The Cannon, the Steam Engine, Man, and the Insect Considered as Mechanical Motors.

Under the above title, we give a resumé of some very curious and interesting information published in a recent work of Mr. E. Jouffret, entitled "Introduction to the Theory of Energy."

These examples, which are submitted in a simple and clear way, are well calculated for disseminating a knowledge of the phenomena of conservation and transformation of energy, by presenting them under a concrete form accessible to all those who are not making a special and continued study of them.

A 100-ton cannon (Italian model of 1879) costs 400,000 francs. It requires a 250 kilogramme charge of powder, and throws a projectile weighing 917 kilogrammes, with an initial velocity, at the mouth of the cannon, of 523 meters per second.

The energy possessed by the projectile, in the form of live power, is 12,772,000 kilogrammeters.

The energy represented by one kilogramme of powder is, according to Noble and Abel, 300,000 kilogrammeters, or 75,000,000 kilogrammeters for the charge of 250 kilogrammes.

The *cannon*, considered as a machine, converts then into work *seventeen per cent* of the total energy of the combustion of the powder. This figure is higher than that furnished by the best steam engines, as these convert into work less than ten per cent of the total energy represented by the coal.

It is the animal machine in which the performance is the highest, and this fact may be established, in a particular case, as follows:

According to the *Guide Joanne*, the ascent of Mont Blanc, starting from Chamounix, is effected in seventeen hours, resting spells not included. The difference of level is 3,760 meters. A person ascending, who has a mean weight of 70 kilogrammes, produces, then, in order to rise, a work of $3,760 \times 70 = 263,000$ kilogrammeters. This work is borrowed from the heat that the carbon and hydrogen contained in the food eaten disengages upon being burned in the lungs. For the sake of simplicity, if we reduce the entire energy to a combustion of carbon, and recall that a kilogramme of the latter furnishes 3,000,000 kilogrammeters, we find that the 263,000 kilogrammeters represented by the ascent correspond to a consumption of 94 grammes of coal—a consumption that comes to be added to the normal rations necessary for the operation of the organs during a state of rest. Such consumption is 8·35 grammes per hour, or 142 grammes for the seventeen hours. The total consumption of coal is 256 grammes, representing 708,000 kilogrammeters. The performance, then, is

$$\frac{263,000}{708,000} = 37 \text{ per cent.}$$

The performance of the human machine drops to 21 per cent when we consider a period of twenty-four hours composed of ten hours of work and fourteen of rest, and a mean daily work of 280,000 kilogrammeters.

The cannon, considered as a machine, is incomparably superior to the steam engine as regards the time necessary to produce a given quantity of mechanical work.

Thus, for example, the 100 ton cannon develops in *one-hundredth of a second* a quantity of work equal to that which would be yielded by a 47-horse power steam engine *in one hour*. A man of average strength is still lighter than an ordinary steam engine of equal power, but he is much inferior to the other animals of creation, and particularly to insects.

Thus, for example, the libellula, which is capable, without apparent fatigue, of following a train of cars for several hours, giving its wings during this whole time some thousands of backward and forward motions per second, is a hundred times lighter than a steam engine capable of producing an equivalent work.

This is what renders the problem of aerial locomotion so difficult, and, as Mr. Hirn says, it explains why we can fly in imagination only.—*La Nature.*

Microscopic Examination of Water.

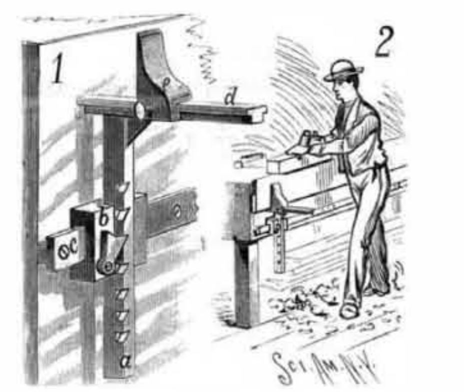
J. Brautlecht produces a precipitate in the water by adding to 100 c. c. 5 drops of a solution consisting of one part aluminum sulphate, one part hydrochloric acid, and eight parts water, followed up by one to three drops of liquid ammonia. The precipitate settles readily, and after decanting off the clear is collected upon a smooth filter, stroked off with a glass rod, and thus transferred to a test tube, in which it is dissolved in ten to fifteen drops of dilute acetic acid. The clear solution is examined with the microscope, at first alone, and then after the addition of a solution of saffranine. By adding one-half per cent of gelatine, permanent preparations may be obtained on Koch's principle.—*Rep. Anal. Chemie und Chem. Zeitung (Cœthen).*

The Parasite of Malaria.

The observations of M. Richard seem to affirm those of Leverau; he found in the red corpuscles of the blood of persons suffering from acute malaria a parasite of oscillating form moving very rapidly, and sometimes disengaging itself from the globule. These parasites have been met with in a number sufficiently large to obstruct the capillary vessels, and to explain many of the symptoms of intermittent fevers. It has also been proved that the culture of these parasites in a fertile gelatine basis can be brought to an immediate cessation if a two per cent quinine solution is added.

STOCK REST.

A convenient, portable, and simple stock rest for the use of carpenters has recently been invented by Mr. James McVane, 2 Shawmut Place, Boston, Mass. The vertical main bar, *a*, is formed with a series of notches so that it may be held at any elevation by the pawl pivoted to the block, *b*, the bar sliding in the dovetailed groove in the block. The block is formed with a horizontal T-shaped groove which fits upon the guide rail, *c*, which is made in sections so as to be conveniently packed in a tool chest. The upper end of the vertical bar is provided with a cross head, *d*, that supports the timber being worked and that is made T-shaped in cross section in order to carry the dog, *e*, which holds the timber upon the cross head against lateral movement. A set screw holds the dog in place. The guide rail is secured to



McVANE'S STOCK REST.

the side of the bench as shown. The block, *b*, and guide rail, *c*, may be made of cast iron and the other parts of malleable cast iron. Constructed in this manner it will readily be seen that the rest can be adapted to all the adjustments necessary, and the changes can be rapidly and easily effected. In addition it can be detached from the bench, taken apart, and packed in a small space in the tool chest.

FELLOE AND SPOKE TIGHTENER.

This invention provides means for tightening or taking up the play in felloes of wheels so as to avoid the necessity of resetting the tire in the ordinary way, and also provides for making the spokes fit tightly between the felloe and hub. There is a right and left threaded screw, represented at A, having an angular head, *a*, midway of its length, and upon the threaded ends screw two bars, B, provided respectively with right and left hand threads. The bars may be of iron and have the threads formed in them, or they may be of wood simply bored and provided with straps embracing two or more sides and having the threads formed in the portions which are at the inner ends of the bars. At *d* is shown a plate having its inner surface gouged out and serrated, and at one end provided with a slot to allow for adjustment in connecting the plate. Two of these plates are attached to the outer end of each bar, B, by a bolt and nut, thereby forming a pair of clamping jaws. A clamp-

GALBRAITH'S FELLOE AND SPOKE TIGHTENER.

ing bar having bolt holes at its ends is shown at *c* and *c'*. Two of these bars are attached to each bar, B, between the jaws and the inner end by a bolt, *e'*, and by aid of a bolt passing through the holes in the other ends forming a pair of clamping bars for holding the apparatus in place, as shown in Fig. 1. The bars are also intended for use to clamp across the ends of the clamping jaws, *d*, which are thereby held securely against the felloes when the tightener is to be used to draw the felloes together. The outer end of each bar, B, is provided with a cushion of some soft material in order that the surface may not be injured.

To use the apparatus the cushioned ends of the bars are placed against the spokes and felloes and the clamping jaws, *d*, arranged as in either Fig. 1 or 3. The bars, *c*, are then placed on each side of the felloe and over the jaws and secured by the bolts, *e* and *b*. The device can be arranged with the clamping jaws in the position most convenient, and the felloes can be tightened by either a drawing or pushing motion, as most desirable. The felloes are tightened by turning the screw, *a*, either in one direction or the other. When drawn together, the space between the felloe and tire is filled by thin perforated pieces of any suitable material put in with any cement or with barbed tacks to hold them in place. A hoop tapering toward the ends can be used. By turning the screw in the opposite direction the felloes are pushed away from each other, and the joints thus formed are filled with a suitable material.

The device obviates the necessity of leaving home to visit the smith, as one of ordinary ability can screw back the nut, put in the material, and screw up again. The exact amount of pressure needed can be put on each place, thus preventing dishing or straining. The felloes are not scorched so as to be in a condition to soak water. When not in use otherwise, the nut and right and left threaded screw bolts constitute a pressure jack.

The spoke tightening device shown in Fig. 2 consists of a cup made of suitable substance, covered to prevent it from chafing the wood, and of a size to fit over the end of a spoke. Extending through the cup is a screw bolt provided with a nut. The cup is applied to the end of the spoke, one end of the bolt entering the spoke and the other entering the hole in the felloe from which the spoke tenon has been removed. The felloes can be either drawn in or shoved out by turning the nut one way or the other. Instead of using a cup the bolt may be made as a cup to set over the spoke, and the nut is made with a flange having holes for screws by which the nut is held to the felloe. In case there is not room enough for the device between the spoke and felloe, the spoke may be cut off.

This invention has been patented by Mr. Archimedes Galbraith, of Amadore, Mich.

Polishing and Preserving Parquet Floors.

The finish and care of hardwood or parquet floors has been and is now a source of great trouble and annoyance to housekeepers, except in cases where the owners have taken the trouble themselves to look the matter up, or have instructed their architects to be particular about that item. It is too bad that where beautiful floors have been laid, in so many cases they have been left to be finished by persons who have not troubled themselves with finding out the best method of finishing. The usual way for such persons to do is to treat them with shellac or varnish, which is all wrong, as a moment's thought will convince any one that a surface that is constantly walked over needs something different to the coating of gum that is left on the surface after the spirit used in dissolving the shellac or varnish is evaporated.

This coating becomes, then, brittle, and is ground up into minute particles by the nails in the boots, and swept away, leaving the wood bare right where it is most exposed to view. As a matter of course, the beauty of the floor is soon gone, and instead of being an attractive part of the furnishing, the sanitary consideration very often is about all that keeps one from nailing a carpet over the whole floor. Others use linseed oil, and everybody knows that an oil finish is one of the best methods of finishing wood, but the objection to that method is that each time the oil is applied it darkens the wood, and in a short time the different kinds of wood are of the same color. Now the question arises, Which is the true and only way of finishing floors properly? and the answer is, by the use of hard wax, which, however, must be so prepared that the trouble of applying it, and the stickiness attending ordinary beeswax and turpentine, are entirely obviated. The wax is treated with special liquids and made into a preparation.

The writer has tried many things and found this hard wax to be the most satisfactory in its results. It is so simple, that when once the floor has been properly filled and finished with it, any servant can renew and keep the floors fresh and bright as long as the wood lasts, and it does not materially change the color—the wood always retains its beauty. An application about once a year is all that is necessary, if the floors are rubbed over, when a little dull, with a weighted brush or cloth. In repolishing old floors that have been in use for a length of time and become dull looking, it is only necessary after they have been cleaned to rub on a thin coat of the hard wax finish with the brush or cloth, as stated before. If the floors have been varnished and the varnish is worn off in places, as mentioned above, the best way is to have the varnish scraped off, and then a thin coat of the hard wax should be applied and treated as the new wood after it is filled. But if it is inconvenient to have the floor scraped, or the expense too much, the main object being to restore the color in those places which are worn and defaced, the following mixture is recommended: One part linseed oil, one part liquid drier, and two parts turpentine. A cloth should be dampened with this and applied to the worn and defaced places, which will have the desired effect. After being wiped off clean it ought to dry twenty-four hours, and then polished with the hard wax finish. It is very important never to use the wax over oil that is not thoroughly dry, as the floor would invariably be sticky. Finally, it would be well to mention that hard wood or parquet floors should never be washed with soap and water, as it raises the grain and discolors the wood.

After the floors have been properly filled and finished with the hard wax, dirt will not get into the pores, but stays on the surface, and consequently can be removed with a brush or cloth; or, if necessary, dampen cloth with a little turpentine. This will take off any stain from the finish.—*Decorator and Furnisher.*

Practical Hints Regarding Tornadoes.

JOHN D. PARKER, U. S. A.

The following hints regarding tornadoes are given in the belief that many people are killed every year who could save their lives by a little practical knowledge of the movements of these destructive storms.

The tornado *season* is embraced between the 1st of April and the 1st of September, but in the latitude of Kansas City most tornadoes occur in the months of May and June. As we go north or south of this latitude they are proportionally earlier or later, and early or late seasons vary the time of their occurrence correspondingly.

Tornadoes occur in the *afternoon*, generally between two o'clock and evening, four o'clock being called the tornado hour.

Tornadoes move from southwest to northeast, generally *east about twenty degrees north*, and their linear movement is ordinarily from thirty to forty miles an hour.

Tornadoes occur on *sultry* days, or when the temperature is very high and the air is thoroughly saturated with moisture.

Tornadoes occur when the *electrical conditions are high*, or when the air is highly charged with electricity.

The approach of a tornado may be known by ominous clouds appearing in the southwest and northwest. The clouds sometimes resemble the smoke of a hay stack, at other times they appear like iridescent fog. Sometimes they present a deep greenish hue, or are intensely black, or have a purplish, yellowish, or bluish tinge. When these two masses or banks of clouds, under the impulse of opposing currents, approach each other they are thrown into great confusion; there is a roaring, likened to the rumbling of distant thunder, and an upward expulsion of air and vapor. Soon the funnel of the tornado is let down to the earth and moves to the front, while scuds of clouds play around it. The tornado now formed has four characteristic movements: a linear movement toward the northeast; a gyratory movement (north of the equator), contrary to the hands of a watch; a zigzag or swaying movement, which leaves dentatee edges in the path of the tornado; and a rising and falling movement, the poise of the upper current, by which the tornado leaps over portions of its path.

If one is familiar with these premonitory signs he is put on his guard, and when the tornado appears, he is prepared to act intelligently and promptly. Under the preceding principles he can easily determine the projected path of the tornado, from the location of the funnel, and whether it will be necessary to run north or south to escape from it. He must, of course, not run east or west.

When a tornado is imminent, certain precautions should be observed. Doors and windows in houses should be closed, animals in harness unhitched, and animals in stables let out. The safest place in a house is the southwest corner on the first floor, or better perhaps, the southwest corner in the cellar. If a tornado overtakes one on a prairie, lie face downward, head toward the east, and place the hands over the head for protection. If near a low solid object, like a large stone or stump, lie face downward, east of it, head toward the object, with hands over the head for protection.

Every home should have a dug out at a convenient distance from the house, or, what is better, a tornado room built into the west or south wall of the cellar, large enough for the family, and for things of great value like deeds or money.

The destructive effects of tornadoes result from the gyratory movement, which is estimated at from one hundred to five hundred miles an hour. Tornadoes with the hour glass form of cloud are the most intense, and seem to be irresistible, but the greater number of tornadoes are of a lower intensity and we can build against them. Frame houses are more tenacious or elastic than brick or stone, and when overthrown are not so destructive to life. They should have strong frames. Brick houses should have an extra layer of brick laid in cement in the west and south walls. Some houses with very thick walls laid in cement are comparatively safe against most tornadoes.

Houses built near a hill or bluff presenting an elevation should be located on the northeast side, as the elevation tends to lift the tornado over the house. A grove of hard wood, such as oak, maple, walnut, and hickory, southwest of a house, or a forest southwest of a town, has a tendency to break the force of a tornado and drive it into the upper air, although it is not safe for a person to be near a tree or in a grove during a tornado for fear of being struck by flying timber. Occasionally a tornado of great intensity will cut a clean swath through a grove, but forests tend to break the force of tornadoes, and will drive most of them into the upper air. All towns in prairie States should plant heavy groves of hard timber southwest of them. During a residence of forty years in southern Michigan when it was heavily timbered, tornadoes were unknown, that is, they were driven into the upper air and rendered harmless; but since the forests have been cut away tornadoes in that part of the State have become somewhat frequent and destructive. Not to build and protect against tornadoes seems like not taking medicine for fevers. Sometimes a fever proves fatal, but most fevers can be cured, and so most tornadoes can be rendered comparatively harmless.

By a careful study of the principles which underlie these storms, and an observance of the premonitory signs, during the tornado season, it is believed that few if any persons, who keep their presence of mind and act intelligently and promptly, when the storm appears, need be killed by a tornado. Still it is always best to have a clear conscience whatever may happen.

Meteorologists are carefully studying these storms. The Signal Service already, in their daily reports during the season, indicate the barometric trough of low pressure, extending from the southwest toward the northeast, along which tornadoes move, and it is believed that the time is not far distant when they will predict to certain districts probable tornado days.—*Kansas City Review.*

The Suez Canal.

The following is the statement of the tonnage which has passed through the Suez Canal in the last four years, with receipts and profits:

Years.	Gross Tonnage.	Net Tonnage.	Gross Receipts, Francs.	Net Profits, Francs.	Percentage Dividend on Capital.
1879	3,286,912	2,263,333	30,949,148	2,744,880	5·974
1880	4,344,519	3,667,421	41,820.899	12,330,142	9·337
1881	5,794,401	4,136,779	54,696,189	24,678,846	13·700
1882	7,122,125	5,074,808	63,409,593	31,674,318	16·240
½ 1883	4,305,862	Not yet reported.			

The New British Standard Wire Gauge.

DENOMINATION OF STANDARDS.

Descriptive number.	Equivalents in parts of an inch.	Descriptive number.	Equivalents in parts of an inch.
No.	Inch.	No.	Inch.
7—0	·500	23	·024
6—0	·464	24	·022
5—0	·432	25	·020
4—0	·400	26	·018
3—0	·372	27	·0164
2—0	·348	28	·0148
0	·324	29	·0136
1	·300	30	·0124
2	·276	31	·0116
3	·252	32	·0108
4	·232	33	·0100
5	·212	34	·0092
6	·192	35	·0084
7	·176	36	·0076
8	·160	37	·0068
9	·144	38	·0060
10	·128	39	·0052
11	·116	40	·0048
12	·104	41	·0044
13	·092	42	·0040
14	·080	43	·0036
15	·072	44	·0032
16	·064	45	·0028
17	·056	46	·0024
18	·048	47	·0020
19	·040	48	·0016
20	·036	49	·0012
21	·032	50	·0010
22	·028		

On and after March 1st next no other wire gauge can be used in trade in England, that is to say, no contracts or dealings can be legally enforced which are made by any other sizes than those above given.

High Steeples.

The following are the heights of a few of the tallest steeples:

	Feet.
Pisa, leaning tower	179
Baltimore, Washington Monument	210
Montreal, Notre Dame Cathedral	220
Boston, Bunker Hill Monument	221
Montreal, English Cathedral	224
Paris, Notre Dame	224
Bologna, leaning tower	272
Cairo, minaret of Mosque of Sultan Hassan, highest Mohammedan minaret in the world	282
New York, Trinity Church	284
Florence, Campanile, or Giotto's Tower	292
Lincoln, Cathedral	300
Washington, Capitol	307
Venice, Campanile	322
New York, St. Patrick's Cathedral (to be when completed)	330
Utrecht, Cathedral (formerly 364)	338
Florence, Cathedral	352
Milan, Cathedral	355
London, St. Paul's	365
Brussels. Hotel de Ville	370
Lubeck, Cathedral	395
Antwerp, Cathedral	402
Amiens, Cathedral	422
Hamburg, St. Michael's	428
Landshut, St. Martin's	435
Cairo, Pyramid of Chefren	446
Vienna, St. Stephen's	449
Cairo, Pyramid of Cheops (original height 480)	450
Rome, St. Peter's	455
Rouen, Notre Dame	465
Strassburg, Cathedral	468
Hamburg, St. Nicholas	473
Cologne, Cathedral	511
Washington Monument (to be)	555

Alizarine Blue.

This bright and solid blue is manufactured by the Badische Anilin und Soda Fabrik, in the form of paste, containing from 10 to 12 per cent of the dry material. The great obstacle to its use has been its slight solubility in water, but this objection has recently been removed by combining it with the bisulphite of soda in a way which, according to the *Textile Record*, is described in the *Moniteur de la Teinture*.

The paste is intimately mixed with a concentrated solution of bisulphite of soda specific gravity 1·25, and the mixture set aside for a week or two. It is then filtered. The alizarine blue, which has not been transformed, remains on the filter. The now soluble portion is found in the filtrate. It may be separated either by precipitation with a solution of common salt, or by crystallizing out by evaporation at a low temperature. The result is a reddish brown powder composed of microscopic crystals, which may be heated to 150° C. without their undergoing decomposition. The powder is known in commerce as alizarine blue S. It is excessively soluble in water, but slightly so in concentrated alcohol. In the state of aqueous solution it is much less stable, its decomposition beginning to take place at 60° C., and if the solution be boiled the whole of the alizarine is precipitated in the primitive insoluble form.

At ordinary temperatures the combination of alizarine blue with bisulphite of soda can be mixed with a solution of acetate of chrome without producing the least precipitate, but if heat be applied and the temperature raised to 60° or 70° C., the chrome lake of alizarine blue is formed. It is to this property of alizarine blue S. that we may ascribe the success which has attended its application in calico printing. For that purpose the following composition is largely employed:

120 grammes solution of starch of 10 per cent.

15 to 20 grammes alizarine blue S.

20 to 30 grammes solution acetate of chrome 20° Baumé.

Steam printed cloth from ten to twenty minutes, and the color will be developed. Wash, soap, and dry. To steam under pressure is useless but not injurious.

This combination of alizarine blue produces a coloring matter which, once fixed on the cloth, perfectly resists the action of light, of soap, and even of chlorine. In this respect it is superior to indigo, all the shades of which it will give.

So much does it differ from the ordinary alizarine blue in its solubility that it can with difficulty be obtained in the form of crystals. Before crystallization is complete, decomposition begins; small quantities of the insoluble blue are precipitated, and the liquid when filtered is found to be richer in the bisulphite. Analyses of the pure product obtained by precipitation with common salt show that one molecule of alizarine blue is combined with two molecules of bisulphite of soda, and that the combination has for its formula, $C_{17}H_9NO_4+HNa_2SO_3$.

The mode of formation of insoluble alizarine blue strongly warrants the assumption that this body belongs to the anthracene series, of which its power to combine with the bisulphite is a new proof. Alizarine and purpurine do not furnish analogous compounds, while with the quinolines combinations very well crystallized are obtained. Of that group alizarine blue certainly possesses the characteristics.

Extensive Mining in Montana.

The enormous mining enterprises carrried on in our Western States and Territories, and the vast cost for machinery and fuel employed in working the mines, seem almost incomprehensible to persons unacquainted with such matters. A correspondent in Montana gives to the Chicago *Tribune* an account of the mining operations in one section of that Territory. Near the Anaconda, says the writer, is the Colusa mine—also copper. It runs its ore directly into smelting works of its own. For the year ending September 1 it had shipped 8,100 tons for export, which averaged 65 per cent copper and 55 ounces silver per ton. Within five minutes' ride of the Anaconda are the Lexington, Alice, and Moulton, all silver mines. The first named, after yielding $1,800,000 to its owners, was sold to a French company for $3,000,000. It runs sixty stamps. Its works cover several acres. Its monthly production of silver bullion now averages $1,106,000—about half profit. The Alice Mine produces $100,000 monthly, the Moulton, $65,000, the Silver Bow Company, $35,000, and so on through a long list of smaller properties, until the mind is bewildered, and millions begin to seem the unit of counting. The shipments of gold and silver bullion, chiefly the latter, average about $500,000 a month. The weekly shipments of copper ore and matte—as the product after smelting is called—averages 100 car loads, or about 3,000 tons, per month. There are 40 mines equipped with steam hoisting machinery, and over 100 smaller mines, all worked at a good profit.

While individuals by prospecting have made valuable discoveries, and attained a moderate competency, the great results mentioned above are only possible where enormous capital can be commanded for the development. Most of these great mines were sold by their first discoverers for $30,000 and less. Then capital stepped in and began its work. One of those above expended $1,700,000 in preparation. One paid $95,000 freight on the machinery and material for its buildings. The silver ore in its reduction requires a ton of salt to each ten tons of ore. The salt costs $30 per ton. Each "pan" of 3,000 pounds of the ore prepared for the action of quicksilver requires 300 pounds of the latter article every hour. Wood costs $6.50 a cord. The Alice, Lexington, and Moulton burn 3,300 cords per month. One mine returned $100,000 to the assessor as the value of its wood on hand. The Colorado and Montana smelters consume each 25,000 cords per year. Coke is brought from Pennsylvania for the smelters, and coal from Utah. The mines and reduction works employ about 2,500 workmen, and their weekly pay roll is about half a million dollars.

THE Chihuahua *Enterprise*, published in New Mexico, quotes dressed sheep to be worth in Chihuahua 75 cents apiece at the present time, 25 cents for a hind quarter, and 12½ cents for the fore quarter. The pelt of a sheep is worth 75 cents. From the tallow is realized from $1 to $1.50. Each sheep killed is worth $2.50 to $3.00.