Animals' Change of Color in Cold Countries.

As winter approaches and the green of summer is replaced by snow and ice, a peculiar change occurs among certain animals. At the first hint of cold they begin to assume a different color; tints of gray and lighter hues appear in the somber black or dark coat of summer, and soon the animal is mottled with dark and white patches, finally becoming a pure white that is at once a protection, rendering it almost invisible on the snow. Before the change was understood it was supposed that the animals were distinct forms; one white and the other dark. But it is now well known that a number of animals change their color with the regularity of the seasons, says the Philadelphia Times.

One of the most interesting examples is the hare, several of which are known to assume a winter pelage, the most familiar being the varying hare and the Arctic hare. The latter, in summer, when it would in a winter coat present a marked and striking contrast to its surroundings, is on its upper side black and a light brownish yellow, mixed; the upper portions of the tail and the tips of the ears black. This color is retained all through the summer, but at the approach of the cold season the pelage begins to fade and gradually becomes white, with the exception of the tips of the ears, which remain black.

This wonderful changeable hare is found in the Alps, Ireland, and Scotland, and in the Arctic regions of Asia. In many of the Arctic explorations it has been of the greatest service to the men from its habit of frequenting camps. The voyagers of the Vega often relied upon the little animals in time of need and when food was scarce.

In America, in the far north, we have the same hare, but a larger and finer animal, known as the polar or glacier hare. The American form ranges from the north to the middle portions of the country, and in regions away from the extreme north changes only slightly or imperfectly. As the cold comes on, its dark coat fades to a lighter hue, becoming pronounced in summer again.

The protection afforded these animals in the far north is almost perfect, as it is almost impossible to distinguish them from the snow. When they run they seem to be swallowed up in the field of white.

The principal four-footed enemy of the white hare is the Arctic fox, that is endowed with a similar protection. It is one of the smallest foxes known, and certainly one of the most beautiful. In summer, when the ground is bare or covered with verdure, the little animal has a silky fur, bluish or brownish gray. This lasts until the snow comes, when the coat gradually changes. The hair becomes longer and thicker, especially on the tail and feet, which are densely furred, and by midwinter, or before, it is pure white, without a suspicion of its summer hue.

If the winter and summer pelage be contrasted, it will hardly seem possible that they represent the same animal. The fox is a very cunning and intelligent creature, as all Arctic travelers have discovered. It is an inveterate thief, stealing for the pleasure of stealing, taking from the Vega explorers not only food, but knives, forks, ammunition, sacks, shoes, and stockings. When the men slept they would crawl under the robes and nose them, and if those awake held their breath, pretending to be dead, the foxes would begin to nibble them, and when frightened off would carry away a hat, mittens, or anything that came in the way. If followed, one of the foxes would go on guard while the others buried the stolen goods.

The ermine, whose fur has become fashionable again, is a familiar example of this remarkable change in color. It is common in all the northern countries and in our own country down to the Southern States, a most destructive little creature, killing chickens, birds, and various animals, often simply for amusement. An ermine has been observed watching a bird, placing itself beneath an inviting roost; when the bird alighted it sprang at it, clinging to it, although carried a long distance into the air.

Some curious experiments have been tried with this little animal. Four or five were caught one summer in the north, and found to have rich coats of a mahogany brown color. Two were sent to some one in the Southern States, while the remainder were kept where the cold winter prevailed. Those in the north began to change as the leaves disappeared, the strange painting of nature gradually going on until the animals, with the exception of the tip of the tail, were pure white. Correspondence had been kept up with those having the other ermines in charge, but in vain they looked for the winter change. The animals retained their mahogany colored coat during the warm winter, showing conclusively that the change is produced by the cold, and is a wise provision of nature, rendering the animals almost invisible to their enemies.

There is another reason given for the change—a wise provision of nature to protect the ermine from the cold. Animals with black or dark colored fur radiate internal heat more effectually than those of lighter colors; so the ermine in its white coat absorbs the rays of the sun, radiating but little; thus the change becomes an important factor in the preservation of the heat supply. In their movements these animals and their allies resemble serpents, and the actions of an ermine stealing along with sinuous motion over the snow is very suggestive.

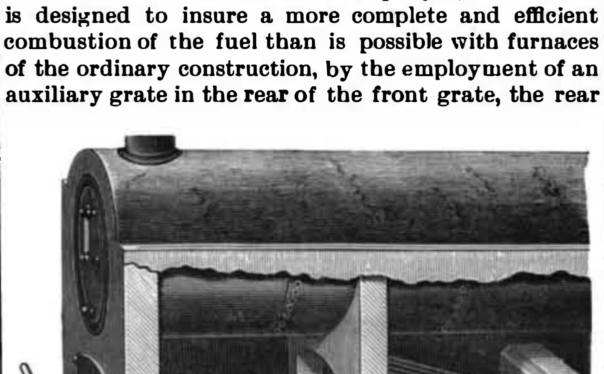
ADJUSTING THE BEAT OF CLOCK PENDULUMS.

The illustration represents a leveling device adapted for attachment to a clock mechanism to control the pendulum and verge, whereby they will be kept plumb, irrespective of the frame carrying the clock mechanism proper. It is a patented improvement of Fred F. Richey and William Bittmann, of Wamego, Kansas. The clock mechanism may be of any desired construction, and the verge wheel shaft is journaled in the frame at the back and in a bracket projected at the front, each bearing being formed with a boss having an integral stud, and on the studs being pivoted the upper members of a U-shaped frame from which depends a weight. The front member of the U-shaped frame is at all times in front of the verge rod, while the rear member is straight. On the inner face of the front member is pivoted a block in which is journaled one end of the verge spindle, its opposite end being held in the usual spring. The verge is thus carried by the weighted swinging frame, and the pendulum rod at its upper end, after passing through the verge, is secured in the usual manner to a post, which is also secured to the back of the forward member of the weighted frame, whereby both the pendulum and the verge are kept perfectly plumb. The device is very simple and inexpensive.

BITTMANN & RICHEY'S CLOCK PENDULUM.

AN IMPROVED FURNACE.

The furnace shown in the accompanying illustration is designed to insure a more complete and efficient combustion of the fuel than is possible with furnaces of the ordinary construction, by the employment of an auxiliary grate in the rear of the front grate, the rear grate receiving the burning or coked fuel from the front grate, and the smoke and gases from the burning fuel on the front grate passing through the fuel burning on the rear grate.



THORN'S FURNACE.

The improvement has been patented by A. L. Thorn, of Lump City, Montana. In a rear combustion chamber, pivoted to the rear bridge wall, is an auxiliary grate, the front of which is adapted to rest, as shown in the dotted lines, on an intermediate grate wall, in the center of which is an opening immediately at the rear of the front grate, so that the fuel from the latter may be conveniently pushed upon the rear grate. Under the front grate is an ash pit with inclined bottom, and the ash pit under the rear grate has an extension under the front ash pit and a separate door. An arm extending downwardly from the rear grate is connected with an exterior lever, by which the grate may be moved up and down, the illustration representing the furnace with the grate in normal position, so that the smoke and gases from the burning fuel on the front grate bars will pass through the fuel on the auxiliary grate, the latter being lowered occasionally to permit the burning fuel on the front grate to be pushed back on the rear grate, the latter being then again raised. The lower ash pit door is normally closed, to prevent the passage of outside air to the rear ash pit, and it is designed to use a water grate in the second combustion chamber, the water thus heated being used as a boiler feed.

The Hardening of Extra Soft Steel.

The subject of the hardening of extra soft steel was dealt with at a recent meeting of the Académie des Sciences, in Paris, by Mr. Osmond. Taking for example a test bar of steel carbonized by cementation in which the proportion of carbon varies in a continuous fashion (from 1·70 to 0·35 per cent) from one extremity to the other, if the bar be well hardened, and an attempt be made to scratch it by means of a sewing needle, the latter will scratch the softer parts—say, up to the part containing about 0·70 per cent carbon. The mark or scratch then disappears, but, contrary to all expectation and to all ideas on the subject, it reappears in the part of the bar containing a proportion of carbon of about 1·30 per cent.

In examining the scratch or mark by means of a microscope in the most carbonized part, it is found not to be continuous, but that it appears to be a series of broken or interrupted lines. The part in question is therefore not homogeneous and contains at least two constituents, which may be here named A and B respectively. A, not scratched by the needle, scratches glass and feldspar. B is scratched by apatite, and probably of fluorspar. By giving them a good polishing, a slight difference in color will be found between the two constituents: B is of a silver-white color, while A has a slightly grayish tint. Polishing in bass-relief on damp parchment, impregnated with a little brown-red, does not sensibly affect B, thus assigning to this constituent a resistance to inordinate wearing, having regard to its relative mineralogical hardness. By attacking it with tincture of iodine or by dilute nitric acid the mass is divided into only slightly coherent polyhedrons, separated or not by traces of definite carbon, to which is attributed the formula Fe_3C. At the same time A and B assume different colors, but are ordinarily homogeneous for the same constituent within the limits of the same polyhedron. The structure thus becomes very clearly defined. In most cases, A becomes distributed in barbed flakes parallel to two directions, which remain constant for each polyhedron; B forms the base. If the attack be prolonged, all the section becomes black, both constituents being carbonized. The hard constituent, A, is the same which forms almost exclusively hardened steel containing 1 per cent carbon. The proportion of the constituent B increases with the content of carbon up to about 1·60 per cent. To continue the experiments, by taking a steel not more complex but of a composition which has been found most convenient (for example, a steel containing 1·57 per cent carbon), and submitting it to a varying hardening process, it will be seen that to obtain the maximum of B, the steel must be heated up to at least 1,000° Cent. (but not exceeding 1,100° Cent.), and cooling it as rapidly as possible in iced water or in very cold mercury, otherwise the carbon, Fe_3C, becomes isolated again and diminishes to that extent the actual content of carbon in the remainder of the mass. Under the most favorable conditions, it is possible to obtain a mixture of equal parts (in round figures) of A and B. Such a mixture is, relatively, only slightly magnetic. A bar of it, with one far end placed against one pole of a powerful horizontal magnet, is supported vertically with difficulty, while a similar bar, hardened by heating up to 800° Cent. and cooling at 15° Cent., is held horizontally.

The same mixture, with the parts A and B practically equal, cannot be filed, and breaks before it bends, owing both to the presence of the hard and fragile constituent, A, and to the absence of cohesion between the polyhedrons. So far as it has been able to ascertain them from a mixture, the properties of B tend to make it similar to steel, having 25 per cent nickel and from 12 to 13 per cent manganese.—The Colliery Guardian.

Sir Edward Harland.

Sir Edward Harland, head of the famous shipbuilding firm of Harland & Wolff, died December 24. He was a member of Parliament for North Belfast in the Conservative interest, was sixty-four years old, and was twice mayor of Belfast. His partner, G. W. Wolff, is member of Parliament for East Belfast in the Conservative interest, and, Mr. Wolff being of German extraction, they were known in the House of Commons as the Majestic and Germanic. Sir Edward Harland was for many years chairman of the Harbor Commissioners of Belfast, and was a bulwark of Conservatism in Ulster. He was one of the foremost organizers of the Ulster convention. His baronetcy was the gift of Lord Salisbury and dates from 1865.

Speed of Vehicles and Pedestrians.

BY JAMES ASHER.

The speed of a railway train in miles per hour can be found by counting the number of rails over which a car wheel passes in 20·3 seconds, because 20·3 seconds bears the same ratio to an hour that 30 feet, the length of a rail, bears to a mile. The fish plates or the thumps may be counted. Thus, supposing that 39 thumps are made by a wheel in 20·3 seconds, the train is then running at the rate of 39 miles an hour.

The rate of a train, or any other moving body, can easily be found where there are posts half a mile apart. I have prepared a table for this purpose, which I give here:

Miles per hour.	Min.	Sec.	Miles per hour.	Min.	Sec.
1	30	00·0	61	0	29·5
2	15	00·0	62	0	29·0
3	10	00·0	63	0	28·5
4	7	30·0	64	0	28·1
5	6	00·0	65	0	27·6
6	5	00·0	66	0	27·2
7	4	17·1	67	0	26·8
8	3	45·0	68	0	26·4
9	3	20·0	69	0	26·0
10	3	00·0	70	0	25·7
11	2	43·6	71	0	25·3
12	2	30·0	72	0	25·0
13	2	18·4	73	0	24·6
14	2	08·5	74	0	24·3
15	2	00·0	75	0	24·0
16	1	52·5	76	0	23·6
17	1	45·8	77	0	23·3
18	1	40·0	78	0	23·0
19	1	34·7	79	0	22·7
20	1	30·0	80	0	22·5
21	1	25·7	81	0	22·2
22	1	21·8	82	0	21·9
23	1	18·2	83	0	21·6
24	1	15·0	84	0	21·4
25	1	12·0	85	0	21·1
26	1	09·2	86	0	20·9
27	1	06·6	87	0	20·6
28	1	04·2	88	0	20·4
29	1	02·0	89	0	20·2
30	1	00·0	90	0	20·0
31	0	58·0	91	0	19·7
32	0	56·2	92	0	19·5
33	0	54·5	93	0	19·3
34	0	52·9	94	0	19·1
35	0	51·4	95	0	18·9
36	0	50·0	96	0	18·7
37	0	48·6	97	0	18·5
38	0	47·3	98	0	18·3
39	0	46·1	99	0	18·1
40	0	45·0	100	0	18·0
41	0	43·9	101	0	17·8
42	0	42·8	102	0	17·6
43	0	41·8	103	0	17·4
44	0	40·8	104	0	17·3
45	0	40·0	105	0	17·1
46	0	39·1	106	0	16·9
47	0	38·2	107	0	16·8
48	0	37·5	108	0	16·6
49	0	36·7	109	0	16·5
50	0	36·0	110	0	16·3
51	0	35·2	111	0	16·2
52	0	34·6	112	0	16·0
53	0	33·9	113	0	15·9
54	0	33·2	114	0	15·7
55	0	32·7	115	0	15·6
56	0	32·1	116	0	15·5
57	0	31·5	117	0	15·3
58	0	31·0	118	0	15·2
59	0	30·5	119	0	15·1
60	0	30·0	120	0	15·0

A ship's rate is sometimes found by a log line or string, about 900 feet long, on a reel and having one end fastened to a thin sector shaped piece of wood named a log. The arc of the log is loaded to make the wood stay vertical when tossed into the sea; it then remains in the same place in the water while the line is unwinding from the reel. A sand glass, through which the sand flows in one $\frac{1}{120}$ of an hour, measures the time. The line is divided into equal parts of 50 feet each, called knots or $\frac{1}{120}$ of a nautical mile. Since a half minute has the same ratio to an hour that a knot has to a nautical mile, the ship runs at the rate of as many nautical miles an hour as it runs knots in half a minute. If say 19 knots pass in half a minute the vessel is then running at the rate of 19 miles an hour.

In another kind of log a small wheel like a screw propeller is fastened to a cord in the water. The other end of the cord in the ship bears hands. As the ship advances, the wheel and the cord continually turn and the rate of the ship is indicated by timing the rotation of the hands of the instrument on the ship.

Many ships now use an electric log, in which a screw wheel in the water occasionally closes an electric circuit and so operates indicating mechanism on board the ship. Neither this log nor the one just described needs ever to be drawn in. The electric log gives very accurate indications. Not only may the speed be indicated by the two logs just described, but they can show the total distance sailed over.

The rate of bicycles and carriages is sometimes found by an instrument which operates like the governor of a steam engine. The higher the speed is, the greater is the centrifugal force, which causes balls to diverge or mercury to rise higher along the side of a vertical cup and point out the speed on a dial.

The writer has recently invented several methods of finding the speed of carriages, bicycles and pedestrians, which will now be explained.

For common wheeled carriages let x = the time constant in seconds and r = the radius of the carriage wheel in inches, then $\frac{x}{3600} = \frac{3\frac{1}{7} \times 2r}{63360}$ $\therefore x = \frac{5r}{14}$

This equation says that the interval in seconds during which the rate per hour equals the number of turns made by the carriage wheel in that number of seconds is equal to $\frac{5}{14}$ of the radius of the wheel in inches. For example, the time constant of a carriage wheel 42 inches in diameter is $\frac{5}{14} \times \frac{1}{2} \times 42 = 7\frac{1}{2}$ seconds, and if we count say 17 turns of that wheel in $7\frac{1}{2}$ seconds, the carriage is then running at the rate of 17 miles an hour. A bright spot one inch in diameter painted on the hub, the slowest part of the wheel, is useful in counting the number of turns made by the wheel. Carriage makers should make such a spot on one wheel of all carriages, and they should also mark the time constant of the wheel on this spot. A small tin disk, an inch in diameter, may be tied on the hub instead of having a painted spot to determine the rotations.

Following are the time constants of carriage wheels and old fashioned bicycle wheels:

Diameter of wheel in inches.	Time constant in seconds.	Diameter of wheel in inches.	Time constant in seconds.
40	7·1	51	9·1
41	7·3	52	9·2
42	7·5	53	9·4
43	7·6	54	9·6
44	7·8	55	9·8
45	8·0	56	10·0
46	8·2	57	10·1
47	8·3	58	10·3
48	8·5	59	10·5
49	8·7	60	10·7
50	8·9		

For common bicycles which have two sprocket wheels the time constant is $\frac{5rT}{14t}$ when r = radius of hind wheel of bicycle, T the number of teeth in the larger sprocket wheel, and t the number in the smaller. Example: What is the time constant of a bicycle whose hind wheel has a radius of 12 inches, the number of teeth in the larger sprocket wheel is 28, the number of teeth in the smaller is 10?

Solution: Substituting in the formula we have $\frac{5 \times 12 \times 28}{14 \times 10} = 12$ seconds.

All that the wheelman on this bicycle, or an observer some distance off, need do to find the rate of this bicycle at any time is to count the number of times he presses down one of his feet in 12 seconds. Thus, if he presses his foot down 14 times in 12 seconds, he is then traveling at the rate of 14 miles an hour.

A cyclist may sometimes with advantage use ten times the time constant of his bicycle, or a driver may do the same with the constant of his carriage, and a pedestrian may do the same with his own constant. When this is done, the number counted must be divided by 10. This is done simply by regarding the right hand figure as tenths of miles and the other figures as miles. Thus, if a person counts 134 down strokes of his foot in 10 times the time constant of his bicycle, he is then riding at the rate of 13·4 miles an hour.

Bicycles are distinguished by their gear, $\frac{2rT}{t}$, which is the diameter in inches which a bicycle of the old style, having the pedals on the wheel shaft, would need to go the same distance as the given bicycle when the pedals on both perform a revolution.

Thus, when we say that a modern bicycle has a gear of 84 we mean that each revolution of the pedals carries the bicycle as far as an old style bicycle 84 inches in diameter, having the pedals on the drive wheel axis, is driven along during one revolution of its pedals.

The gear of a bicycle is found by multiplying the diameter of the hind wheel in inches into the number of teeth in the larger sprocket wheel, then dividing the product by the number of teeth in the smaller sprocket wheel. Thus, the gear of a bicycle which has 25 teeth in the larger sprocket, 10 in the smaller, and has a hind wheel 24 inches in diameter is $\frac{25 \times 24}{10} = 60$.

Since the time constant $\frac{5rT}{14t}$ divided by the gear $\frac{2rT}{t} = \frac{5}{28}$, the time constant may be found by multiplying $\frac{5}{28}$ into the gear of the bicycle.

Thus the time constant of a bicycle whose gear is 56 is $\frac{5 \times 56}{28} = 10$ seconds.

Here are the constants for bicycles of 13 different gears:

Gear.	Time constant.	Gear.	Time constant.
50	8·9 sec.	70	12·5 sec.
52	9·2 "	82	14·6 "
54	9·6 "	84	15·0 "
56	10·0 "	88	15·7 "
57	10·1 "	89	15·8 "
60	10·7 "	91	16·2 "
63	11·2 "		

The radius of the hind wheel should be taken as the distance from the axis to the ground, when the seat sustains the weight of the rider, for the pneumatic tire is compressible.

The time constant of a pedestrian can be approximately found on principles similar to the foregoing. First find the average length of step in inches. Let x = time constant and s = average length of step.

Then $\frac{x}{3600} = \frac{s}{63360}$

That is to say that the time constant bears the same ratio to the number of seconds in an hour that the average length of step in inches bears to the number of inches in a mile. Solving the equation, we find that $x = \frac{5}{88}s$. Now, since $\frac{5}{88}s$ is a very small number, 10 should always be multiplied into it; then the number of steps in this time may be divided by 10 by simply regarding the right hand figure as tenths and the left hand figures in the numbers as miles. For example, if a man's constant is 1·78 seconds, he would count the number of steps taken in 17·8 seconds, and if he takes, say, 38 steps in this time, he is walking at the rate of 3·8 miles an hour. The average length of step when walking very rapidly should be found, then the average length when walking very slowly; the mean of these two averages may be taken as the person's average length of step. For example, in walking very rapidly over 100 yards I found that my average length of step was 36 inches; in walking over the same distance very slowly the paces had an average length of 27 inches. I now regard $\frac{36 + 27}{2} = 31·5$ inches as my average length of pace in calculations for speed. It is, of course, impossible to obtain as accurate results by this method as we can with wheels.

A pedestrian walking on a railway may find his rate in the same way as the rate of a train, explained in the beginning of this article: but it is better to count the number of rails passed in 10 × 20·3 seconds, or 3 minutes 23 seconds, then regard the right hand figure as tenths and the left hand figures as miles. This method is very accurate.

A person when walking or driving may find his rate by counting telegraph poles. If they are set 176 feet apart, or 30 to the mile, the number of poles counted in two minutes exactly indicates the rate in miles per hour.

Thus, if he passes 4 poles in 2 minutes he then travels at the rate of 4 miles an hour.

This method is available for finding the rates of sleighs or of a horse when the traveler rides in a saddle. The rate of a horse may also be approximately found by finding his average length of pace and proceeding as in the case of a pedestrian, explained in a foregoing paragraph.

The rate of a pedestrian or a vehicle can also be easily found by counting the number of ridges in fields passed or fence posts along the road if the time constant has been found on principles like those explained in the present article.

Resonance and Echo in Large Halls.

Architects should keep in mind the golden rule, that resonance, such as is to be obtained by thin elastic linings, or even by masses of air judiciously distributed, is a thing to be sought in designing rooms for hearing music, or for public speaking, while echo, such as is produced by hard, unyielding surfaces, is to be avoided as much as possible. Every architect who has ever designed a music room for a private house knows how greatly the effect of music is improved by lining the walls of the room, and if possible the ceiling, with thin wooden paneling; and every layman who has ever bought a piano must have noticed what depth and richness is given to the tones of one played in the dealer's wareroom by the sympathetic vibrations with which the strings of the surrounding instruments respond to the playing.

For twenty centuries, at least, architects have sought in various ways to secure similar resonance in large rooms, understanding thoroughly the advantages to be derived from it. The Gewandhaus, at Leipsic, reputed to be acoustically the most perfect music hall in the world, owed its quality to the fact that it was surrounded by thin partitions, set at a little distance from the main walls of the building, which by their own elasticity, joined to that of the mass of air between them and the walls outside, provided the resonance which experience has shown to be indispensable. In the same way, La Scala Theater, at Milan, one of the largest and acoustically the most perfect of all European theaters, was lined throughout with thin woodwork.

The ancient Greeks to secure resonance without the use of woodwork, placed under the seats of their theaters earthen pots, with the mouth turned toward the stage, the vibrating mass of air in these serving to reinforce the sound. On the other hand, rooms in fireproof buildings, surrounded on all sides by hard, rigid masses of masonry, are very apt to be acoustically bad. Even where the large rooms, by careful study of their proportions, are successful, the smaller rooms, which cannot be so proportioned, are in such buildings almost always intolerably noisy.—American Architect.