force is exerted. The mean driving force is more difficult to obtain. There are two instruments in use for measuring this, namely, the indicator and dynamometer. These two names are used in this paper in a restricted sense. The first is applied only to the well known steam engine indicator, and the latter to that form of dynamometer which is used to measure the force transmitted by revolving wheels or shafts.

It would be impossible, in the limits of this paper, to give a detailed description of the indicator. We therefore will mention only such features as are necessary to explain its mode of operation. The indicator is so constructed and attached that steam from the main cylinder presses upon one side of a small piston in the instrument, the atmospheric pressure being upon the other side. To the indicator piston is attached a spring and a pencil, the latter arranged to mark on paper. The predominating pressure on the indicator piston, whether of the steam or of the atmosphere, extends or compresses the spring in proportion to the intensity of the pressure, and moves the pencil up and down on the paper. The paper is arranged on a drum, which is so connected that it has a side motion corresponding to that of the engine piston. Consequently, as the engine piston moves the paper is moved sideways, and, as the pressure changes, the pencil is correspondingly moved up and down; so that the figure or diagram traced on the paper is a combination of the two movements, and should show the pressure at each and all points of the stroke. The mean of a number of ordinates on the diagram represents the mean pressure per square inch of piston, which, multiplied by the area of the piston, gives the total force which produces the piston movement, from which the power may be calculated, as has been before explained. The indicator is a beautiful instrument, of such great value to the steam engineer that it may be said to deserve the numerous words that have been spoken in its praise. Still, in many cases where it has hitherto been considered practically perfect, its indications are of the most deceitful and unreliable character. It shows very perfectly whether the valves are adjusted properly; and often, when applied to an engine which is working improperly, a mere glance at the diagram will reveal the difficulty, and suggest the remedy. Large leaks in the valves or piston may also be detected in this way. The indicated pressure at the end of the stroke has very often been employed to determine the quantity of steam used by the engine. Calculations founded on such a basis are entirely worthless, as will be explained when treating of the cost of the power. It has often been attempted, also, to calculate the friction from indicator friction diagrams; but the system is practically erroneous, as will be explained hereafter. The indicator is chiefly employed, however, to determine the power of an engine, it being supposed that the diagram shows correctly the pressure at all parts of the stroke. Even this it fails to do under certain circumstances. The moving parts of the instrument must have weight and friction, and some force is necessarily required to overcome the latter, and put the mass in motion. If, therefore, the pressure be ascending, the indicator will show less than it should; and when the pressure is descending, the instrument will show more than it ought. In either case, then, the length of the ordinates is increased during any change of pressure, whence the mean pressure indicated is greater than actually existed in the cylinder. Until quite recently we supposed that these inaccuracies were too small to require serious attention. Experiment has, however, proved the contrary.

To be continued.]

THE NATURAL AND THE ARTIFICIAL.

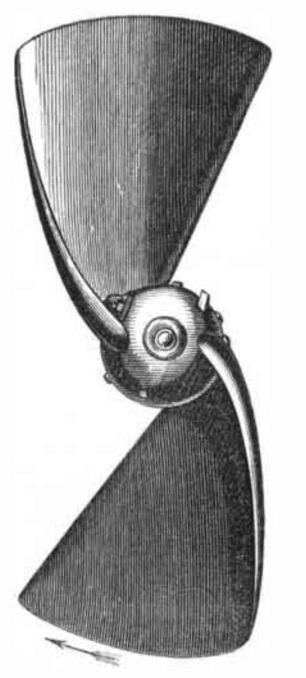
All artificial forms have sprung from natural forms. The proof of this is simple. Imagination is the grouping together of remembered images. Forms thus imagined, and constructed, although as a whole they may differ from anything else known, still are derived forms, so far as their elements are concerned. The first objects ever copied by man must have been natural forms. The grouping together of these gave new patterns for imitation, and the re-grouping of secondary forms others, and so on until those now in vogue in various departments of the arts were obtained.

A principal element in a good design is that the suggestive forms, the elements of the composition, should be so combined that no single one is conspicuously shown. If the contrary is the case, there is a want of harmony—of tone; the eye is carried from a general to a particular effect; from the result to one of the means intended to produce the result. Hence in the composition of designs for dress patterns, paper hangings, etc., it is rare that natural forms and colors of objects are preserved. The form may be retained and the color altered, or *vice versa*; or both may be modified to suit the general character of the design.

A chaste design always subordinates details to general effect. To this end a rose is often painted green or blue; blackberries may be represented as growing upon grapevines; any other incongruity may form a part of the composition. It is evident then that the profession of a designer in any department of the arts, requires great skill and judgment. There is only a short step from the harmonious and tasteful to the monstrous and disgusting; and the multiplication of new combinations, to the extent required in some departments of industry, calls for talents of a very rare and peculiar type. Especially is this the case in the manufacture of prints, and paper hangings, and a close scrutiny and criticism of the patterns of such goods exposed for sale in the shop windows, will soon convince the observer that a truly chaste and harmonious conception, is the exception not the rule. It is hardly possible from the circumstances of the case that this could be otherwise, but it is equally obvious, that there is much room for improvement in these designs,—not impossible improvement, but such as might easily and profitably be made.

HANCOCK'S SCREW PROPELLER.

The many advantages offered by screw propulsion over the paddle-wheel system have led to innumerable improvements and modifications in the former principle. Some of these are to be taken for what they are worth—which is little or nothing—while others possess a practical value which has led to their adoption. Among the most recent inventions in this direction, and one which has given the most signally successful results under competitive trials, is the screw propeller of Messrs. F. and C. Hancock, of Dudley. This screw has recently been tried against a two-bladed Smith's screw with results entirely in favor of the former. In the interests of steam navigation, we propose to place before our readers all the facts we have obtained respecting the trial, feeling assured that the Hancock screw embodies elements of superiority which entitle it to every consideration, and which there is every reason to believe will place it before every other competitor. The trial in question took place in a steam tug belonging to the Shropshire Union Canal Company, on one of their lines of water near Wolverhampton. This company for some years used a Griffith's screw in their tugs, but the results being unsatisfactory they instituted a series of experiments, at a cost of several thousand pounds, with the view of obtaining an efficient screw propeller. These experiments led to the adoption of a two-bladed Smith's screw, the blades each filling a quadrant of the whole circle, so that the entire screw area is equal to half the area of the circumscribing circle. No other form of propeller, Messrs. Hancock's alone excepted, has given such good results as this on the Shropshire Union Canal, and it was one of these against which the Hancock screw recently competed. The same boat was used in all cases, the screws only having been changed as required. The screw shaft makes two revolutions while the screw makes three, and the relative speeds of the crank and the propeller shafts remained the same throughout, the screws only being changed.



The Smith screw is 3 feet 1 inch in diameter, 4 feet pitch, and 20 inches along the shaft, and is driven by a double cylinder engine of upwards of 20-horse power. The Hancock screw is of an entirely new curve, as will be seen by the annexed engraving; it revolves from left to right, that is, the concave face moves forward. It is 3 feet in diameter, 6 feet pitch, 6 inches along the shaft, and has two thirds less surface than the Company's screw. The following tabulated statement gives the results of two runs with the tug boat alone, one with the Hancock and the other with the Company's or Smith's screw:

HANCOCK'S SCREW.

	Pressure in boiler in lbs.	*Revolutions per minute.*	*Miles run.*	*Time in minutes.*
First mile, not full steam	22	68	1	21
Second mile, full steam	23	80	1	17
Half mile, full steam	23	80	½	8
Total			2½	46

THE COMPANY'S SCREW.

	Pressure in boiler in lbs.	*Revolutions per minute.*	*Miles run.*	*Time in minutes.*
First mile, full steam	45	115	1	19
Second mile, full steam	45	115	1	21
Half mile, full steam	45	115	½	11
Total			2½	51

It will be seen by the above statement that the Company's screw had double the pressure of steam, and made upward of thirty-five revolutions per minute more than the Hancock screw. It is, therefore, fairly to be inferred that double the quantity of coal was consumed with the former, while a lower rate of speed was speed was obtained than by the latter screw. The value of a screw on a canal is its power to carry weights behind it; experiments were therefore made in towing, and the tug boat took in tow four loaded boats containing 95 tuns of goods. The first run of 2½ miles was made with a four-bladed Hancock screw. The pressure in the boiler was 50 lbs. full pressure; the run was accomplished in 67½ minutes, the engine making 86 revolutions per minute. The Hancock screw was then removed and the Smith screw put on, the boiler pressure remaining the same. The same four boats, with their 95 tuns of cargo on board, were again taken in tow, and the run was accomplished in 65 minutes, the engine making 148 revolutions per minute. From these figures it would appear that nearly the same results were obtained in both cases with a very different consumption of steam, and consequently of fuel, highly in favor of the Hancock screw. In a third experiment with the Hancock screw, the boiler pressure being 60 lbs., the engine made 103 revolutions per minute, and the run of 2½ miles, towing the four boats loaded as before, was accomplished in 55 minutes, upward of half a mile an hour faster than the run with the Company's screw. Such a result was certainly never obtained with the ordinary screw. Although we have no exact figures as to the consumption of fuel, neither were any indicator diagrams taken from the engine, there is evidence of a considerable saving in fuel. As this saving has been realized on the narrow and shallow waters of a canal, we may anticipate similar results with increased speeds in ocean steamers fitted with the new propeller. It should be borne in mind that speed cannot be obtained, however great the power used, in shallow canals where the boat draws four feet of water, as was the case in the present instance, leaving only six or eight inches of water below the bottom of the tug boat. It was found that with the Hancock screw no vibration whatever was experienced, while in all cases with the Company's screw, and in fact with all other screws, considerable vibration results.

It was at one time hoped that a revolution of the screw would be made to give a result analogous to that of a cart-wheel. The wheel revolves upon an unyielding substance, and carries its load the entire length of the revolution, without loss or slip. But as the screw revolves the water yields to its pressure, and the fastest ships in the Royal Navy only obtain a speed of one fourth the margin velocity of the screw with a best Griffith propeller. The small steam launches attached to the navy, fitted with a pair of twin Smith screws, attain in some few cases a speed equal to about one third of the margin velocity of the screw. But then it is only in those cases where the engines are proportionately more powerful than any that could be put into a large ship. The loss of propelling power in the screw is due to the great amount of slip. The long angle screws require too much power, and throw the water sideways. The lighter angles throw the water more in a line with the vessel, but the screw requires a high velocity to obtain speed, and this is one of the great defects our large ships have to contend with. The *Warrior*, with an engine giving out upward of 6,000-horse power, has to work at about 75 revolutions per minute to give the ship its full speed. So high a speed of the engine with so large a power cannot be maintained for long with safety; and this is the general position of our navy and our merchant ships. The Hancock propeller was invented to meet this special point and to remedy this great defect. It proposes to give a higher speed to a ship, and at the same time to greatly reduce the revolutions of the engine. So far as the trials have at present gone, these results have been attained. They go to prove that the engine will work one third slower, and the ship move faster, than with any other screw. To these advantages is to be added the economy of fuel, which is a most important feature in every case. The experiments have been very conclusive in establishing the superiority of the Hancock screw for one class of navigation. That it will prove as efficient in larger vessels, and under different conditions, there is no reason to doubt. But we cannot of course pronounce a decided opinion in the absence of actual trials. The invention is one full of promise, and we shall watch with interest the progress of the Hancock screw, feeling assured, from what has already been done, that if a trial in an ocean vessel were made, and the results carefully noted in detail, such advantages would be shown as would lead to its adoption in all future cases. We look forward with confidence to this result, and in the meantime congratulate the inventors on having inaugurated a new era in the history of screw propulsion.—*Mechanics' Magazine.*

The Water Power of Maine.

The report of the Commissioners appointed to conduct the hydrographic survey of the State of Maine contains some interesting statements. Returns were obtained from 2,015 sites of water power, all located within an area of 14,000 square miles, the entire area of the State being 31.000 square miles. The Penobscot River, in the twelve miles above Bangor, has power equal to 40,000 horses. The Kennebec River has power equal to 32,800, divided as follows: Augusta has 5,000; Waterville, 8,900; Solon, 4,900; Skowhegan, 5,700; Fairfield, 7,300; Anson and Madison, 2,000-horse power. The Androscoggin has power equal to 58,990 horses, divided as follows: Lewiston, 14,500; Brunswick, 8,600; Lisbon, 6,740; Livermore, 3,200; Jay, 4,950; Rumford, 21,000. From these figures it appears that the three principal rivers of the State afford power equal to over 130,000 horses. The report gives a total of 450,000, and taking into account the powers not reported, the aggregate water power of the State will not fall short of 1,000,000 horses. Lowell, in Massachusetts, has 9,000-horse power. The water power of Maine indicated above is, in the drouth of summer and at its present stage of development, equal to the working power of 4,000,000 of men, and is twice greater than the power, both steam and water, employed in Great Britain and Ireland, in 1856, in cotton, woolen, worsted, silk, and flax manufacture.

TESTING THE POWER OF STEAM ENGINES.

We commence this week the publication of a paper entitled "The Best Modes of Testing the Power and Economy of Steam Engines," read before the Polytechnic branch of the American Institute, Oct. 22, 1868. The paper is a marked contrast to the majority of the papers, and the discussions which have occupied the time of the Institute for a considerable period, and although exceptions may, and probably will be taken to some of the views of the author, its perusal will be found both interesting and instructive. We therefore strongly urge our readers to give it earnest and candid attention. It will be found that the author, although in the portion of the paper that we publish this week he points out important defects and sources of error in the application and use of the indicator, still claims, as he proceeds with the subject, that this instrument is the only one that can well be universally used for testing steam engines. His directions for its proper use, and the interpretation of its diagrams, are of value to all interested in the subject.