## T-RAIL SHELL-PROOF FRIGATES—LEARNING BY EXPERIENCE.

Nine months ago (on page 345, Vol. IV. (new series) of the SCIENTIFIC AMERICAN) we urged our naval authorities to proceed instantly and plate several powerful steamboats with T-rail, and thus render them shell-proof and adapted to attack forts and other strongholds of the enemy. We advised the employment of such plating, not because we thought it equal to forged, or rolled iron plates for the purpose, but to provide, in the shortest possible period of time, a number of invulnerable vessels for active warfare.

We said, "Let us adapt ourselves to the circumstances of the case and make the best use we can of what we have. Thus we have plenty of T-rail iron, and we think it can be bent and adapted to several powerful steamboats." Had our advice been acted upon, every shore fort, every harbor and vessel in secessiondom would now have been in the possession of the Union forces.

It grieves us to reflect that our navy, for the first time in this conflict, has been humiliated, in a measure, by the secessionists acting upon the very advice which our naval authorities stupidly rejected. Since we penned the article referred to, the sunken frigate *Merrimac* has been raised at Norfolk, plated with rail iron, and on the 8th inst. she steamed out into Hampton Roads, destroyed the frigate *Congress*, of 50 guns; the sloop-of-war *Cumberland*; the gunboat *Oregon*; injured several other vessels, and but for the timely arrival of the *Monitor* at the scene of action, she would have destroyed the *Minnesota*, and perhaps the whole of our shipping at Fortress Monroe.

The days of wooden war vessels are numbered. The *Merrimac* proved far more formidable than we had anticipated, and she has given us a dear-bought lesson. We could have had at least seven iron-clad vessels equal to the *Merrimac* ready for action at the present moment, instead of but one—the *Monitor*—had those in authority appreciated the practical information which has been published in our columns on iron-clad ships of war.

## HOW LONG HAS THE SUN SHONE, AND HOW LONG WILL IT CONTINUE TO SHINE?

At the late meeting, at Manchester, of the British Association, Professor W. Thompson read a paper entitled "Physical considerations regarding the possible age of the sun's heat," in which he gave expression to some of those daring and sublime speculations that are constantly being suggested by our rapidly enlarging knowledge of the universe.

The author prefaced his remarks by drawing attention to some principles previously established. It is a principle of irreversible action in nature that, "although mechanical energy is indestructible, there is a universal tendency to its dissipation, which produces gradual augmentation and diffusion of heat, cessation of motion, and exhaustion of potential energy, through the material universe." The result of this would be a state of universal rest and death, if the universe were finite and left to obey existing laws. But as no limit is known to extent of matter, science points rather to an endless progress through an endless space, of action involving the transformation of potential energy through palpable motion into heat, than to a single finite mechanism, running down like a clock and stopping for ever. It is also impossible to conceive either the beginning or the continuance of life without a creating and over-ruling power. The author's object was to lay before the Section an application of these general views to the discovery of probable limits to the periods of time *past* and *future*, during which the sun can be reckoned on as a source of heat and light. The subject was divided under two heads: first, on the secular cooling of the sun; second, on the origin and total amount of the sun's heat.

In the first part it is shown that the sun is probably an incandescent liquid mass radiating away heat without any appreciable compensation by the influx of meteoric matter. The rate at which heat is radiated from the sun has been measured by Herschel and Pouillet independently; and, according to their results, the author estimates that if the mean specific heat of the sun were the same as that of liquid water, his temperature would be lowered 1°. 4 Centigrade annually. In considering what the sun's specific heat may actually be, the author first remarks that there are excellent reasons for believing that his substance is very much like the earth's. For the last eight or nine years, Stoke's principles of solar and stellar chemistry have been taught in the public lectures on natural philosophy in the University of Glasgow; and it has been shown as a first result that there certainly is sodium in the sun's atmosphere. The recent application of these principles in the splendid researches of Bunsen and Kirchhoff (who made an independent discovery of Stokes's theory), has demonstrated with equal certainty that there are iron and manganese, and several of our other known metals in the sun. The specific heat of each of these substances is less than the specific heat of water, which indeed exceeds that of every other known terrestrial solid or liquid. It might therefore at first sight seem probable that the mean specific heat of the sun's whole substance is less, and very certain that it cannot be much greater, than that of water. But thermodynamic reasons, explained in the paper, lead to a very different conclusion, and make it probable that, on account of the enormous pressure which the sun's interior bears, his specific heat is more than ten times, although not more than 10,000 times, that of liquid water. Hence it is probable that the sun cools as much as 14° C. in some time more than 100 years, but less than 100,000 years.

As to the sun's actual temperature at the present time, it is remarked that at his surface it cannot, as we have many reasons for believing, be incomparably higher than temperatures attainable artificially at the earth's surface. Among other reasons, it may be mentioned that he radiates heat from every square foot of his surface at only about 7,000-horse power. Coal burning at the rate of a little less than a pound per two seconds would generate the same amount; and it is estimated (Rankine, "Prime Movers," p. 285, edit. 1859) that in the furnaces of locomotive engines, coal burns at from 1 lb. in 30 seconds to 1 lb. in 90 seconds per square foot of grate-bars. Hence heat is radiated from the sun at a rate not more than from fifteen to forty-five times as high as that at which heat is generated on the grate bars of a locomotive furnace, per equal areas.

The interior temperature of the sun is probably far higher than that at the surface, because conduction can play no sensible part in the transference of heat between the inner and outer portions of his mass, and there must be an approximate convective equilibrium of heat throughout the whole; that is to say, the temperatures at different distances from the center must be approximately those which any portion of the substance, if carried from the center to the surface, would acquire by expansion without loss or gain of heat.

The sun being, for reasons referred to above, assumed to be an incandescent liquid now losing heat, the question naturally occurs, how did this heat originate? It is certain that it cannot have existed in the sun through an infinity of past time, because as long as it has so existed it must have been suffering dissipation; and the finiteness of the sun precludes the supposition of an infinite primitive store of heat in his body. The sun must therefore either have been created an active source of heat at some time of not immeasurable antiquity by an overruling decree; or the heat which he has already radiated away, and that which he still possesses, must have been acquired by some natural process following permanently established laws. Without pronouncing the former supposition to be essentially incredible, the author assumes that it may be safely said to be in the highest degree improbable, if, as he believes to be the case, we can show the latter to be not contradictory to known physical laws.

The author then reviews the meteoric theory of of solar heat, and shows that in the form in which it was advocated by Helmholz it is adequate, and it is the only theory consistent with natural laws which is adequate to account for the present condition of the sun, and for radiation continued at a very slowly decreasing rate during many millions of years past and future. But neither this nor any other natural theory can account for solar radiation continuing at anything like the present rate for many hundred millions of years. The paper concludes as follows:—"It seems, therefore, on the whole, most probable that the sun has not illuminated the earth for 100,000,000 years, and almost certain that he has not done so for 500,000,000 years. As for the future, we may say with equal certainty that inhabitants of the earth cannot continue to enjoy the light and heat essential to their life for many million years longer, unless new sources, now unknown to us, are prepared in the great storehouse of Creation."

### British Patents Issued.

The following is an analytical list of patents granted in England in 1861, as prepared by Mr. G. Shaw of Birmingham and published in the *Ironmonger*:—Working mines and raising mineral, 23; capstands, crabs, and windlasses, 8; raising weights, machinery for, 9; alarums, 4; reducing and smelting ores, &c., furnaces for, 19; iron manufacture, 24; steel manufacture, 23; lead refining, and making litharges, 5; copper and tin, 9; zinc, brass, and other alloys, 7; tinning, coating and plating metals, 17; casting metals and foundry operations and apparatus, 6; rolling metals, 4; drawing pipes and wire working, 6; pinching, die sinking, stamping, carving and ornamenting, 42; sawing, planing, turning and boring metals and wood, 38; metallurgical operations, various, 19; bellows, blowing machines and forges, 6; rolls and cylinders, 4; nails, bolts, screws, nuts and rivets, 24; chain manufacture, 6; files, rasps and cutting of, 1; saws and edge tools, 1; cutlery, 9; fenders and fire-irons, 2; locks, latches and fastenings for doors, 24; hinges and springs for hanging and closing doors, 11; casters for furniture, 6; spoons, forks and corkscrews, 1; tea and coffee apparatus, 4; Japan ware and papier-maché, 1; bell hangings and bells, 4; vices, 3; button manufacture, 11; pins, needles and fish-hooks, 5; firearms, 74; breeching, locks and triggers, 3; gun and pistol barrels, 4; ordnance and gun carriages, 38; shot and projectiles, shot and powder cases and fire-works, 48; gunpowder and detonating powder, 4; packing presses, hydrostatic and other, 13; mangles and calendring machines, 10; steam engines, 75; steam boilers and generators, 96; marine steam engines and propelling machinery, 38; railway and locomotive engines and carriages and railways, 83; sheathing and preserving ships' bottoms, 7; anchors, cables and stoppers, 8; springs for hanging carriages, 9; wheels for railway and other carriages and naves of wheels, 38; axletrees and axleboxes, 15; drags and retarding apparatus, 32; small wares, 2; surgical instruments and operations, 20; fire-proof safes and boxes and rendering articles fire proof, 2; miscellaneous machinery and apparatuses, 60; sewing machinery, 40; plows and plowing, 15; reaping and mowing machines, 35; thrashing, separating, winnowing and dressing grain, 11; hay making machines, 4; cutting chaff, turnips, &c., as food for cattle, 7; churns, churning and treating milk, 13; agricultural and horticultural implements and processes, various, 9; mills for grinding grain, coffee, &c., 14; fire and garden engines and syringes, &c., 10; water closets and urinals, 6; metallic pipes and tubes for water, steam and gas and joints for ditto, 25; cocks, taps and valves, 40; filtration and purification of liquids, 10; freezing and making ice and substitutes for ice, 2; lamps, lanterns, chandelliers and candlesticks, 32; warming and ventilating buildings, ships, carriages, &c., 29; stoves, grates, fire places and kitchen ranges, 24; jacks and roasting apparatuses, 1; culinary apparatus, various; mincing and sausage machines, 9; skates, 2; buckles and substitutes for, 1; stirrups, housings and spurs, ; horseshoes and substitutes, heels and tips for boots, &c., 12; type foundry and stereotype, 10; telescopes and microscopes, 4; miscellaneous optical instruments, cameras, &c., 7; mariners' compasses, 6; barometers, pressure gages, thermometers and hygrometers, 13; philosophical and mathematical instruments, miscellaneous, 5; weighing machines, 11; coffins, hearses and preserving the dead, 2. The following is the number of patents applied for in each of the last four years:—

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| In 1858 | 3,007. |
| In 1859 | 3,000. |
| In 1860 | 3,196. |
| In 1861 | 3,276 |

During the last year 536 patentees paid the stamp duty of £50, due on their patents at the end of the third year from their respective dates; and in the same period 138 patentees paid the stamp duty of £100 due on their patents at the end of the seventh year from their respective dates.

AN exchange recommends carrots in coffee. Dry it, grind and mix with coffee to suit the taste.