TRANSPORTATION OF GRAIN IN THE UNITED STATES.

The immense grain crop of the present year has attracted much attention. It is believed that the subject of the transportation of the vast quantity of grain of all kinds will be of interest to our readers.

The Armour Elevator Co., of Chicago, Ill., one of whose elevators forms the subject of the illustrations accompanying the present article, is a representative company. They possess a number of these structures, with an aggregate storage capacity of nine millions of bushels of grain. In a working day fifteen hundred cars can be unloaded, and in an hour about 300,000 bushels can be loaded into cars or vessels. The different elevators are designated by letters extending up to F. They receive grain from the Chicago, Milwaukee, and St. Paul and the Chicago, Burlington and Quincy Railroads. An immense area of country is tributary to these lines, the first named representing 6,664 miles and the last named 6,295 miles of road. Through these lines North and South Dakota, Minnesota, Wisconsin, Illinois, Indiana, Iowa, Nebraska, Kansas, and Missouri are drained to the great center of distribution where these elevators are situated. Even Texan grain reaches them *en route* to the East and to Europe.

An interesting shipment occurred in August last, when the elevator illustrated in the cuts received a cargo of wheat by special train from the newly settled Oklahoma. This was the first shipment of wheat to the North from that region.

The same company have a line of grain propellers plying on the lakes, and own 2,500 cars devoted to transporting grain.

The elevator known as elevators A and B, receiving grain from the St. Paul road, is the largest elevator in the world under a single roof. Elevator D and its annex belonging to the Armour Company surpass it in capacity, but are not a single unbroken structure. It is rated at a storage capacity of 2,500,000 bushels, can unload 500 cars per day and deliver 100,000 bushels per hour to cars and boats. Cars enough to keep it at work for four days can be accommodated in the great yard annexed to it. The building proper is 550 feet long and 156 feet high. An engine of 1,200 horse power is employed in driving the elevating belts.

The general features of its construction are the following. It comprises a main building surmounted by what is termed the cupola. The main driving engine is situated on about the ground level, at one end of the building. Along the top of the cupola a counter-shaft, the full length of the building, is carried. This is driven by the engine. The main belt is of India rubber and canvas, eight ply in thickness and sixty inches wide. This runs very nearly vertically from the engine driving pulley to the pulley on the countershaft, one hundred and fifty feet above it. All along the countershafts are the driving pulleys for working the twenty-eight elevator belts. These belts are made also of India rubber belting, and carry steel buckets riveted at regular intervals along their outside face. As the belt travels up on one side it carries up full buckets. At the top these pass over the driving pulley and are emptied as they turn over, and then they descend empty on the other side of the belt. From the point of delivery of the belt the grain passes by gravity through inclined chutes to the main body of the elevator, and is directed by one or the other of the chutes to any desired point. Fig. 7 shows a portion of an elevator belt, with the buckets on the ascending side of the belt.

The grain from the elevating belt falls into the mouth of a chute which rotates on a vertical axis, whose prolongation would pass through its receiving end or mouth. Thus, when swung around on its pivot, its receiving mouth remains unchanged in position. The open ends of a number of chutes leading to the garners corresponding to respective bins below are arranged in a circle around the revolving chute or "revolver." Each is numbered in accordance with the bin it leads to. The revolver can be swung so as to connect with any one of these. In this way one elevator is made to feed a number of bins. The arrangement is shown in Fig. 2 and can also be seen in Fig. 3.

Below the chutes on the next floor are what are known as and have just been referred to as garners. These are simply square bins holding 1,000 bushels each. Immediately under each is a platform scale with its bin of the same size as the garner above it, and receiving grain from the garner, when desired. Here the grain is weighed. The garner, it will be seen, can receive grain during the operations of weighing and discharging the weighing bin, and when the latter is emptied can at once refill it. In Fig. 3 the garners and weighing bins are shown. In Fig. 6 one of the scales and weighing bins is illustrated. A hand hole is provided for each weighing bin whence samples can be drawn. This is shown also in Fig. 6.

From each weighing bin the grain is delivered into the bins and pockets that completely fill most of the height of the main building. These range in size from 500 to 7,000 bushels capacity, so as to suit every requirement. Much of the grain received is simply graded and an equivalent weight of grain of the same grade is delivered when called for. Other grain is received to be received with its "identity preserved." In this case, the specific grain and no other must be delivered on call. The great variety in size of bins adapts the elevator to this work.

The garners, weighing bins, and storage bins have sloping bottoms, so that no grain lodges in them. An inclination of six inches in a foot is sufficient to insure this.

Grain is weighed once when received and once when delivered. Each weighing operation involves the elevation of the grain from the lower floor, where the bins deliver it clear to the top of the building, for delivery through the revolver and fixed chute to the proper scale.

Transfer elevators are employed to effect the transfer of grain from one bin to another. These elevate it, so that it can descend through inclined chutes in the desired direction. If the chute does not carry it far enough, one or more additional elevators and chutes are called into requisition.

It is evident that a vast amount of complication is involved in the perpetual filling and emptying of bins, due to the receiving, delivery, and transfer of grain among the number of bins and pockets of the great building. The receiver's office is shown in Fig. 1. In this room the record is kept. It contains a large blackboard divided into squares. Each square denotes a bin and is numbered in accordance with the bin number. The numbers are the same as those painted on the mouths of the fixed chutes as shown in Fig. 2 of the cuts. Upon each square the accountant marks with colored chalk the contents of the particular bin, the bushels of grain, its kind, grade, etc. For different classes of grain different colored chalk is used.

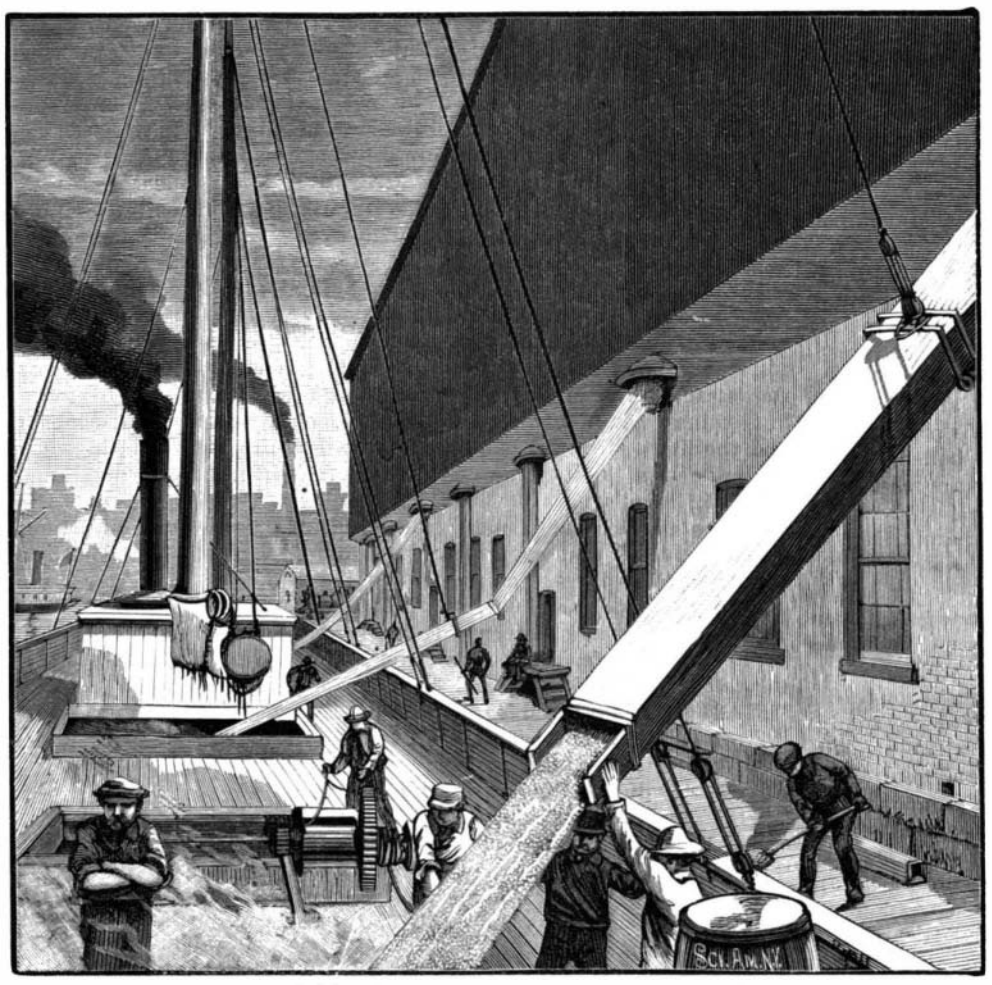
Again the bins are divided into storage, cleaning and delivery bins. It is important to see at a glance how these inter-connect by the elevators and chutes. Accordingly above the blackboard proper is a plan of the system of elevators and chutes, so that the proper course to be followed by grain under any given circumstances is at once seen.

One function of the elevator is the cleaning of grain. Some of the bins, termed, as has been just stated, cleaning bins, are equipped with winnowing fans for blowing out dust and chaff and with screens through which the grain has to pass. The latter remove the coarser particles. The winnowed and sifted grain then falls into the bin.

The bins all terminate some distance above the ground level. A train of cars has ample head room below them. From the level of the bottoms of the bins to the weighing floor the entire area is devoted to the honeycomb of bins, except the few small trunks through which the elevator belts travel or through which grain descends into bins situated under other ones. A space at one end is also free for the great driving belt to travel in.

The elevator belts descend into hoppers below the ground surface into which grain to be elevated is delivered. At intervals along the platforms forming the bottom floor are trap doors giving access to these hoppers. Grain never remains there, but it is at once elevated.

One of the cuts, Fig. 5, show how it is delivered from cars into these elevator hoppers or chambers. What is known as a steam shovel is employed. This is a scraper about three feet square to which a rope is attached. The rope is attached to steam apparatus by which it is taken in at the proper time, as if on a windlass. The operative draws the shovel back into the car of grain, and holds it nearly vertical and pressed down into the grain. The rope draws along the shovel with the grain in front of it and a number of bushels are delivered at each stroke. In this way a couple of men can very quickly empty a car. The movements of the shovels succeed one another with sufficient rapidity to keep the men in active movement.



LOADING A VESSEL WITH GRAIN.

One of the features of this elevator is the use of the electric light. It is equipped with some so arranged as to light the interior of cars, so that night work can be carried on. In the recent heavy grain deliveries it was found necessary to work day and night.

The portion of such elevators containing the bins is built without framing. Planks are laid flatwise upon each other and spiked through to the layer below. In this way the outer walls and the bin divisions are built up, giving immense strength and power to resist lateral thrust. A usual timber for the sides is 2 × 8 inch spruce, giving eight inch walls, and for the bins 2 × 6 inch is often employed. The Armour elevator contains over 8,000,000 feet of wood, and about 4,000 kegs of nails were used in its construction. The main building is bricked in outside of the timber walls, and the roofs and cupola walls are covered with tin. It was erected between June, 1887, and March, 1888, being put in operation on the last named date. It cost about $600,000.

The elevator described represents one of many similar structures situated in the principal cities of the United States and designed to handle the enormous grain crops of the Western States and Territories. This group of elevators, Fig. 4, represents but a fraction of Chicago's elevator capacity. To give some idea of the extent of the business in our cities, the following statement of number of elevators and their capacity for some leading cities will be of interest:

Name of City.	Number of stationary elevators.	Capacity in bushels.	Name of City.	Number of stationary elevators.	Capacity in bushels.
New York	27	27,275,000	St. Louis	12	11,950,000
Chicago	26	28,675,000	Milwaukee	9	5,430,000
Duluth	14	19,200,000	Detroit	4	2,900,000
Minneapolis	16	13,290,000	Peoria	5	2,150,000

The elevator charges of course are subject to change, but in general are based on the following services rendered: 1. Receiving, which includes a fixed period of storage, which may be twenty days. 2. Extra storage based on a minimum period, such as fifteen days. 3. Cleaning grain as described for the cleaning bins. 4. Transferring grain, as from cars to barge or vessel, or *vice versa*. The favorite position of elevators is on water, to enable them to serve either cars or vessels as required.

The great crops are corn, wheat and oats. In the year 1890 the corn crop was 1,489,970,000 bushels, at an average of 20·7 bushels per acre; the wheat crop 399,262,000 bushels, at an average of 11·1 bushels per acre; and oats 523,621,000, at an average of 19·8 bushels per

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TRANSPORTATION OF GRAIN IN THE UNITED STATES.

(*Continued from page* 258.)

acre. Rye with 27,140,000 bushels and barley with 58,800,000 complete the great grain crops giving a grand total of 2,498,793,000 bushels from 139,589,286 acres.

Much of this is exported either as grain or as flour. We will take 1890 as before. Of wheat as grain, 49,271,580 bushels were exported, representing about one-eighth of the crop. This is supplemented by an exportation in the same year of 11,319,450 barrels of wheat flour. Of corn 86,817,220 bushels and of oats 12,207,359 bushels were exported. There were smaller exports of rye and barley and of rye flour, while 14,725,268 lb. of bread exported represent a quantity of flour of different grades.

The total exports reduced to a bushel basis covering flour and meal and all cereals was 203,220,344 bushels, which is less than one tenth of the crop.

Thus it is evident that America, while fond of considering herself the world's granary, is far busier feeding herself than in feeding others.

These exports are of domestic produce, but there was an export also of foreign grain, aggregating 654,225 bushels. While thus pouring out her surplus products, America also imported 11,795,548 bushels of grain, including 9,375,407 bushels of barley alone.

The business done in exports at the different seaports is interesting. Reducing flour and meal of all kinds to the bushel standard, we have for the following ports in 1890:

Name of City.	Bushels of grain of all kinds exported.	Name of City.	Bushels of grain of all kinds exported.
New York	64,324,034	Montreal	13,168,963
Philadelphia	21,346,268	New Orleans	13,951,463
Boston	12,165,965	Baltimore	36,207,554

What is ultimately done with the grain received at any given city is not easily determined, except in the case of seaboard cities. In the case of New York, 122,013,670 bushels, on the basis of the last table, were received, indicating that a little over one-half the receipts was exported to foreign countries from this center.

At seven Atlantic seaboard ports, 280,149,420 bushels were received, an excess of about 77,000,000 bushels over the total exports.

The year 1890 by no means represents a good crop. The comparison with other years is given here.

Year.	Crop of all grains in bushels.	Acreage.	Year.	Crop of all grains in bushels.	Acreage.
1880	2,703,575,966	120,103,484	1886	2,830,710,000	140,941,741
1881	2,056,543,370	122,559,255	1887	2,649,613,000	140,910,809
1882	2,682,375,143	125,721,423	1888	3,197,692,000	145,368,370
1883	2,621,650,135	129,776,207	1889	3,449,667,000	149,265,826
1884	2,981,764,000	135,413,363	1890	2,498,793,000	139,589,286
1885	3,002,813,000	134,961,686			

What the production and acreage of the present year will be cannot be yet definitely stated. It is certain that it will be very large. One very curious thing to notice in the last table is the almost unbroken increase of acreage, with attendant fluctuations in crops. Thus 1887 shows an increase in acreage of about 11,000,000 acres over 1883, but with a very slight increase in production.

The fluctuation in yield per acre is shown in the following table for the same years. This fluctuation is at the root of the above difference in proportion of area cultivated to crop produced.

Year.	Bushels per Acre of Wheat.	Corn.	Oats.	Rye.	Barley.	Year.	Bushels per Acre of Wheat.	Corn.	Oats.	Rye.	Barley.
1880	13·1	27·6	25·8	13 9	24·5	1886	12·4	22·0	26·4	11·5	22·4
1881	10·2	18 6	24 7	11·6	20·9	1887	12·1	20·1	25·4	10 1	19·6
1882	13·6	24·6	26·4	13·4	21·5	1888	11·1	26·2	25·9	12·0	21·3
1883	11 6	22 7	28 1	12·1	21 1	1889	12·9	27·0	27·4	11·9	22 2
1884	13 0	25·8	27·4	12 2	23·5	1890	11·1	20·7	19 8	11·8	21·0
1885	10·4	26·5	27·6	10 2	21·4						

As regards transportation by different methods, New York offers as great a variety as any city. It receives grain, flour, and meal by canal, by vessels coastwise, and by rail. For 1890 the following were the receipts:

By Canal. Bushels.	By Vessels, Coastwise. Bushels.	By Rail. Bushels.
30,185,400	1,609,551	90,218,719

This shows that the slowly moving canal boat is a very large factor in the transport question even at the present day. In grain alone the canal figures to still greater advantage as follows:

By Canal. Bushels.	By Vessels, Coastwise. Bushels.	By Rail. Bushels.
30,185,400	846,440	63,938,068

For the fiscal year July 1, 1890, to June 30, 1891, the aggregate value of cereals exported was $152,425,224, at an average rate of 66·2 cents per bushel. Wheat and flour represented $102,312,074 of this amount.

England is our best customer. The following figures show the distribution of exports from the United States.

	Wheat. Bushels.	Corn. Bushels.		Wheat. Bushels.	Corn. Bushels.
Great Britain	38,240,523	54,601,034	Belgium	3,741,303	4,793,323
Canada	2,270,769	9,365,811	Brazil	1,768,234	
Germany	8,786	11,419,063	Denmark		5,788,733
France	3,846,505	8,481,129	Portugal	2,812,483	20,000

Correspondence.

Cheap Shoes Wanted.

To the Editor of the Scientific American:

Will not some philanthropic genius invent a cheap summer shoe, fit for human beings to wear and leaving the foot in its natural position, with freedom for natural expansion in all directions? Hints might be gathered both from the sandals worn at the birth of the Christian era and the moccasins worn by the American Indians, neither of which would cramp the toes or elevate the heel, and one of which would give free ventilation, which the modern shoe prevents.

R. S.

Casting Bullets for Ready Identification.

To the Editor of the Scientific American:

I have invented an improvement in bullets, the idea being to insert a plug of harder metal to designate and identify the bullet wherever it may be found. Thus if a policeman was to discharge his revolver at a burglar and the night being too dark for recognition, were the burglar to escape with one of the marked bullets in his body, it would serve as an identification. Much speculation is now spent as to size of bullets, etc., when taken from wounded criminals. The cartridge men think it would hardly pay to make special bullets, although the novelty is admitted. I think the idea is too good to lie dormant, and am willing to contribute it to the public through either of your papers, of which I am a subscriber.

The idea would be for the police in each city to have a distinguishing mark, such as the following: +, ■, I, ●, △, and others.

GEO. H. IRELAND.

Springfield, Mass., Sept. 18, 1891.

Interesting Discovery at Wolfville, N. S.

To the Editor of the Scientific American:

At the head of Minas Basin, a few feet above tide water, some very interesting remains have lately been found on the premises of Mr. W. C. Archibald, of the town. The place in question has been a small hill of sand as far back as any of our residents can remember; but within the last twelve years Mr. Archibald has removed about six feet of soil, and in doing so came to traces of building. Recently he has had the place thoroughly dug over, and the following remains have come to light.

1st. A floor of hewn boards, probably hemlock, charred on upper side.

2d. Rough bricks or irregular pieces of clay reddened and hardened by fire.

3d. Charcoal, or charred wood, and sticks which may have been wattles.

4th. Iron implements, as wrought nails, file, knife, and portions of vessels.

5th. Copper coin and gun guard.

6th. Small pieces of crockery, a bowl of clay pipe two inches high, and several stems.

There was evidently a small house here at some remote period, which was burned down and the site of which has since been covered by six feet of sand. The land surrounding this is alluvial, but it is not easy to account for this evidence, or to say whether the remains belong to the Acadian or Norse period.

A. E. COLDWELL.

Acadia College, Wolfville, N. S., Oct. 1, 1891.

English and American High Speed Performances.

Concerning the rapid railway trips lately made in this country, our London contemporary *Engineering* remarks:

There has been a train run in America which has eclipsed the best examples ever yet seen in any part of the world. We pride ourselves on having the finest express service in existence, and no doubt we have, if it be considered as a whole, but our best performances are now equaled in America, and our very finest run, which only a few years ago excited the greatest enthusiasm, has been surpassed. It will be remembered during the race to Edinburgh that on August 13, 1888, the West Coast train ran from London to Edinburgh (400¼ miles) in 7 hours 38 minutes, and on the following day the East Coast train covered its distance (392½ miles) in 7 hours 32 minutes. Again, on the 31st of the month the East Coast did the distance in 7 hours 26¾ minutes. The feat thus performed was 392½ miles in 416¾ minutes of running time, subtracting the 26½ minutes for lunch at York, 2 minutes at Selby, and 1½ minutes at Ferry Hill. The speed, excluding stoppages, was 56·5 miles an hour all the way. Including all the stoppages, except the 26½ minutes for luncheon, it was 56 miles an hour. This was certainly the best run ever made up to that date, but it was not an example of a regular service. The race only lasted about a fortnight, and ever since 8 hours has been the standard time for the journey on both routes, which gives an inclusive speed of 50 miles and a running average of 53½ miles on the longer route. Omitting the luncheon time, the average speed, including all other stops, is 53 miles an hour, or 400¼ miles in 460 minutes.

Now let us see what is being done in America. The Royal Blue Limited between Jersey City and Washington makes the run daily at an average speed of 52·8 miles an hour. This is just a trifle better than our West Coast Scotch expresses.

All these good runs have been put into the shade by one on the 14th of September, from New York to East Buffalo, 436⅓ miles in 439¾ minutes. When the news of this came by telegram it was received with incredulity, as the invention of a newspaper reporter, but with the full details before us it is impossible to deny credence to it. The run has certainly been made, and would have fulfilled the plan of its author, Mr. H. Walter Webb, third vice-president of the New York Central and Hudson River Railroad Company, of covering the entire distance at a mile a minute, had there not been 7½ minutes delay for a hot bearing. The following table gives the particulars of the runs:

Miles.		Time.	Speed.
	New York.	7:30 a.m.	Miles.
143	Albany..... arr.	9:50 a.m.	61¼
	dep.	9:53½ a.m.	
291¼	Syracuse... arr.	12:19½ p.m.	61
	dep.	12:22 p.m.	
463⅓	E. Buffalo.	2:50	58⅓

59·52 miles an hour.

From New York to Albany the line follows the windings of the Hudson River, which are very sharp, entailing curves of short radius. The track is practically level, except that a summit of 100 feet is surmounted at one place. The distance is 143 miles, and was covered in 140 minutes, at the rate of about 61¼ miles an hour. Three minutes and a quarter were consumed in changing locomotives, and the next stretch to Syracuse of 148 miles was done in 146 minutes, or at the rate of 61 miles an hour over an undulating country. In 2½ minutes another locomotive was coupled on and the run of 145 miles to East Buffalo was commenced. This was over a level line, and was done in 148 minutes, in which is included a stop of 7½ minutes for a hot bearing. Had it not been for this delay, the splendid run of 145 miles in 140½ minutes would have been made at the rate of 62 miles an hour. As it was, the entire journey only exceeded by 3½ minutes the determined rate of 60 miles an hour for 7 hours 16 minutes, including stoppages.

The train consisted of a locomotive weighing 60 tons and a tender weighing 40 tons, a drawing room car 40 tons, a buffet car 33 tons, and a private car 38 tons, or about 210 tons in all, by no means a light train. The engines had cylinders 19 inches in diameter by 24 inches stroke. The first had 6 feet 6 inches coupled driving wheels, and the other 5 feet 9 inches wheels. The total heating surface of the first engine reached the high total of 1821·5 square feet, and the grate area was 273 square feet. All the tenders were fitted to take up water during transit, and were able to carry 6¾ tons of coal.

It is easy to guess the cause of this feat being attempted. There will be great rivalry among the railways running to Chicago during the exhibition year, and they are already beginning to show the public what they can do. On the line on which the run was made there are four tracks over the first section and six over the remaining sections to Buffalo, so that it offers ample facilities in the way of a clear course for fast traffic. It has a well laid roadbed and easy gradients. The curves are very bad as far as Albany, but American rolling stock is built to follow a sinuous track, and winds its way with comparative ease. If there should be a notable increase of railway speed in America, we shall expect to see further improvements here, and our moderate distances still further decreased.

Floral California.

The Orcutt Seed and Plant Company, San Diego, California, have issued an interesting descriptive list of Californian trees and flowers. The writer thinks that there is perhaps no country in the world where the early spring flowers so change the face of the earth from a desolate waste to a beautiful garden as on the Pacific coast—hills, mesas, mountains and valleys, and the arid plains of the desert, alike quickly responding to the vivifying rain. "California," he says, "has probably already furnished to the horticulturist a greater variety of beautiful flowers and stately trees than any other State in the Union. Yet many others are awaiting the appreciation of man, or wasting their sweetness on the desert air."

Getting Rid of Fleas.

A correspondent of the Washington *Star*, who has been studying the subject of getting rid of fleas, gives this as the result of his investigations: If those who are troubled with this insect will place the common adhesive fly paper on the floors of the rooms infested, with a small piece of fresh meat in the center of each sheet, they will find that the fleas will jump toward the meat and adhere to the paper. I completely rid a badly infested house in two nights by this means.