Correspondence.

PROBLEMS OF THE PYRAMIDS.

To the Editor of the SCIENTIFIC AMERICAN:

Fig. 1 represents the earth's orbit, divided into 365·244 day parts, having the sun in the center.

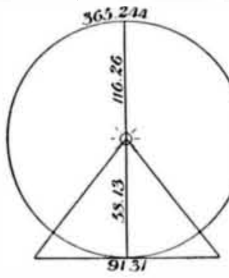

Fig. 1.

The diameter of the orbit is 116·26 day parts and the radius is 58·13 day parts. A right section of a pyramid is also shown whose height is the sun distance and whose base is equal 91·31 day parts. This pyramid is a type of the Great Pyramid of Egypt, whose height of 5,813 inches is evidently 100 inches to the day part. It is a π pyramid, and therefore the base is 100 inches to the day part, or 9,131 inches. It is stated by Pliny that the height of the Great Pyramid was 500 Roman feet. The Roman foot must have then been one-tenth of the earth's orbit in day parts, and called inches, 11·626 inches.

The base side length then was 785·4 of these feet and the circumference 3,141·6 of these feet.

The height of the pyramid was then intended to represent the sun distance; and by a late estimation it is one-billionth of that distance, which would be equal to 500,000,000,000 Roman feet. And if so, the circumference of the base would be one-billionth of the earth's orbit of 3,141,606,000,000 feet.

As to the coffer in the pyramid, according to the measures of Professor Greaves, the outside dimensions are equal to ten times the two foot cube, and the inside dimensions, within the measures of Professor Smyth, are equal to ten times the two foot sphere. Whether

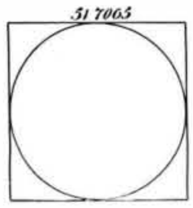

Fig. 2.

this was intentional or not, the measures which we call avoirdupois are derived from the one foot cube; and the troy and apothecaries' weights and measures are derived from the one foot sphere, the grain being 0·004 cubic inch of water, and 250 grains in the cubic inch of water.

The one foot sphere is peculiar. It is 3·1416 feet in circumference. It has a surface of 3·1416 square feet. It will contain the apothecaries' pint of 28·8 cubic inches 31·416 times.

It will contain 31·416 apothecaries' pounds of water or wine of 7,200 grains to the pound; and 31·416 troy pounds of wheat of 5,760 grains to the pound.

If there are eight pints in a gallon, it is equal to 230·4 cubic inches, which has been rounded off by legislation to 231.

The two foot sphere will contain 31·416 of these gallons and 314·16 pounds troy of water or wine.

This was probably the origin of the old wine barrel, which is now set down at thirty-one and a half gallons. Two of these barrels will make a hogshead of 62·832 gallons, now rounded off to 63. Four of these barrels will make a pipe or butt of 125·664 gallons, rounded off to 126. Eight of these barrels, or the four foot sphere, will make a tun of wine of 251·328 cubic inches, now rounded off to 252.

Ten of these barrels will make a chaldron. A tun of wine will just balance a chaldron of wheat. The outside content of the coffer by measure of Prof. Greaves will hold 6,000 pounds troy of 5,760 grains to pound; 5,000 avoirdupois pounds of 6,912 grains to the pound; and 4,800 pounds apothecary of 7,200 grains to the pound; also 600 troy gallons and 500 avoirdupois gallons of water. No measure but the one foot rule will produce these results, and it is the radius of the two foot sphere. W. F. QUINBY.

Wilmington, Del.

[Mr. Quinby's interesting letter adds a few more to the many striking coincidences, which have been pointed out by various writers, between the dimensions of the pyramids and the various measurements of time and space. Perhaps the most celebrated writer on this subject was Prof. Piazzi Smith, whose voluminous work was largely devoted to proving a relation to exist between the dimensions and order of the various stones in the great gallery and the history of the world. Although Prof. Smith, in common with many others, allowed his zeal to carry him beyond the bounds of probability and pointed out so-called analogies where only a prejudiced eye could see them, there are certain coincidences of the kind ingeniously worked out by our correspondent which are widely recognized. It is conceded, for instance, by many that the builders of the Great Pyramid seem to have intended that its height should bear to the perimeter of its base the same ratio as the diameter bears to the circumference of a circle. If this is true, all that our correspondent says about "day parts" would follow; and the question as to whether the Egyptians intended any reference to "day parts" becomes a matter of interesting conjecture.

The height of the Great Pyramid is variously given, the difference between the determinations being several feet. Our correspondent gives the height as 5,813 inches, or 484 feet. As the upper tiers of stones are gone and the exact angle of the slope is not determinable, the precise height of the pyramid is a matter of conjecture, though the height given agrees approximately with the generally accepted height. Upon the other point discussed in the note, viz., the relations of the sphere, whose diameter is one foot, to our numerous English measures of capacity and weight, his deductions are very curious. We have not verified them.

It cannot be implied in all or any of these comparisons that this was the manner in which our system of weights and measures came into existence; for, as a matter of fact, most of the units have been changed in value many times and have at the same time had different values among different nations. A perusal of the article on weights and measures in the Encyclopedia Britannica will convince one of this. The agreements above, so far as they are exact, are to be classed as coincidences, and where they fail in exactness is proof that no agreement was intended historically.—ED.]

The Theories Upon Which the Knapp Roller Boat was Built.

To the Editor of the SCIENTIFIC AMERICAN:

I am not a scientific man, but even an unscientific man of good ordinary intelligence can understand scientific matters when clearly explained, and, being untrammeled by any preconceived ideas, may be even better able to apprehend the principles of an entirely novel design than one technically trained.

It was doubtless just this freedom from the trammels of technical training which made Ericsson actually cross the Atlantic in a screw steam vessel while the scientists were figuring out proofs that it could not be done.

It is possible, then, that in spite of my frank confession, the following statements respecting Knapp's roller boat may be worthy of some attention, more especially as I have had the advantage of a close intimacy with the inventor, and frequent discussion with him during practically the whole time he has been inventing it.

Your article is one of the very few which have gone to the real point of the problem. The speed of the present type of vessel is limited by the amount of power required to force the hull forward against the resistance of the water, which in calm weather increases as the cube of the velocity.

When the water is set in motion by the wind in a contrary direction to the progress of the vessel, this resistance is enormously increased, and has perforce to be reduced by a corresponding reduction in the vessel's speed. Thus the Campania, which in calm weather can travel 560 miles in a day, is brought down to 180 miles in a strong head sea. I say a head sea rather than a head wind, because the weight of water meeting the 33 feet of submerged hull is obviously so much greater than the weight of wind meeting the upper works that it must be regarded as the chief element in the retardation of speed. It is, in fact, the only element needing serious consideration, the water being 700 times heavier than an equal bulk of air.

The effect of this resistance is, however, very different as regards ordinary vessels and the roller boat. The vessel of to-day is practically a water plow, forcing its way through the water, which, as long as no great speed is attempted, easily yields before it.

But as the speed of the boat increases, the resistance also increases in a vastly greater ratio, and consequently an enormous increase of horse power is necessary to increase the speed. How great this increase is is strikingly shown in a comparison of the Campania and Turbinia.

The Campania, making from 20 to 21 knots an hour, has 2⅛ horse power for every ton of her displacement. The Turbinia, making 32 knots, requires no less than 50 horse power per ton displaced. Nothing could more eloquently tell of the disproportion between the increased rate of speed and the increased resistance of the water.

The Bazin boat is but a modification of the plow principle. Her rollers are plow-shaped, i. e. they are disks, thin at the circumference and thick at the center. They do, indeed, roll, but they roll through and in the water, not upon it; and, although the proportion submerged is not so great as in an ordinary vessel, yet they are being forced through the water in the same way. They do, it is true, decrease somewhat the skin friction, and this, at low speeds, is a consideration. But, when high speed is reached, although skin friction exists and is increased by the speed, it is not the main obstacle to progress, but the water resistance, which cannot be overcome save by a greater increase of engine power than his boat is capable of carrying. And this is also true of all the roller boats planned or tried during the last half century.

The Knapp roller boat, however, is not a plow. Although a small portion of it is submerged, its mode of progression is essentially that of a broad-tired wheel rolling on the water. If it could rest on the water without any displacement, it would be a wheel or cylinder moving on a level surface. But, this being impossible, its partial submersion produces the effect of a wheel or cylinder rolling up a hill. What will be the effect of water resistance on such a mode of progression?

I think it must be admitted that, if the resistance were nil, the progress would be nil also. The paddles and skin of the boat would simply slip round and round, without going forward. But the more resistance can be increased, the faster the boat will go forward. It matters nothing how this resistance is gained, whether by paddles or by increased speed (utilizing the skin friction for all it is worth) or by the propulsion of the water toward the boat by the wind. For example, a cylinder or barrel will turn round and round in the water; but, placed on a solid, resisting body, it not only turns round, but moves forward. And the effect is the same, whether the power is applied from outside, as by hand or foot rolling the barrel, or from inside by gravitation, as by the squirrel revolving his cage, or from inside by leverage applied to the axle, as in the unicycle you described some months ago, or in Mr. Knapp's design for his boat. For the method of applying the power in the Toronto model is not his idea, nor has he ever approved it.

The increase of resistance to the ordinary vessel may be compared to a solidifying of the water in front of her. It becomes, so to speak, harder and harder to force the boat through, and at last a point is reached where she is no longer able to carry engines sufficiently powerful to overcome any more resistance. Of course the water is not actually hardened, but the effect is much as if it were; for, water being incompressible, it is also incapable of displacement at a high rate of speed.

With the Knapp boat, the more resistance is increased by her speed, the more easy becomes her forward movement, not through but on the water. Instead of reducing resistance by reduction of speed, the resistance will lift her out of her displacement, thus reducing resistance without reducing speed, and if sufficient speed can be obtained to increase resistance until it equals the weight of the boat, she must roll on the surface of the water without any displacement. At this point far less power would be necessary to keep her going than would be necessary previously to lift her out of her displacement and roll her up the hill. The real question to be solved, then, is: What power will be needed to start her and acquire the necessary speed?

Some idea as to this may be gained from the preliminary trials. Her engineers say that only about twelve horse power was developed at either attempt. Some of this was lost by the unfortunate slipping of the wheels on the track. Yet this small horse power was sufficient not only to revolve her about six or seven times in a minute, but also to send her forward at the rate of four to five miles per hour. This horse power is only about one-ninth horse power per ton displaced. It seems probable, therefore, that a comparatively small power will give her considerable speed, but this, of course, has yet to be tested. The slipping of the wheels, due to the moisture on the rails from the exhaust steam (a matter which the builders ought to have foreseen), will be guarded against during the winter, and next spring we may hope to see the real trial of her speed capability.

To sum up. The ordinary vessel is built on the finest possible lines to obtain the least point of resistance. The Knapp boat is built to go broadside on, to obtain the greatest possible contact with the water, and, consequently, the greatest resistance, because the resistance tends always to lift her out of her displacement and decrease the power necessary to acquire speed. This is the real point of the invention.

It is perhaps necessary to say that Mr. Knapp is not responsible for anything in this article, save when his own words are quoted. ROBERT W. RAYSON.

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[We publish the above letter as being, we believe, the first statement of the theories upon which the Knapp roller boat was built. We cannot agree with the writer that, if the boat could be driven fast enough to roll herself onto the surface of the water, the power necessary to propel her would be less than in a vessel of the normal type and the same displacement. If the normal draught of the Knapp boat is say 2 feet and her weight 200 tons, a certain proportion of the horse power of the boat must be expended in raising 200 tons 2 feet and maintaining it at that level. In the ordinary boat the weight is carried by the water, and the whole effort of the engines can be devoted to propulsion; but in the Knapp boat, as explained by our correspondent, the engines have not only to propel the boat but carry a part of its weight as well.—ED.]