years, has been so feeble that I could not study much on any subject. The theorem which I sent you had been lying on my table since August, 1848. A few months since, I sent it to Mr. E. C. Herrick, of New Haven. He declined, however, expressing any opinion on the subject, and suggested that I should submit it to yourself. It was, as you suppose, the nebular hypothesis that suggested my law of rotation.

* * * * *

I feel under great obligations to you for your offer to make what you call my "discovery" public "through the medium of some of our journals and scientific memoirs."

I regret that I have nothing in proper form for publication; and, as I am about leaving Pottsville, to spend my August vacation in the country, I shall not be able to give the subject attention before September. * *

Allow me to leave the matter entirely in your hands. Anything I have written is at your disposal. Should you see proper to publish an article, in your own name, giving me credit for suggesting the law itself, I should be highly gratified.

The mass of Uranus, 21000 , which you have used, is one of which I had not heard. Struve's value, mentioned in my former letter, was furnished me by Mr. Herrick. I labor under considerable disadvantage from the want of libraries and scientific journals.

I shall be glad to hear from you at any time.

Very respectfully, your obedient servant,

DANIEL KIRKWOOD.

For the Journal of the Franklin Institute.

The Screw Propeller.

The question of the relative merits of the side wheel and screw propeller, as methods of applying steam power to the purposes of navigation, is one which has of late years engrossed much attention from Engineers, and seems still to be undecided; for the repeated failures which have hitherto induced so great a want of confidence in the latter form of wheel, may, we think, be attributable, not to the falsity of the principle involved, but to its injudicious application.

So far as theory is concerned, the screw propeller presents many and great advantages over the old plan, and as the results of practice do not appear to correspond to the hopes of improvement held out, we think that an inquiry into the reasons of such a discrepancy may not be amiss.

The advantages which should result from the use of the propeller are briefly these: a decreased cost and increased stowage for freight, and a more economical and equable result from the engine; both of which will, we believe, appear reasonable from the following considerations.

First, To develop an equal amount of power, propeller engines may be made much smaller than those for side wheel; for, by "equal power," is to be understood an equal amount of water converted into steam and used (at the same point of expansion) in a given time, or, as implying the same thing, an equal amount of boiler surface. Now, as propellers may be worked at a much higher number of revolutions than side wheels, it

follows that a proportionably smaller cylinder may be used, in order to develop the same power. The engines, therefore, being smaller, will of course be less expensive, (making the whole cost less,) and will require less room in the vessel, thereby leaving more room for stowage. That this latter is not a trivial consideration, will appear from the fact that a pair of ordinary side lever engines, (which are generally used in this country,) attached to side wheels, require more than twice the space demanded by engines of the same capacity placed transversely in the vessel for attachment to the propeller shaft, not to mention an equal disparity in the *weight* of the machinery, whose diminution permits a decreased draft of water, and thereby lessens the resistance, or increases the speed of the vessel with the same consumption of fuel. As an example of this position, two side lever engines for a steamer of 900 tons require a space of 7500 cubic feet, and will weigh, including wheels, shafts, &c., 130 tons; while a pair of propeller engines for the same vessel, to give the same power, require 3500 cubic feet, and will weigh but 70 tons, including the propeller and shaft; thus effecting a saving of 60 tons and 4000 feet of space, which is equivalent to a stowage of 110 tons. So that nearly one-seventh more *weight* may be transported at the same expense, or if the cargo is of a bulky nature, *one-fourth* more freight may be carried without increasing the resistance.

But, Secondly, we argue that the use of propellers admits of a more economical and equable action in the engines. For a screw propeller *properly constructed*, always acts upon the water through every point of its surface with precisely the same pressure, because, in such a wheel, every point will advance through equal distances in the same time, thus making available every inch of the blades as propelling surface; while in side wheels, however large they may be, there is always a considerable difference in the velocities of the outer and inner points of the bucket, so that a portion of the bucket is *dragged* by the vessel, or is at least comparatively useless, while another portion moves at a velocity far exceeding it, and a part of the propelling power of the wheel is expended without an adequate result. Besides which, the side wheel acts upon the water, not in a direction opposite to the motion of the vessel, but enters and departs from it at an angle which increases with the diminution of the diameter; while in the screw, the pressure against the water is uniform in amount, and constantly in a direction parallel to the vessel's motion.

A practical proof of the value of such advantages is found in the fact, that the "slip" in the side wheel varies from 25 to 30 per cent., and in the propeller, when of proper form, only 15 to 18 per cent.

In heavy weather, at sea, this disparity becomes still more strongly marked, for here the motion of the vessel, and of the sea, causes the paddle wheels to be alternately immersed to a great depth, and entirely raised out of the water, thereby producing two evil effects: 1st, to yaw the vessel from side to side, and of course increase her resistance, it being evident that the continued immersion of one wheel only would cause the vessel to turn round; 2d, to produce an irregular and very trying strain on all parts of the engine, but especially on the shafts.

If, then, these are some of the advantages which ought to result from the use of the screw propeller, the question naturally presents itself, Why

has not experience verified so plausible a theory? What have been the causes of so many failures? We need only point to the numerous small propeller craft which ply along our coast, to prove that at least one branch of our trade has received a valuable auxiliary in the screw; and we think that the reasons why it has not been equally successful in marine navigation, on a larger scale, and involving a higher speed, are principally to be found in a want of knowledge and calculation of the relations which should exist between the means and the end.

It must be remembered that, while the talents and experience of the last forty years have been expended, both in England, France, and America, in perfecting the side wheel and its applications, only ten years have elapsed since the screw propeller was introduced to the American public, of which five only have gone by since the first successful application of the principle to a large sea steamer;—that while the examples of the first-named plan are numberless, both in the old world and the new, those of the last are but few in number, and generally made under discouraging auspices;—that while the former has received the sanction of continued and successful use, the latter has to contend with that prejudice which always exists against new inventions; and, with these things in view, can it be a matter of surprise that there should be repeated, and, in some cases, disastrous failures? We have yet to learn from that expensive teacher, Experience, the best form to be given to the propeller, a point which has never been so decided as to leave no room for discussion. We have to learn the best shape for the vessel, for why, if side wheel steamers require a different form from sailing vessels, should it be unreasonable to suppose that the two kinds of steamers require different proportions? And, more than all, we must trust less to guess-work and use more calculation, both in proportioning the engines and propellers to each other, and to the work they have to do, and in disposing the machinery in the hull with a view to the speed and sea qualities of the steamer. This is, we are aware, a simple thing, and one easily arrived at, yet three-fourths of the failures which have disgraced the cause of propellers have been due, in great part, to an utter want of the necessary calculations.

And, despite the triumphant attitude of the advocate of side wheels, when pointing to the long list of sea steamers upon that plan, now built or in process of construction, we venture to predict the time, not far distant, when the experience of our commercial marine shall vindicate the just claims of the screw propeller, and entitle it to a higher degree of consideration than the much vaunted side wheel itself.

HELIX.

For the Journal of the Franklin Institute.

Our Steam Navy.

Within the last twenty years, the navies of England and France have undergone a great change by the introduction of steamers, and in any naval contest this country, at the onset, would suffer from the want of a suitable number of vessels of that class. By the liberal aid which the English Government have extended to private companies, they have in reserve a very large number of first class steamers at a nominal expense. Our own go-