood employed—chiefly aspen or poplar—the log was taken out steaming hot, the bark was ripped off it, and it was placed on a cutting-machine and rotated against a knife-blade, with a peculiar oscillating motion which ensured a clean cut. The sheet was then rolled out and cut into lengths varying according to

Mr. Rawson. the size of the diameter of the barrel required, the log having been, in the first instance, cut into a length which would correspond with the height of the barrel. Then, the diameter of the barrel being in that way obtained, the sheet was taken, still hot and damp, to the V cutting-machine where the gores were stamped out, so as to give the barrel the required bilge. The V's might be closer or further apart from one another, by which means a greater or less bilge was obtained. When that was done the sheet was taken to a crozing-machine which cut the ends clean and square, bevilled them, and cut the grooves for the heads. The sheets were then taken to the drying-house, where they were dried by hot air in eight to twelve hours. They were prevented from warping, being fixed down with clamps, and were then ready to be converted into a barrel or to be shipped to another place where there was a factory to turn them into barrels by specially-constructed machinery. That machinery was thus arranged:—First, there was an endless band by which the sheets were taken through the steam-box and moistened sufficiently to enable them to be bent without cracking. Then they were trussed by one or other of the various trussing-machines and hooped, and, finally, a hot-blast was sent through them to fix them in shape, after which the wooden hoops and heads were put on in the ordinary way. That was a rough outline of the method. There had not been much done in England yet, because the necessity for a separate making-up plant at every place where large quantities of sheets were dealt with, involved a greater outlay of capital than the company had at its disposal; but in Belgium and in Germany those barrels had been made to a considerable extent already, and at the present moment the manufacture was being further experimented upon.

Mr. Robinson. Mr. T. N. ROBINSON mentioned that about twenty years ago his firm had put down a plant for Messrs. Bass and Co., of Burton, for making beer-casks. The process of manufacture did not differ very greatly from that by the machines described by the Author. At the time, the great question was, whether cask-making by machinery would be more extravagant in the use of timber than by hand; and the problem was to produce machines that would joint the staves accurately, and waste as little material as possible. To that end, his firm had introduced a machine for jointing staves which was very similar to that illustrated in Fig. 9, the only difference being the way in which the cutter-block worked. In the latter machine he noticed the cutter-block rose and fell as the stave passed the cutters, whereas in the machine he alluded to,

the cutter-block moved in a lateral direction, being guided by a template and dummy roller, as the stave passed the cutters. The template was bevelled on the edge, and the roller which pressed against it was fixed on a vertical slide which could be raised and lowered by means of a screw; so that as the amount of bilge was required to be altered, it was only necessary to raise the dummy wheel higher or lower on the template, which gave more or less belly to the stave. In that way it was not necessary to change the template to vary the amount of bilge. With regard to jointing-machines in general, he did not think any of those described would make a perfectly accurate joint. The amount of bilge and of bevil would vary in a stave as its width altered, and if the machine was to work accurately, there would have to be some variation in those two points in almost every stave, unless they were all of exactly the same width, which was not usually the case. The general use of machinery for making casks had certainly not been very largely adopted in this country, and he thought the reason was in a great measure that so many processes were necessary. Here there were about twelve different machines for making a cask. That meant a large outlay of machinery for a cooper, and unless he had a big trade to keep them fully employed, it was not likely to pay well. If, instead of having to move the staves and different parts of the casks into so many machines, those operations could be combined into one, and a machine could be produced that would make a cask entirely, there would no doubt be a large demand for such machines. He had seen, some years ago, a machine—the invention of Mr. Dunbar, he believed—in which the operations of chiming, crozing, and setting-up were very successfully combined. In that machine, the staves were set-up on a horizontal collapsible core or drum, arranged something like a double umbrella—as if two umbrellas were mounted end to end on one stick, so that they could be opened and closed together, and outside the frames strips of steel were attached to form a shell. In that machine the staves were set-up round the circumference of the core in its expanded state. Two cones similar to that shown in Fig. 3 were then caused to approach one another by a screw-feed, and in that operation both ends of the cask were trussed at once, the inner core being simultaneously caused to collapse and so to free itself from the staves. The operation of chiming and crozing was performed whilst the cask was held in the cones, which formed a good support for the staves when under the cutters, and enabled the work to be turned out with accuracy and finish. He did not

Mr. Robinson. think the machine had been used for large casks, but for small casks it seemed to be serviceable and quick in operation.

Sir Benjamin Baker. Sir BENJAMIN BAKER thought it would be interesting to have on record some brief description of how the staves were shaped in the old days by hand, and how the hoops were coned. He supposed it was not done by rollers in the early days but by hammer.

Mr. Routh. Mr. W. POLE ROUTH said the hoops were formerly coned by hammer, and the hollowing of the staves was done with the adze. He had had some experience of cask-making on the Continent, where the staves were cut on the block with a large adze which the workman put against his side, lifted up and chopped down, cutting the stave. He would like to say one word about jointing. It had been stated that it was almost impossible for a machine to be made to cut perfectly the chamfer and bilge of the stave. He thought that Messrs. Ransome had brought out a machine some years ago which met every necessity. It shaped the exact form of the bilge and also the chamfer at the same time. If a stave was somewhat wide, it had to have a different bilge and chamfer from that given to a narrower one, and he thought the machine alluded to cut the chamfer and the bilge according to the width of the stave. Theoretically it was perfect, though in practice it was not so. It had two cutters, one on each side of the stave, and the difficulty was to pass the stave through without cutting away too much wood. If the stave was $5\frac{1}{2}$ inches and the machine was set for 5 inches, $\frac{1}{2}$ inch was lost— $\frac{1}{4}$ inch on each side—and the difficulty was to adjust the machine so as to save the wood. It could be adjusted by a hand-wheel, but that would have to be done with every stave, which was impossible in practice; and all the staves had to be sorted into different sizes. He believed the manufacture of the machine had been discontinued on account of the waste of wood resulting from its use. Taking $\frac{1}{8}$ inch off each side of a stave, on only a small business, meant a loss of £1,000 or £2,000 at the end of the year. He noticed that Messrs. Ransome had, however, adopted another machine on proper lines, in which they had followed another manufacturer.

Sir Benjamin Baker. Sir BENJAMIN BAKER said it was quite clear that the information on the subject was not yet exhausted, and he hoped there would be some correspondence to supplement the remarks which had been made. With reference to Mr. Rigby's comments on the hoops, so far as he could judge, the riveting seemed very slight, and he should think was not a fifth, or perhaps even a tenth of the strength of the hoop. Mr. Ransome in reply would perhaps have that fact in his mind in answering Mr. Rigby.

Mr. LEWIS H. RANSOME in reply, observed that, although several speakers had assumed that all the machines shown on the diagrams were made by his firm, such was not the case. In writing the Paper he had endeavoured to select what he believed to be the best machines at the present date. He had been requested by Mr. Straker to explain how it was that the wire-rope in the process of windlassing did not slip off the cask, and whether it did not tend to pull the cask over. It would be seen on the diagram that the table was close up to the wire-hoop, and therefore the leverage on the cask was not great. The staves, before going to the windlassing machine, were steamed and were quite wet, and the rope seemed to hold better in consequence of that; at any rate, it did not slip at all. With regard to the speed of the chiming and crozing machine, Mr. Straker was correct in supposing that machine finished a cask in one revolution. The cutter-blocks revolved at nearly 4,000 revolutions a-minute, therefore the cutting-speed was very great, and a perfectly clean cut resulted. The only difficulty was that, in doing the chiming in a heavy cask, a great quantity of stuff had to be removed, and consequently the cutters, if not of good steel, were apt to become dull. He had never known a machine that would stand more than twenty brewers' casks without requiring to be sharpened. He was glad that he had been asked about the capacity of the casks made by machinery, because that was the point upon which he claimed that the machine-made cask was particularly superior to the hand-made cask. If a machine was made properly, it must make all casks exactly alike—and consequently their capacity must be the same. The capacity was gauged by the setting-up apparatus. The number of staves should be the same in every case, but the width, of course, varied; the operator had by him a bundle of staves; he fitted in all but the last one or two, and then selected the last one of the right size to fit the two gauge-hoops; consequently they got precisely the same amount of timber in every cask. That being so, and the heads being the same distance apart, and the cask being trussed in a machine which did not vary, the capacity must be invariable. He might mention that everybody who used casks kept a very keen eye on the capacity, and manufacturers would soon hear of it if they did vary. The result of steaming, of course, was to make the cask pliable, and enable the staves to be bent; and he should have mentioned that, after steaming and trussing the staves, many people liked to fire them over a cresset, which, they said, set them, and prevented them from going back. Mr. Lewis had asked about the comparative cost of

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Ransome.

Mr. Lewis H. Ransome. hand- and machine-made casks. That was a difficult question to answer, seeing that there were so many varieties of casks. Taking cement-casks, it might be said that machinery turned them out ten to fifteen times as quickly as could be done by hand. The cost of the machinery was, of course, considerable. About 20 effective HP. would be required to drive a set of machines, and calculations could be made on that basis. For brewers' casks it might safely be said that machine-made casks (even when turned out in small quantities) could be made at at least half the price of hand-made ones. It had been said that the sawn joints were not correct. That was quite true: in neither of the machines described were the joints theoretically correct, but practically they were so; and after the stave had been steamed and subjected to the tremendous pressure put on it in the trussing machine, the joints would never leak. He had seen recently in Messrs. Bass's brewery a machine-made cask with sawn joints which the manager of the cooperage vouched for as being twenty-two years old, and it was not leaking yet. One would not want a better joint than that. A machine referred to as having been made by Messrs. Ransome many years ago, no doubt was theoretically correct. The two cutters-blocks were hung from a centre, which represented the centre of the cask, and opened out radially to the required bevil. That machine did waste some wood, but he had lately seen a machine working on the Continent on the same principle, by which the operator could gauge each stave and set the cutter accurately to the width, insuring no waste, and thus insuring a perfect joint. It was a little slower than the machine described in the Paper, but it produced a theoretically perfect joint. With reference to shaping staves, when undergoing the various operations, he regretted he had not samples of them to exhibit. The stave was first of all, roughly speaking, of equal thickness throughout and rectangular. The operation of jointing was to bevil the two ends. The stave was then rounded and hollowed, which enabled it to be more readily bent. In reply to Mr. Rigby, hand-coopers, and also those who used machinery, bought their hoop-iron ready made. He believed it was rolled, and to be strong enough for its purpose. The thinnest hoops were those used for soap-casks, and they were hardly as thick as ordinary brown paper, but for beer-casks the hoops ran to 14 B.W.G. or even more in thickness. When extra strength was required, two rivets were used in preference to one large rivet, which would weaken the hoop too much. He was much interested by the description of the single-stave cask, known commonly as

the "Onkin" barrel. He had seen it made in America about seven years ago. It was a fine-looking barrel, but was much more costly than the ordinary cement-barrel. On going over the factory the day it was opened, he was much struck with the enormous quantity of waste wood which he was told had been rejected. If there was any blemish or defect, the piece was cut off and thrown out. He was also told that as the casks were made of one piece, there was not the same tendency to resist warping as in a barrel made up of several staves. A point in which the manufacture of the barrel varied from that described by Mr. Rawson was that the grooves were sawn out by a series of "drunken saws" set on a horizontal spindle, which were out of truth when they entered the staves, and gradually righted themselves as they approached the middle of the stave—so making a V-cut. No doubt, as Mr. Robinson had said, cask-making machinery was not new. On going over the Admiralty Victualling Department at Deptford, he had seen some machines which had been at work over twenty years, with many features almost the same as those now under discussion; but the chief difference was that the new machines would turn out about six times the amount of work that the old type was capable of. The cutter-spindles of those old machines, instead of running at 3,000 or 4,000 revolutions per minute, generally ran at about 500 revolutions. The methods of handling the casks, getting them into and out of the machines and bringing the cutters into action, were all much slower than at present. Far from it being a weak point in cooperage machinery, that every operation was separately performed, the fact was, if an operation was to be done well, it generally had to be done singly. For instance, in making a box there was not a machine for putting the lid on, nailing the sides together and planing it all in one operation, and a cask was a much more complicated thing to make than a box. He maintained that the right plan was to take each operation singly. Of course, it did not pay small makers to have machinery, but for the manufacturer who turned out casks by the thousand, machinery was a necessity. He thanked the members for the attention they had given to his Paper.

Mr. Lewis H.
Ransome.