trunk skylights amidships, led to the very highest part of the structure surrounding the funnel, all the main passages and arteries of the ship leading to the principal uptakes. It is now accepted as an axiom in all matters connected with ventilation, that if you have one large and comprehensive exhaust to remove the air from any space, the fresh air will find its own way through any openings there may be. The passenger quarters are well dotted with automatic downcomers placed in such positions that the air currents have to travel about a good deal before reaching the final exhaust or main up-current.

The water service also claims a good deal of attention on a passenger steamer of any size. There is a complete system of gravitation salt water installed for sanitary purposes throughout the vessel as may be required; this is supplied from the engine-room by a special pump which discharges into a tank of suitable capacity open to the atmosphere at the highest part of the ship; the water is thence led to baths, sprays, douches, w.c's., sculleries, galleys, and other places where required.

Occasionally a gravity supply of fresh water is provided by lavish owners who wish to keep ahead, and the writer knows of an instance where fresh water shower baths daily can be had all the way across the Pacific. This, of course, entails an enormous supply leaving port; but, as a rule, on long voyages passengers are restricted to about 4 gallons of fresh water per day, and gravity supplies are not fitted, excepting to galleys, pantries, bars, and lavatories. There are also a few taps conveniently placed for the use of stewards in filling the service tanks and jugs for state-rooms. This combines convenience with economy in a satisfactory way. Some builders introduced a hot water service to baths and lavatories, but this involves duplicating the system of piping and a correspondingly increased cost of installation.

Most builders do their own joiner and plumber work; others sub-let these portions of the structure; and all specialties, such as steam or hydraulic steering or cargo gear ,electric lighting installation, bell communication to rooms, cooking and pantry apparatus, signalling and navigating appliances, upholstery, and such like, are installed by sub-contractors who are specialists in their own line.

Some builders keep a highly qualified architect, who designs and carries out all the decorative features and effects of saloons, boudoirs, drawing-rooms and smoking-rooms; others invoke the services of an eminent man for any special work required, and for the ordinary plain work their own joiners are sufficient.

Altogether, it would be difficult to give within the limits of this paper more than a resume of the subject in its varying phases, and we shall now review the engineering phase. Excepting in the case of very large units, the ordinary triple expansion engine, with three cylinders and three cranks, is almost universally adopted for ordinary work; for very high speeds, say, 18 to 23 knots, the four-cylinder triple expansion balanced engine is frequently chosen. The steam pressures vary from 160 to 200 lbs. per square inch, and for the machinery to be successful the materials and workmanship must be of high grade.

The introduction of new machinery of various kinds has reduced the manual processes to zero, and eliminated largely the personal factor, leaving nothing for the fitter to do but assemble the various parts. There is now hardly any hand work, excepting the dressing of flanges where cylinders join, or bed plates attach; the champion chipper and filer is only a memory of 15 or 20 years ago. Design in the details is specially studied by the draftsmen, and frequently modified so as to allow the part in question to be entirely finished by some machine in as few operations as possible. The whole of the details are carefully drawn and dimensioned, down to the merest screw and pin hole, nothing being left to the discretion of the shop hands. The work thus gravitates along towards completion without any necessity for interim fitting, the parts being brought together once for all. The operations on nearly all parts have been simplified a good deal of late years. For instance, in the building of a crank shaft, the webs are accurately sawn out of a slab by means of a band saw travelling at 180 feet per minute; they are planed all at once, two bored at a time; when the parts have been assembled for fitting together, the shaft sections are mounted on true V blocks on a suitable bed, the crank eyes heated by Bunsen gas burners, conveniently handled and cleanly, and the shaft is ready to go in for the truing up cut in an astonishingly short time.

The boring of chambers and cylinders is effected also with a good deal of dispatch. Cylinders of large diameter are bored with as much as $\frac{1}{2}$ inch feed, six tools following each other at $\frac{1}{8}$ inch axial distance, leaving a surprisingly smooth surface for such coarse feed.

The drilling, tapping, and studding of flange joints is now a continuous operation, performed by the same machine in one-third of the time occupied by the hand process of tapping and studding only, with the advantage of all being at right angles to the surface.

It is generally found expedient to standardize details, such as stop valves of medium sizes, plummer blocks, turning gear, platforms, stanchions, rails, wrenches, flanges, sea cocks, boiler mounting, lubricating gear, and many other articles that do not vary much with the size of machinery to which they are applied.

Most of the leading auxiliaries introduced in the machinery department of the steamers of to-day are made by outside firms who specialise the particular article in question, such as feed heaters and pumps, evaporators, filters, governors, reversing gear, circulating and ballast pumps, refrigerating machinery, motors and dynamos, ash ejectors, and fan engines, and other adjuncts continually called for. The firms who specialize one or more of the above articles have laid down suitable plant for turning out inter-changeable parts with the maximum of dispatch, and at a price more or less according to the demand and the value of the patent rights. An article for which there is a great demand, when same is well protected by patents, the proprietors get their own price —in moderation—for a few years; till after a while others cut in, with modifications that may or may not be improvements, and prices are cut down by half in some cases.

As in shipbuilding, so it is in the engineering branch, that good facilities for transporting and removing materials, be they heavy or light, make rapid production possible.

The modern erecting shop is fitted with business-like travelling cranes that are geared up to as much as 180 feet per minute of travelling capacity, and yet can be regulated to a nicety. The details of these appliances are complete and instructive, one of the most useful being its swivel hook or eye, which is delicately set on ball bearings and can be whirled with one's finger. This is a decided contrast to the older article that needed two or three men to move the loaded swivel, with the aid of a lever.

The tool shop is another comparatively modern development that tends in no small degree to expedite production. This department makes, grinds, and keeps in repair all cutting, shaping, and gauging tools used throughout the works. It is well fitted with small handy oil or gas furnaces for dressing cutting tools of various kinds; universally adjustable carborundum wheels for grinding all classes of drills, milling cutters, turning and shaping tools, gauges, and others too numerous to mention.

Many of the best milling cutters are now made of mild steel, cut, then case hardened and ground. These are found to be very durable, and of much less cost than those of cast steel.

The automatic turret lathe has done much to assist in the cheap and rapid production of the many subsidiary appliances called for in the fitting out of a well-appointed engine-room; special milling machines and boring mills, where two or three operations go on at once, deal with parts in one adjustment, and turn them out finished, or ready for another process.

When many reproductions of the same article are involved, it generally pays to hand particulars and a sample of the article required to a reliable firm of machine tool makers, who in a short time give you a machine that will turn out many repeats with no perceptible difference in dimension.

In the manufacture of marine boilers the processes are much the same in regard to expediting work, and one can almost see a boiler grow. Take a single-ended, 1200

H.P., 170lbs. pressure as an example: the shell plates are marked off templates with the regulation pitch, and, before bending, a few holes are punched, just enough to hold them together. They are then rolled to the proper curve, assembled, and bolted together. The end plates are flanged by a hydraulic machine which does its work on the plate in segments, as it is heated and moved round a centre. The result, after allowing for shrinkage, is an almost mathematically true result.

The front plates for furnace mouth attachments are flanged by a special machine fitted with a series of dies for each diameter of furnace. Each furnace mouth is flanged in one operation, which occupies, including heating, 20 minutes. The writer has personally timed the flanging of three furnace mouths, 48 inches diameter, in one hour. The combustion chamber plates are rivetted to the furnace, and to each other (excepting the back plate) by hydraulic machine, dressed and caulked by air tools, amid a din that baffles description, and where no one ever attempts to speak. The outside of each furnace is rough turned for 6 inches at its mouth, and the end flange is bored for its reception. The shell rivetting machine is made with a duplex ram, which holds the plates together while the rivet is driven home, with 1¼ inch plates, or over; this device is necessary to ensure good work. When the ends have been put into the boiler shell temporarily and, all bolted well together, the shell plates are drilled, and the edge taken off the holes, inside and out, and the whole taken down to have the joints cleaned and the burr removed.

After the shell has been put together finally and rivetted, combustion chambers and furnaces put in position, and the front rivetted circumferentially, the boiler is deposited in front of a lofty adjustable drilling, tapping, and facing machine. Here all the stay holes are bored, tapped and faced, the stays screwed in and also the tubes, the latter being expended with an air motor which occupies about 20 seconds per tube; meanwhile a handy radial drilling machine driven by an electric or air motor is put to work drilling the flanges for furnace mouth attachments. The drill has a counter-sinking shoulder, and by feeding it in a little more after the hole is through, each is completed in one operation. Each furnace mouth is bored, countersunk, ready for rivetting in about three hours. The holes for all shell mountings are bored and faced by the above machine; and when these have been fitted the preliminary test pressure is applied. There are seldom any "weeps" from the lower pressure when it is applied, but after any such have been made good the full test of double working pressure is made, and kept on for two days.

The boilers are then placed in position similar to what they will occupy, and all smoke boxes, up-takes, etc., fitted up and finished as far as possible. The whole of the boilers are then heated by steam and covered with silicate or asbestos compound, and are then all ready for lifting on board.

The spaces left in the decks for the purpose are sufficient to allow the boilers and mounting plenty of room while being shipped, and much time is saved by simultaneous operations, instead of consecutive ones.

The system of drawing office work is so complete that the details of the steam and water pipe arrangements are worked out; pipes made to sketch; a few loose flanges left here and there; but, in the main, mistakes are few and trivial. Three to four weeks is the usual time elapsing between a launch and trial trip of, say, a 4000 H.P. steamer, and, considering the work involved, it is a good performance.

Nearly all the operatives engaged on the works before described are on piece work, and average about double time rates, with which both parties are satisfied.

The elaborate tools and appliances provided render slumming or careless work unusual, more especially when the workman has to make the defect good at his own expense.

Australia seems a long way off from developments of this kind, judging from present conditions of labour; but the utilisation of her own resources will undoubtedly be the first stage of the march to final eminence in the iron and steel trades.

At the conclusion of the reading of the paper, which had been listened to with marked attention by all present, dealing as it did with questions of great importance in engineering circles,

Mr. J. Shirra, in rising to propose a most hearty vote of thanks, said that he must compliment Mr. McAllister on the concise manner in which he had dealt with the subject. It placed beyond question the fact that the Clyde was easily first in shipbuilding and engineering in the world, and if more of the same energy and progressive principle could be shown here, it would not take long to make Port Jackson, with its manifold natural advantages, a second Clyde.

Mr. J. Macartney, in seconding the vote of thanks, said that the paper would naturally provide good food for reflection and prove most interesting reading, and provide a good discussion at the next meeting.

Mr. J. L. C. Rae, in conveying thanks to Mr. C. McAllister for his contribution, said that the paper would be printed and placed in the hands of the members, to enable them to fully grasp all its points and discuss them at length. It would be hard to follow the details and keep them in mind from the reading, but there was not the slighest doubt in his mind that a most interesting discussion would result. To have the opportunity of hearing Mr. C. McAllister's views on engineering in the Old Country did them all good, and he personally was proud to think that in spite of all opposition they were going ahead there. He looked forward to a most enjoyable and instructive evening resulting from the discussion of the paper.

Mr. McAllister said that when asked to read a paper on his impressions during his recent visit Home, he was rather afraid, as his material had been gathered in such a fugitive sort of way, but he had treated the subject generally, and he was pleased to think it had met with approval.

The turbine is as yet a sort of a curiosity, and up to the present not generally known to Clyde engineers. In a short space of time turbines for the U.S.S. Co. will reach Australia, but he might venture the opinion that they are smooth-water machines, and do not work very well double-ended. Then, again, for use in our own harbour, the runs to be made are so short that it would be against their use, as it is on long runs they shone out.

He thanked them again for the kindly manner his paper had been received, and would do his best to answer any points brought forward at the next meeting.